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Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan

by

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Thesis for the degree of Doctor of Philosophy in Education

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UNIVERSITY OF SOUTHAMPTON
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Thesis for the degree of Doctor of Philosophy
TESTING THE EFFECTIVENESS OF A CRITICAL THINKING SKILLS INTERVENTION FOR INITIAL TEACHER EDUCATION STUDENTS IN PAKISTAN

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ABSTRACT

This study investigates the effectiveness of an intervention designed to develop critical thinking skills in an Initial Teacher Education (ITE) institution in Pakistan. The study carried out an explanatory sequential mixed-methods approach in which a quantitative inquiry phase was followed by a qualitative inquiry phase. A CT skills intervention was designed for a educational psychology module to be taught in an MA Education programme. The students' motivation and self-regulation and classroom learning environment were studied as confounding variables.

The intervention teaching lasted for four weeks and used a mixed approach (explicit and embedded) to teach CT skills. An explanatory qualitative phase was conducted as a follow-up to seek understanding and explanation after the intervention. The implementation observations were made to gauge the fidelity of the implementation, followed by qualitative interviews with participants. The results show a non-significant effect of the instructional intervention on students' learning of CT skills at this time. The study found that of all motivational learning strategies, students' extrinsic and intrinsic goal orientation and metacognitive self-regulation positively predicted learning of CT skills. Also, the gain in CT skills was predicted by students' metacognitive self-regulation and learning environment. Factors such as unsystematic intervention implementation, ineffective role of the teacher as an interventionist, interaction between learning and instruction as well as students' motivation/self-regulation, the poor learning environment and the short time, in terms of the length of the instructional intervention, appeared to be most influential in holding back the effectiveness of CT skills intervention.

The study concluded that the effectiveness of CT skills learning and instruction is closely associated with classroom- level interactions, the learning environment and how instruction is delivered within a wider organizational culture. Moreover, the dynamic relationship between the students and teacher, the CT skills approach and the professional development of teachers need further attention.

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DECLARATION OF AUTHORSHIP

I, Shumaila Mahmood, declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

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I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. Parts of this work have been published as:

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Signed: ....

Date: ....

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Abbreviations

ACT	American Collegiate Testing
ADE	Associate Degree in Education
AIOU	Allama Iqbal Open University
AJK	Azad Jammu Kashmir
AM	Argument mapping
BA	Bachelors in Arts
BEd	Bachelor of Education
BoC	Bureaus of Curriculum
CA	Constructive alignment
CAAP-CT	Collegiate Assessment of Academic Proficiency Critical Thinking test
CASE	Cognitive Acceleration through Science Education
CLIA	Competence, Learning, Intervention, and Assessment
CoI	Community of inquiry
CPD	Continuing Professional Development
CPK	Content, pedagogical, knowledge
CT	Critical thinking
CV	Confounding variable
DBRC	Design Based Research Collective
DR	Delphi Report
DV	Dependent variable
EFA	Education for All
ESRP	Education Sector Reforms Pakistan
ESRP	Education Sector Reform Programme
FA/FSc	Faculty in Arts/Faculty in Science
FIE	Feuerstein’s Instrumental Enrichment

HEC	Higher Education Commission
ICT	Information and communication technology
ITE	Initial Teacher Education
IV	Independent variable
LE	Learning Environment
LSRC	Learning and Skills Research Centre
MCC	Manchester Community College
MDG	Millennium Development Goals
MM	Mixed Methods
MSLQ	Motivated strategies for learning questionnaire
NACTE	National Accreditation Council for Teacher Education
NCRC	National Curriculum Revision Committee
NCRTI	National Center on Response to Intervention
NCSALL	National Center for the Study of Adult Learning and Literacy
NPST	National Professional Standards for Teachers
OCE	Observing the classroom environment
OECD	Organisation for Economic Co-operation and Development
PCEPT	Professional Competency Enhancement Program for Teachers
PCK	Pedagogical Content Knowledge
PD	Professional development
PHEC	Punjab Higher Education Commission
PITE	Provincial or Regional Institutions of Teacher Education
Pre-STEP by USAID	Pre-Service Teacher Education Program by United States Agency for International Development
PTC	Primary Teacher Certificate
QEC	Quality Enhancement Cell
SCL	Strategic Content Learning

SED	Sequential Explanatory Design
SHEC	Sindh Higher Education Commission
SPSS	Statistical Package for the Social Sciences
TPACK	Technological, pedagogical, and content knowledge
TRC	Teachers resource centres
UE	University of Education
UNESCO	United Nations Educational, Scientific and Cultural Organization

Chapter 1: Introduction

Knowing is not enough; we must apply. Willing is not enough; we must do.

—Goethe

This introductory chapter consists of eight sections on the context of Pakistan, the rationale, my motivation and the aim and scope of the study, the research questions and, last but not the least, its significance to the wider field of educational research. A position statement and an overview of the thesis structure are provided at the end.

This section introduces the context and rationale of the problem under study; that is, testing the effectiveness of a critical thinking (CT) skills instructional intervention for initial teacher education (ITE) students in Pakistan.

1.1 Pakistani context

The concept of critical thinking has deep roots in European, USA, UK and New Zealand education systems and society (see literature review, Chapter 2). Little is known about the origins of CT or logic in schools and educational institutions in India, Pakistan, and China or in Asian cultures in general. CT skills as a concept have a local meaning in Asian/subcontinent culture. Historically, there is a local knowledge basis for logic and thinking in the form of books and philosophical/socio-political literature (e.g. B.K. Matilal's *The Character of Logic in India* (1998) and D. Perdue's *A Course in Buddhist Reasoning and Debate: An Asian Approach to Analytical Thinking* (2014), drawn from Indian and Tibetan sources as reference points). However, these are not widespread or known in either society or educational institutions, hence are limited to intellectuals and literary circles. The words used to refer to CT in local/national language(Urdu) in Pakistan are *Tanqeedi Soch* (CT), *Tanqeedi Jayza* (critical review), *Ghor-w-fikar* (thoughtfulness), *Tameeri Soch-w-bichar* (productive, positive thinking), *Faisla sazi* (decision making), and so on.

Pakistan, with a population exceeding two hundred million people (the sixth most populated country in the world), is a low-middle income country situated at the crossroads of central Asia and Western Asia. She has been in the news and interest of world organizations for reasons not so pleasant, such as poverty, terrorism, a low universal primary education, a worse gender gap and a low ranking in human development indexes (WDI, 2016; Pakistan EFA Review Report, 2015). In terms of education (primary, secondary and tertiary), too, the conditions are not encouraging. According to UNESCO Statistics (2014), Pakistan spends a total of 2.5 per cent of its GDP on education. In international reports, some of the most frequently mentioned problems of the education system in Pakistan relate to the severe policy and implementation gap, infrastructure, resources and the low quality of teachers' professional development, both pre-service and in-service (Chapter 3).

Despite little awareness of the concept of critical thinking educationally, it must be noted that, to some extent, at a societal and institutional level a small proportion of the population is active in raising such consciousness. The frontline participants are social media, journalists, artists, educators and national think-tanks in Pakistan, raising their voices for change in the systems of policy and practice in education. In the national newspaper *The Nation*, international research from UCLA on increased use of technology and its pros and cons for critical thinking skills was published under the heading 'Is technology producing a decline in critical thinking and analysis?' (January 2009). Similarly, the importance of CT for changing social perceptions about women has been voiced by author/activist Sonia Farooq: 'Critical thinking can help change our general perception of women' (Farooq, http://nation.com.pk/blogs/09-Apr-2016/critical-thinking-can-help-change-our-general-perception-of-women, 2016).

On the other hand, National Education Policy (NEP, 2009) and National Professional Standards for Teachers (NPST, 2009) have taken the initiative to acknowledge explicitly the low quality of teacher's professional development and call for reforming curriculum and university-level teacher training in Punjab and overall in Pakistan (see Chapter 3). In educational settings, especially in teacher education, the concept was fairly new or non-existent until the explicit recognition of approaches towards teaching-learning took a paradigmatic shift from teacher-centred methods to student-centred methods in Pakistan, especially in universities.

Research into teaching and learning CT skills in a Pakistani context is limited. Efforts towards encouraging thinking in education teaching-learning that are research based are absent from educational institutions. Few explicit efforts to entertain such thinking as part of secondary (e.g. Iqbal and Shayer, 1995, 2000) or tertiary education (e.g. Ashraf and Rarieya, 2008; Cassum et al., 2013; Gul et al., 2014) have been undertaken. Research into classroom-level learning and instruction is also rare and is mostly focused on educational research from the perspective of participants and questionnaires on the perceptions of stakeholders. However, classroom-level learning and instructional research is hardly approached. This is due to the challenges of this field, perhaps.

The results of a study by Pak Institute for Peace Studies (PIPS), conducted with more than a hundred university and college teachers who were provided with workshop-based training in promoting tolerant narratives in educational settings, were published nationally in the Nation newspaper as 'Critical thinking to help build inclusive society' (PIPS, 2016). It called for an inclusive curriculum to promote tolerance and the need for a separate space for discussing and thinking critically about controversial topics. In another national newspaper, Dawn, a blog was published entitled 'We need to produce thinkers, not assembly line workers with wonderful test scores and no critical faculties' (Amir, August 2014, Pakistani teachers, check your egos at the door, https://www.dawn.com/news/1126103), in a trend for frequent and critical articles on the education system and need for CT in society in general, and especially in education. CT has also been seen as an agent for social change, justice and improvement of education in previous writing, as an encouraging sign of awareness of the need for critical thinking in society.

1.2 Rationale of the study

Broadly speaking, research on learning and instruction of critical thinking skills stretches along a variety of continuum in educational research. At one end, it serves as a role and function of education in society and, at the other end, researchers describe approaches to curriculum and assess the critical thinking ability of an individual for the development of critical citizenship or any other goal that uses the appellation 'critical' (Davies and Barnett, 2015). CT, especially in the context of higher education, is complex and has many strands running in different directions and overlying each other (Davies and Barnett, 2015). CT in higher education means different things to many people; it may mean an ethical attitude, a critical pedagogy, education to develop critical intellectuals, political critique and the like (ibid.). It can also mean critical feminist approaches to curriculum (ibid. Thayer-Bacon, 2000).

Equally, it can be concerned with a single aim of developing general skills in reasoning that every graduate might possess (Davies and Barnett, 2015). Despite all these 'multiplying interpretations', the fundamental question remains the same: what does CT mean?. Just as basic skills of a certain sort (analysis, inference making, evaluation and so on) are the core attributes of CT skills, so CT is so much more than this (ibid.). Across the broad scale of CT research on learning and instruction, Moseley et al. (2004) write that four perspectives are prevalent in thinking skills research: psychological; sociological; philosophical; and thinking skills in education. For teaching and learning, however useful, the first three have a highly impregnable body of knowledge on the cognitive, social and logical syllogism of learning and instruction of critical thinking. The fourth perspective is the transversal point of disciplinary roads. It can be said to be the intersection of disciplinary knowledge, where the applicability is looked at in terms of learning, teaching and educating. Of these four perspectives, this thesis is located in the fourth in an endeavour to test the effectiveness of a CT skills instructional intervention that has been carefully designed for ITE students at a teacher education university in Pakistan.

Before arriving in the UK to start my PhD, I had started teaching at a teacher education university in Lahore, Pakistan. During this short period of my professional life, I not only observed my own teaching style, but also observed how students were regulating their learning. The value of classroom time for learning, the effort and the motivation of the teacher education degree intrigued me to look at the potential lack of CT skills in the classroom learning environment. My fundamental aspiration for the profession and my interest were united in this research study. My personal motives for undertaking this topic, if put into words, would be as Wegerif (2008) stated: that teaching thinking based on research is important and can be a way to assess the effectiveness of teaching programmes. I have always been fascinated with the idea that CT skills are not impossible to teach/learn, but we only need to teach these with the right approach and in the best way possible.

I think that our educational experiences play a huge part in educating individuals and shaping societies at many levels, therefore the professional development experiences can be influenced greatly by setting the outlook onto the professional development experience that one is provided with. Not only my own student years but my short three years of experience as a university teacher changed my perspective on teaching. It changed me as person who looks at a teacher's professional development quality reciprocated in the wider education system. I knew that my research must be on CT skills, and from the perspective of how to teach/learn it, from the lens of a researcher who observed the effectiveness of instruction and experience provided to students in Pakistani classroom.

Intellectually and personally, this thesis is my testimony of the illumination that has gradually developed my professional perspective embarking on the journey to trying to understand the teaching and learning of CT skills, and what it means to intervene/experiment CT skills in a course at classroom level, in teacher education, and study the classroom learning environment for learning and instruction of CT skills and how I approach my professional life.

1.3 Motivation for the study

Although readers might find the nature of this study ambitious both in the context of the study (Pakistan) and the topic of the study in its disciplinary field, to date there has not been sufficient research on the connections between the multidimensionality of CT skills teaching and learning as a dynamic whole and the multifactorial nature of intervention research in this field. This type of research is mentioned as a current trend in the field of teaching/learning thinking skills has called for identifying the key underpinning pedagogical principles and making connections with broader movement in educational research (Baumfield, 2015). Testing the effectiveness of an instructional intervention not only involves what is taught as in the actual intervention design, its implementation, which in reverse calls for observing not only implementation. To some extent, it involves the interaction of teacher-student-study materials in the classroom, and in the end not just quantifying the results as useful or not useful but looking at understanding the effectiveness of CT skills interventions as a consequence of all the aforementioned stages essential to reflect on whether it worked, the effect on student learning and consequently finding out the how and why operation of in situ that is, to test the effectiveness of a CT skills instructional intervention for ITE students in Pakistan.

This research study wishes to build on the learning and instruction (pedagogic) research for the benefit of future research work in critical thinking skills in Pakistan and elsewhere. CT skills can be a way to promote good teaching and learning (professional development of ITE students) and therefore can be a way to raise the quality of initial teacher education programmes in developing countries such as Pakistan (Biggs, 2003; McBer, 2000,2001; Halpern, 1998; Facione, 2000; Darling-Hammond, 2010). Teaching for CT is important for students (Lipman, 2003; Ennis, 1998; Facione, 2000; Halpern, 1999). By teaching for CT we are teaching students to engage in better thinking, whereby they employ criteria and standards for their own thinking, can assess their own thinking and are involved in practical reasoning (ibid.).

Comparing Pakistan in this context, where the research culture is almost non-existent and actual research does not go beyond suggesting theories and finding perceptions, I think it is high time to start implementing policy mission statements in practice and see how ‘in a structured and explicit way’ these interact in educational context in real life. Teaching for CT requires drill and practice in thinking skills (Lipman, 2003). If students are lacking in CT skills, the simplest way to implant such skills is infusing them in the course content and drill. Though this sounds simple, it is not an easy task (ibid.). Building these skills by the thinking drills approach demands several trials, so one can, first, ask if it works and then secondly ask how it compares with the non-infused teaching and learning method (ibid.).

CT skills intervention research at classroom level can bring first-hand learning and instruction knowledge, hence the importance of activities that put CT skills at the forefront of learning and instruction increases (Lipman, 2003; Ennis, 1998; Paul and Elder, 2002; 2006). Asking questions in class, reflecting on learning materials and the use of systematic instruction that encourages inquiry learning, rational thinking and a responsible attitude among young students in teacher education programme serve a dual purpose of research in learning and thinking skills, as well as CT skills for teachers; a way to include CT in educational environments. This type of research is especially important for producing context, unique group interactions (teacher-student-classroom) with learning materials and might enable us to gauge the practicality and scope of CT skills in professions and professional education (Lipman, 2003).

Research also suggests that the teachers who can promote metacognitive knowledge and strategies among students and know the relationship of knowledge with motivation and thinking skill would teach better than those who have insufficient content knowledge and pedagogical content knowledge (Darling-Hammond et al., 2005; Muijs et al., 2014). Teacher education schools/institutions have been established to help future teachers to learn how to teach. Certified/qualified teachers are considered to be more productive and effective than those without any prior or later teacher training (Darling-Hammond et al., 2005).

Testing the effectiveness of a CT skills intervention can help to initiate a dialogue for quality teaching for improving learning of students. Along with this, education quality (good teaching) can be associated with many internal and external factors, but most importantly to *teacher quality,* as it has the direct effect on student learning, policy implementation and achievement of educational goals. Hence, teachers trained in professional competencies, skills and knowledge about the profession can play a key role to improve education quality (McBer, 2000, 2001; Muijs and Reynolds, 2010).

Pedagogic research from diverse contexts is important to complete knowledge about the phenomena and factors that interact within them (Burden, 2015; Williams and Burden, 1997). One way of studying such interactions is by applying specific interventions in educational settings with a certain rationale behind them. Interventions are an interaction between materials, teachers and learners, and therefore claiming success of educational interventions is a complicated business. If success means being certain that an intervention caused learning, then we need to look carefully at the intervention in a particular setting (DBRC, 2003). The findings may not be generalized, but studying them closely in a particular context may be helpful in understanding a similar context and will also help in understanding the how, why and where an intervention works or not.

1.4 Aim and scope of the study

The single aim of the endeavour is to test the effectiveness of a carefully designed CT skills instructional intervention for ITE students in a teacher education university in Pakistan. This single aim involved several laborious stages of research process. The scope of the study can be defined in several ways that broaden as well as limit what this study is about or what it is not about.

Before testing the effectiveness of the instructional intervention, the first step is to achieve a carefully designed CT skills intervention.

For this purpose of creating a carefully designed CT skills intervention in a context where it has not been pursued in the past, the task was rather greater, because, as a researcher, I did not want to test something that is off the shelf, but would rather have an intervention that is based on sound theoretical foundations. The task in the pursuit of careful design was first of all to define CT skills for this study, second to look thoughtfully at the learning and instructional sciences for pedagogical and CT skills learning principles, and finally to achieve the need-based and objective-oriented instructional intervention based on selected CT skills and learning science principles of teaching thinking for ITE students in Pakistan. The next stage was then to test the effect of this carefully designed intervention. To achieve this in a careful manner, implementation observations were necessary. It was also necessary to inquire about the participants' experience to ascertain the effectiveness of the instructional intervention in case of both positive and negative outcomes. In consequence of the aforementioned, the aim of testing the effectiveness of a carefully designed CT skills' instructional intervention applied in an ITE education programme classroom in Pakistan was met.

At the same time in the Pakistani context there is limited research on CT skills learning and instruction research at classroom level or otherwise. The study intended to look at the multidimensional holistic perspective of learning and instruction of CT skills. The study sits with the fourth perspective (Moseley et al., 2004) on CT skills learning and instruction.

In pursuing this endeavour carefully, the study had to attain a great deal. It looked at the concept of CT skills in a multidimensional way, followed thinking frameworks and internationally valid research findings as fundamental principles for the intervention, and attempted to record the whole procedure from design to implementation to outcome evaluation. The international research on critical thinking skills has shown mixed evidence of positive and negative attempts to address the CT skills learning and instruction (Burden, 2015), however it lacks in empirical research studies that: a) look at learning and instruction of CT skills from a multidimensional holistic approach; b) are rooted in pronounced conceptual and theoretical framework of CT skills; c) design and observe learning environment; and d) have opted for a mixed-methods approach in order to attempt a holistic broader and deeper understanding of the phenomenon (Higgins et al., 2005; Abrami et al., 2008; Lai, 2011; Tiruneh et al., 2016).

With this wide aim of being realistic and achievable, necessary boundaries were drawn to be able to work within the constraints of a PhD at each stage for the successful pursuit of the endeavour.

The first challenge of the study and the place to define the scope for testing CT skills and dispositions that do not take away its multidimensional nature, in terms of research, was the wide-ranging continuum of perspectives on skills and dispositions. After a careful reading of the research literature in the field of CT skills and dispositions, the comprehensive lists of Ennis (1998) and Facione (2000) were chosen (for detail see Chapter 2, literature review), so the CT skills and dispositions are limited to the literature reviewed in this study and, to keep it simple, to teach only the basic skills selected.

The motivation for the study is the near absence of this type of research (at least to my knowledge, to date) in a Pakistani context and the need for careful design. The next step was the selection of an approach to teach CT skills. Again, with the help of positive evidence from research literature on learning and instruction of CT skills, Ennis (1998) proposed a mixed approach to CT skills at the higher education level. The teaching approach to CT skills in this study is limited to explicit curriculum-embedded strands; that is, a mixed approach to teaching CT skills in this classroom.

Because the intervention was a mixed approach to teach CT skills (Chapter 2, 4,) it needed to include explicit CT skills instruction as well as that embedded in the curriculum. The design and development of the intervention (preparation stage) were next. The curriculum was studied and the class teacher was contacted, materials were received from Pakistan and the course was designed. Consensus was achieved with the collaboration of the participant teacher, using my previous experience of teaching on the subject (see Appendix B).

Care was shown in obtaining access to the site of the study. Before acquiring permission to collect data, the researcher was asked to present the intervention plan to the staff concerned and, upon receiving satisfactory remarks from the department, the research proceeded.

The validity and reliability of the CT skills intervention subject course are limited to the expertise of the staff, teacher and researcher.

In order to check the suitability of the intervention lesson plans and the procedure for systematic instruction, as a beginner researcher I wanted to check the direction. Once the design of the intervention was ready it was piloted on a small scale and revised. Therefore, the piloting was conducted within the constraints of PhD in UK, at the University of Southampton, and I included Pakistani undergraduate students and a Pakistani university teacher for relevance in the sample (see Appendix C). The small-scale piloting was to check the suitability of the intervention instructional design and test the content validity of quantitative instruments, which may have been subjective yet was completed to show the care and rigour of the process. The pilot was limited to the sample and the expertise available in the sample. It was then sent to the class teacher in Pakistan and agreement was achieved.

How it is taught is also important when investigating the effectiveness of intervention studies based on CT skills (Higgins et al., 2005; Tiruneh et al., 2016). Therefore, consideration of the methodology of the study was another important step. To have the activity space for the holistic design that I intended to implement, a mixed methodology was most suited to pursue the research questions on the quantification and interpretation of CT skills learning and instruction. Both were based on a pragmatic world view (see Chapter 5). The observation of implementation and classroom learning environment were supplementary to the primary stage of intervention implementation to test the effectiveness of CT skills instructional intervention. The mixed-methods sequential explanatory design provided the flexibility and rigour to capture this aim. The CT skills and dispositions (motivation/learning environment), the implementation fidelity and participants' views were collected through well-established research procedures. The protocols of rigorous research were followed throughout (see Chapter 5).

To test the effectiveness of the intervention, the selection of instruments was another challenge where a practical decision about aim and scope of the study was made. What is taught is important and it must align with the instruments of measurement and variables that this study was looking at. Valid and reliable instruments were used for the pre-test/post-test, and for measuring student motivation/self-regulation, classroom learning environment and observational tools. The tools are limited to the ability of the researcher and previous research validity, as these have not been applied in this context before for the purpose of CT skills learning and the instructional environment.

In the next stage the field data were analysed and interpreted in a deductive-inductive manner to gauge the effectiveness of the instructional intervention. This involved rigorous analysis and revisions of the data to look at the effect, effectiveness and observational and interpretive data to reach triangulated in-situ evidence to answers of research questions and the extent to which this study succeeded in testing the effect of an instructional intervention for ITE students in Pakistan.

The study is limited to classroom-level teacher-student interaction and instruction, and the classroom as a learning place for CT skills instructional interventions. The study is also limited in its aim and scope to looking at NEP (2009) and NPST (2009) only as a reference to introduce the place for CT skills teaching and learning in teachers' professional development. The scope does not extend to presenting analyses of policies and their discourse or historical comparisons.

For the study to be achievable, I noted the limits from the start and drew the boundaries. For example, I am not looking at CT skills beyond the basic three skills, and same skills are measured throughout the test. For disposition (motivation/self-regulation and classroom learning environment), I limited their role as confounding variables for the experimental group only. Implementation fidelity is limited to the five clearly defined aspects of intervention implementation and to the field notes of implementation observation. The integration of data is limited to the design of the research, and quantitative and qualitative data are merged according to the research design and limited to the research questions.

1.5 Research questions

The aim of the study is to test the effectiveness of a carefully designed CT skills instructional intervention for ITE students in Pakistan. To achieve it, the following research questions were formulated:

(1) If using a carefully designed instructional intervention increases learning CT skills among students?

(1a) Do students' perceptions about motivation/self-regulation influence the learning of CT skills?

(1b) Do students' perceptions about classroom learning environment influence the learning of CT skills?

(2) What are the participants' experiences about how a specific instructional model helped or did not help in the learning of CT skills?

(2a) To what extent implementation fidelity influenced the effectiveness of a carefully designed CT skills instructional intervention to increase students' CT skills?

(2b) What are the experiences of students and the class teacher about the experience of a carefully designed CT skills instructional intervention?

1.6 Significance of the study

The effectiveness of CT skills instructional intervention has not before been studied at a public university on an ITE programme in Pakistan. Apart from that, the significance of the study lies in its exploration at classroom level with a zoom lens on student/teacher interaction with curriculum materials in a classroom. It also lies in the fine-grained analysis of the holistic nature of teaching/learning of CT skills, in which the role of the teacher, students, and the systematic implementation and review of the intervention itself are verified, and conclusions drawn from an understanding of the dynamic holistic nature of teaching thinking, through an intervention and its impact on teachers.

The study responds to the current need for teaching thinking skills based on research. It is aligned to the current trend for 'securing a sound foundation for the teaching of thinking' (Baumfield, 2015, pp. 62-63) by identifying the key underpinning pedagogical principles and making connections with the broader movement in educational research. The task of testing the effectiveness of CT skills in teacher education is in keeping with this trend because, first, the study is a foundation for a pedagogical principles-based approach to teaching CT skills in teacher education. Moreover, it tests for impact/effect by systematically reviewing its effectiveness within its context, so we can discuss it and draw conclusions.

Another contribution is designing, implementing and evaluating a small-scale study in a context where CT skills are a benchmark that is not applied in practice. This study shows how those theoretical principles can be translated into applicable classroom learning materials and activities, and, further, their effectiveness tested. I derive theory to practice-based educational research that contributes to state of the art use of CT skills pedagogical research and also looked at for further application of CT skills learning and instruction research in a much-needed discipline in Pakistan; that is, ITE and teachers' professional development in general.

The valid conclusions of the study took us beyond the CT skills instructional effectiveness research to wider connections of CT skills teaching/learning with field of educational effectiveness research, especially teacher effectiveness, and the field of school effectiveness and improvement. These have been lacking in current studies to explain the reasons/factors of effective, ineffective or potentially flawed CT skills instructional interventions (McGuiness, Curry, Greer, Daly and Salters, 1999; Topping and Trickey, 2014; Muijs et al., 2014; Baumfield, 2015; Burden, 2015; Abrami et al., 2015; Higgins, 2015; Davies and Barnett, 2015; Tiruneh et al., 2016).

The concept of CT skills provision is very often added to mission statements, but the actual application is zero. This study is an ambitious step towards researching in best possible manner the implementation of a CT skills intervention in a Pakistani teacher education university. By doing so, this study touched lightly on policy extension in terms of implementation in this institution for teacher education and its likely application at classroom level. In a Pakistani context, studies that unite policy and its implementation, consolidate research theories into educational practice, especially in teacher education, are much needed. This is the significance of this study. Such educational research can facilitate teachers' knowledge, skills and dispositions and may provide modelling for their practice (McBer, 2000, 2001; Darling-Hammond, 2010). Empirical research about teaching and learning of CT skills can be useful for teachers and effectiveness of teacher education programmes (Lipman, 2003, p. 75; Abrami et al., 2008; Wegerif, 2008).

1.7 Position statement

The study is limited to testing a full holistic approach for CT skills instructional intervention that also led to strategic compromises and limitations in working within the constraints of PhD timelines. The practical choices to be made for the successful completion of the project were not limited to the planning stage, but were faced during the implementation stage, as well. This shows the challenges and difficulties that a solo researcher has to face in the field of intervention research in terms of the selected methods, sampling techniques, data collection and analysis methods and the time frameworks, and at the same time the determination to maintain one's academic standards.

It was only after the data collection, during the write up, that I become aware of the scope of this study, and it was overwhelming. It took me on another journey of self-realization to rethink the importance of the burdens that I took on my shoulders. It revealed to me how much I cared for the profession in which I work, and for the rigour and standards of research that is almost non-existent in my country. I do not know where the energy to take on such task came from but, once I decided to take this research, it was only with discipline, the resilience of a researcher and the determination of a woman that pushed me forward, and I pursued and completed the task.

1.8 Overview of the study

Chapters 2 and 3 are a review of critical thinking literature. Chapter 2 covers the meaning and definition, defining CT skills and dispositions for my study, and the literature on learning and instruction of CT skills is explored with relevance to the careful design of a multidimensional nature of the skills. Chapter 3 reviews of the context and field of CT skills instructional intervention; that is, teacher education programme, and the background of the study is provided. Important aspects emerging from the review lead to the formation of conceptual framework in Chapter 4 of the study. Here, I reflect upon the literature review and derive the design principles for critical thinking instruction at classroom level, working towards the conceptual framework where design principles of the learning and instruction of CT skills are specified. This leads to the design and development of the instructional intervention and piloting (Appendix C).

In Chapter 5, the methodology of the study is presented. I examine my position as a researcher who has a pragmatic worldview, the research design explaining the mixed-methods design (quantitative and qualitative inquiry), research instruments, and features and limitations of methodological approaches. I also explain how the quantitative and qualitative data are to be analysed.

Chapter 6 deals with the data analysis and results of the data collected to find answers to the research questions. I use data representations such as statistical data presenting tables, text tables and thematic figures for thick description of participants' experiences and voices, as well as observational data. I begin with quantitative analysis and findings, and then qualitative.

Chapter 7 presents the discussion with an integration of the findings in the sequence of the research questions. When analysing and discussing the data, I triangulate the quantitative results by qualitative observations, and students' and the class teacher's accounts.

In Chapter 8, conclusions, contribution to knowledge, implications, limitations and further research with final thoughts are presented.

Chapter 2: Literature review

This chapter discusses the literature on critical thinking under two main themes. Under the first theme the field of research in critical thinking is explored to find the common meaning and definition of the concept. Three main disciplines were selected on the basis of their relevance to educational environments and as foundational knowledge basis for education and teacher education: the educational, the psychological and the philosophical. A differentiation is made about what CT is comprised of, in terms of mental abilities, skills and individual characteristics – critical thinking skills and dispositions. This section focuses on combining core disciplinary literature on CT- to clarify for the reader my stance - and helped in choosing what skills and dispositions comprise the concept of CT in this study.

Moreover, the meaning and definition of the concept is limited to which proponents have inspired me and influenced my understanding of CT as a learnable skill and its potential in teacher education environment in Pakistan. Possible useful connections were drawn to build a theoretical framework. I conclude that, in a Pakistani context, selecting from the consensus on core skills of CT and presumably influencing disposition - student motivation and self-regulation, learning environment- would be thought provoking to test the effectiveness of a CT skills intervention.

Under the second theme the literature relating to the teaching/learning aspects of CT skills is dealt with, what works and what does not from previous research studies. The development and the implementation aspects (steps and principles) of a CT skills teaching/learning programme are discussed. Studies related to instructional issues of CT skills and literature on intervention studies in the field are unfolded. The literature here is primarily discussed with a focus on how best CT skills can be taught to adult students, what needs to be considered in classroom situations when teaching for CT skills. Efforts that have been made in the discipline of teacher education, in the subject of educational psychology or any other domain were analysed. Deducting principles from intervention studies conducted internationally and locally are a big part in this section, due the main research questions asked.

The literature review plays an important role to determine the boundaries of the topic under study. It provides recommended principles and feeds into the conceptual framework in Chapter 4 and methodology in Chapter 5 of the study. Through the literature review it is hoped to paint a picture to inform what is meant by 'CT' skills in this research study, it is learnable, and what aspects are important to consider while teaching/learning CT skills.

The last part of the literature review discusses some of the practical issues and challenges of theory in practice-led research. This includes the complexities and limitations of real-world research, the challenge of trying a holistic approach to teach critical thinking and the instructional effectiveness (teacher effectiveness/teacher role, personality traits, formal qualification and experience and implementation fidelity of CT instruction), learning environment, student readiness and role.

2.1 Theme 1: Meaning and definition of the concept critical thinking

The research literature from themes one and two play an important role in building the conceptual framework of the study later in the thesis. Theme one sets out the understanding and boundaries of the concept for my research study and its theoretical basis. It has two subsections: an analysis of definitions from three main disciplinary grounds for understanding meaning of critical thinking educationally, and the selection of core CT skills and dispositions based on selected scholars and research influences and relevance for the study.

2.1.1 Interdisciplinary meaning and definitions of critical thinking

In this section, I analyse and synthesize critical thinking definitions from education, psychology and philosophy, reaching at an understanding of what is meant by CT (skills and disposition). The main areas of agreement or disagreement and CT skills, its relationship to other concepts are next examined briefly to clarify my standpoint and help to choose what skills and dispositions are the focus of this study. Before starting on concept of CT, the terms 'skills' and 'abilities' will be used interchangeably to refer towards those cognitive skills that can be demonstrated by physical actions/activities, and 'dispositions' and 'characteristics' will be used for metacognitive skills or personality traits for thinking critically.

Just three main disciplines were selected for their relevance to educational environments: the educational, the psychological and the philosophical. The reasons why only three are included are because the universal nature of the concept has brought a vast amount of vagueness and blurry boundaries to it, therefore a particular perspective may mean something else to others, thus by selecting three I was able to narrow down the field of literature. Also, because the application of the critical thinking was to be in the field of teacher education, the concept demanded a 3D view of it being related to the theory, teaching and learning situations in mainstream education. The sections are summarized in the form of a text table. The additional commentary on the similarities and differences in these definitions with reference to the selected critical thinking definition of John Dewey as a reference point can be read in the Appendix A.

Table 1: Summary of interdisciplinary meaning and definition of critical thinking

Discipline	Key definition and meaning of critical thinking
Education (Instructional view)	Active, persistent, careful consideration (Dewey, 1933) Attitude and knowledge of methods of logical inquiry and reasoning (Galser, 1941) Ability to respond, distinguishing, judge, infer and conclude form assimilated information (Manchester Community College Initiative (n.d.); Anderson and Krathwohl, 2002)
Psychology (Learning view)	Mental processes, strategies and representation to solve problems, learn new concepts and make decisions (Sternberg, 1986) Mental skills to increase the probability of achieving desirable outcomes (Halpern, 1998) Adaptability and openness of mind (Willingham, 2007)
Philosophy (Decision making ability view)	Reflective and reasonable thinking (Ennis ,1985) Goal directed and purposive (Bailin et al. ,1999) Purposeful, action oriented self-regulatory judgment (Facione ,1990) Skilled active interpretation and evaluation (Fisher and Scriven ,1997) Skilful, responsible thinking that relies on criteria, self-evaluation and context (Lipman ,1988) Purposeful, self-regulatory judgement combining skills and dispositions for a rational and democratic society (Delphi Report ,1990) Disciplined, self-directed thinking to a particular domain (Paul ,1992)

2.1.2 Areas of agreement and disagreement of critical thinking

Similar to the wide range of perspectives on meanings of the concept, critical thinking is debated on various aspects among scholars. There are many areas both related to the very nature of the concept (e.g. skill or disposition) or learnability of the concept (e.g. transfer or criteria) that scholars are in agreement or disagreement. Key points are briefly presented in the form of text tables 2 and 3.

Table 2: Areas of agreement related to the concept of critical thinking

Areas of agreement	Key points and researches
Skills for critical thinking	• Analysis i.e. analysing arguments, claims, or evidence (Ennis, 1985,1996; Facione, 1990; Halpern, 1998; Paul, 1992) • Inference i.e. making interpretations using evidence (Ennis, 1985,1996; Facione, 1990; Paul, 1992; Willingham, 2007) • Evaluation i.e. judging or evaluating (Case, 2005; Ennis, 1985,1996; Facione, 1990; Lipman, 1988, Tindal and Nolet, 1995) • Decision making i.e. making decisions or solving problems (Ennis, 1985, 1996; Halpern, 1998; Willingham, 2007).
Dispositions for critical thinking	• Behaviours such as asking and answering questions for clarification, defining terms, identifying assumptions, interpreting and explaining, reasoning verbally, predicting, and seeing both sides of an issue (Anderson and Krathwohl, 2001; Ennis, 1985; Paul, 1992; Facione, 1990; Halpern, 1998; Tindal and Nolet, 1995; Willingham, 2007). • Open-mindedness, fair-mindedness, the propensity to seek reason, inquisitiveness, the desire to be well informed, flexible, with respect for and willingness to entertain the opinions of others (Bailin et. al., 1999; Ennis, 1985, Facione, 1990, 2000; Halpern, 1998; Paul, 1992).
Background knowledge for learning critical thinking	• Most researchers (Ennis, 1989; 1990; McPeck, 1990; Bailin et al., 1999; Case, 2005; Kennedy et al., 1991; Willingham, 2007; Facione, 1990) agree that in order to think critically, students or individuals need 'grounds' - in order to arrive at any explanations, interpretations and evaluations, domain-specific knowledge is necessary. This means that the students must know and understand specific principles, norms and contexts before applying CT skills to any area of life (Lai, 2011).

Table 3: Areas of disagreement related to the concept of critical thinking

Areas of disagreement	Key points and researches
Skills versus dispositions of CT skills	• Preferring CT skills over CT traits perspective emphasizes that principles of good thinking are universal, and that dispositions of good character such as truth, honesty, trustworthiness and open mindedness have the same understanding in all cultures, albeit with understandable and delicate variance (Abrami et.al. ,2008; Ennis, 1998; Halpern, 2011; Higgins, 2015; Lewis & Smith, 1993; Lipman, 1991; Paul, 1992). • The dispositional and creativity perspective, argues that the characteristics and skills are not taught: they are natural, perhaps nurtured in individuals (Mathews & Lowe, 2011). However, they may be culturally biased (cf. Ennis, 1998) and contextually sensitive (Norris, 1985), so even if taught may not transfer to other situations and cultures (cf. Linda & Paul, 2007; Higher Education Academy, 2014).
Domain specificity versus generalizability of CT skills	• Another area of disagreement to what extent CT skills are domain specific or generalizable. Some researchers argue that CT skills can only be taught in the context of a specific domain (Lai, 2011). • Others argue that it would be unlikely that students could learn to transfer CT skills unless they are provided with sufficient opportunities to practise these skills, meaning that the teaching of CT should not be confined to a single domain (Ennis, 1992).
Transferability and criteria for CT skills and dispositions	• Research on the issue of a transfer Willingham (2007) and McPeck (1990), for example, conclude that students fail to transfer learned abilities and skills from one context to the other, therefore CT needs to be regarded as highly domain specific. • The counterargument is that concluding CT to be completely domain specific is due to scepticism of students' abilities to transfer the skills from one domain to another (Ennis, 1989, 1992). Research on the issue of a transfer of CT skills certainly shows both successes (e.g. Halpern, 2001)and failures/ mixed (Nickerson, 1988). There is much ambiguity about the degree of transfer in each case and the nearness or distance of domains - in other words, the transfer of CT skills from one domain to the other may depend on context, subject and situation, as well as on what was taught and how well (Bailin, 2002; Ennis, 1989).

2.1.3 Critical thinking skills and its relationship to other concepts

Critical thinking is a complex construct to explain because of its multidimensionality and the complex cognitive processes involved. However, it is considered to be related to the three concepts of metacognition, creativity and motivation, which may overlap with some aspects of CT and also have independent identity, table 4 explain the three concepts briefly.

Table 4: Critical thinking skills and its relationship to other concepts

Critical thinking skills and its relationship to other concepts

Metacognition

Metacognition can be defined as 'thinking about thinking' - Martinez (2006, p.696) defines it as 'the monitoring and control of thought'. What is the relationship between CT and metacognition? Kuhn (1999) sees CT as a form of metacognition which includes metacognitive knowing, meta-strategic knowing and epistemological knowing. Likewise, Flavell (1979) considers CT as a part of the construct of metacognition. While some perceive metacognition as being included under the construct of CT where it is used to monitor the quality of CT (van Glader, 2005; Willingham, 2007), others identify it as monitoring thinking and its use of strategy use (cf. Halpern, 1995). Halpern considers metacognitive monitoring of thinking by asking questions such as 'What do I already know?', 'What is my goal?', 'How will I know when I get there?' or 'Am I making progress?' (Halpern, 2014, p.556)

Motivation

CT is also linked to motivation. Many researchers agree that CT includes a certain set of skills, abilities and dispositions, and the disposition to think critically has been defined as the 'consistent internal motivation to engage problems and make decisions by using CT' (Facione, 2000, p.65). Motivation itself is an essential internal process to move towards a goal. Halpern (1998) considers students' motivation as a precondition for CT skills, and Paul (1992) calls it 'perseverance': a trait of mind that leads someone to be a critical thinker. There are various views about how the issue of the difficulty level of a task might lead to high or too low motivation, but some certainly suggest that the more difficult the task, the higher the motivation of students (Turner, 1995). However, motivation is also associated with self-regulation and the need for thinking (Meyers, 1986; Sternberg, 1988).

Creativity

One other concept considered to be related to CT is creativity. Many researchers have made connections between CT and creativity by calling both 'good thinking'; others cast creativity as part of CT or vice versa (Bailin, 2002; Bonk and Smith, 1998; Ennis, 1985; Paul and Elder, 2006; Thayer-Bacon, 2000). Paul and Elder (2006) point out that in practice both concepts are parallel and that teachers should try to integrate both during instruction (in Lai, 2011). Sternberg (1988), and Bloom and Krathwohl (2000) also relate that creativity is the ultimate form of CT.

2.2 Defining concept of critical thinking for my research study

In the presence of such a wide range of literature and points of views on the educational affordance of critical thinking, it is essential to pick up on the thoughts and works that define the position of teaching/learning of CT skills for this study.

Considering the vast number of perspectives, skills and personality traits attached to CT skills, it was important to refine the concept of CT. This was achieved by widespread scrutiny across many disciplines, to ascertain what skills and dispositions are accepted as core elements that would be practical to consider in my study. As described in the history of CT in Pakistan, because the introduction of CT in education policy is fairly new, one practical consideration was to keep the concept approachable and simple for the intended population. The tools of inquiry; for instance, categorization, analysis, memory (see Facione, 1990; Ennis, 1998; Dewey, 1910) are mentioned in almost all literature as the basic skills that can be the first step towards CT instruction, although hard to teach (Willingham, 2007). These skills can be improved and developed to ultimately attain 'perfect thinking' (Paul, 1992). In this sense, instruction in CT skills can be seen as means to a greater end, and not an end in itself (Bonney and Sternberg, 2011, p. 191).

For this purpose, the comprehensive lists developed by Ennis (1998) and Facione (2011) were used as a starting point. It should be noted that details of not just skills but also dispositions are important for understanding the scope and dimensions of CT. Since it is not practical to test all potential skills and dispositions in one single research study, the field was narrowed down to include only the most important. The selection criteria were:

a) relevance to the objectives and research questions of the study;

b) evidence of substantial contribution in operationalizing CT skills into educational settings, and defining and discussing educational implications including classroom, teacher and learner assessment of CT skills and dispositions; and

c) practicality of capturing the researchable variables within the scope of the study.

The following (table 5) provides a summarized description of the skills and dispositions considered by Ennis (1998) and Facione (2011).

Table 5: Summary of CT skills and dispositions

List of CT skills (Ennis, 1998)	List of CT skills (Facione, 2011)
Clarification Basis for the decision Inference Supposition and integration Auxiliary CT abilities	Interpretation Analysis Inference Evaluation Explanation Self-regulation
List of dispositions (Ennis, 1998)	**List of dispositions (Facione, 2011)**
Care to get it right Care about representing a position clearly and honestly Care about the dignity and worth of every person	Systematic Inquisitive Judicious Truth seeking Confident in reasoning Open-minded Analytical

2.2.1 Comparison of critical thinking skills and dispositions lists

The lists of critical thinking skills and dispositions of Ennis (1998) and Facione (2011) are very similar. They basically put together the evidence from psychology and education about CT abilities and characteristics. Ennis' listing is more explanatory, whereas by contrast Facione (2011) brings simplicity to the list using nouns and examples, making it easier to apply in educational environments.

Both lists present an orderly description of skills and dispositions. Lists of skills are more similar in meaning than the lists of dispositions. Ennis lists five skills of thinking whereas Facione lists six. By looking closely, one can conclude that clarification (describing, or asking question to know what a situation, issue, and topic is about and what it means) means what Facione lists as interpretation. Analysis (of a situation, learning material or an issue) is a basis for decision. Supposition and integration is the evaluation of something.

Both researchers list self-regulation/auxiliary CT abilities as a skill. I interpret the auxiliary CT abilities listed in Ennis (1998) which is self-regulation in Facione (2011) as an independent disposition. Skills are taught and practised. But self –regulation, discipline and regulating one's thinking may come from within (internal motivation) as well as from the learning environment (external motivation). In this way, self-regulation/ motivation and learning environment might independently affect the learning process for an individual as well as the learning environment in a classroom. In the context of the traditional education system in Pakistan with a low quality of teacher education where a lack of reflective teachers has been noted in local and international research (e.g. Dilshad and Iqbal, 2010; UNESCO, 2006a), it might be that self-regulation and motivation influence students as dispositional factors rather than as skills. Therefore, in contrast with Ennis (1998) and Facione (2011), I have taken self-regulation/ motivation and learning environment to be part of the complexities of individual and environmental factors that may have effects on the learning of CT skills.

Dispositions listed by both researchers are of universal value; for instance, taking care to get things right, being systematic, caring about the dignity and worth of every person and open mindedness. The description of dispositions comes from a logical yet emotional place in Ennis's list whereas Facione's lists are operational. For example, in Facione (2011), 'judicious' is used as a CT disposition, and the meaning that naturally comes to mind is considering both sides of a story/issue and doing justice to assess both positions. By contrast, in Ennis's list the disposition is described as 'care about representing a position clearly and honestly' and further detail is provided on what care means. The terms that Facione (2011) uses are more familiar in educational environments hence make understanding easier.

Elsewhere (for instance, Ennis (1963) and Facione (1990b)) both authors mention the non-linear association between skills and dispositions complementing the multidimensional aspects of learning thinking. Assessment of such skills and dispositions shown by students in learning environments can be used to identify strong or weak critical thinkers (Facione, 2011) and help find ways of improving the thinking skills of the weaker students.

In order to specifically frame the scope of CT, I had to limit the number of individual aspects of the two main parts of skills and dispositions of the construct 'CT'. My approach was to analyse what traits prominent scholars have identified and how many agree on these traits, and from there to deduce what the essential elements of the CT construct are.

After extensive reading of Ennis (1998) and Facione (2011) and others, it was possible to define CT in a way that most researchers agree on for the teaching/learning. By looking at the detailed descriptions of various aspects related to CT above (the multidisciplinary definitions and comprehensive lists), one can observe that all the researchers include a mix of 'abilities and dispositions' in their concept of CT.

All of the definitions discussed earlier in are overlapping. The Table 1 definitions from education, philosophy and psychology show some overlap between skills and dispositions, but a selection can still be made on the basis of the greatest relative agreement. The assumption is that these are the core skills and dispositions which are likely to be the most useful for teacher education and for students in general.

In this study, the construct/concept of CT is to be understood, in the words of Dewey, as:

> (a)ctive, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends. (Dewey, 1933, p.118)

The analysis of various stances on the definition of CT supports the idea that although the concept of CT is of long standing - originating from as early as Plato/Socrates time - it was the educationist John Dewey who provided the first comprehensive explanation of the construct. Dewey's definition helped to disaggregate the complexity of the construct into simple words, whereas other detailed definition helped to explain and paraphrase the concept.

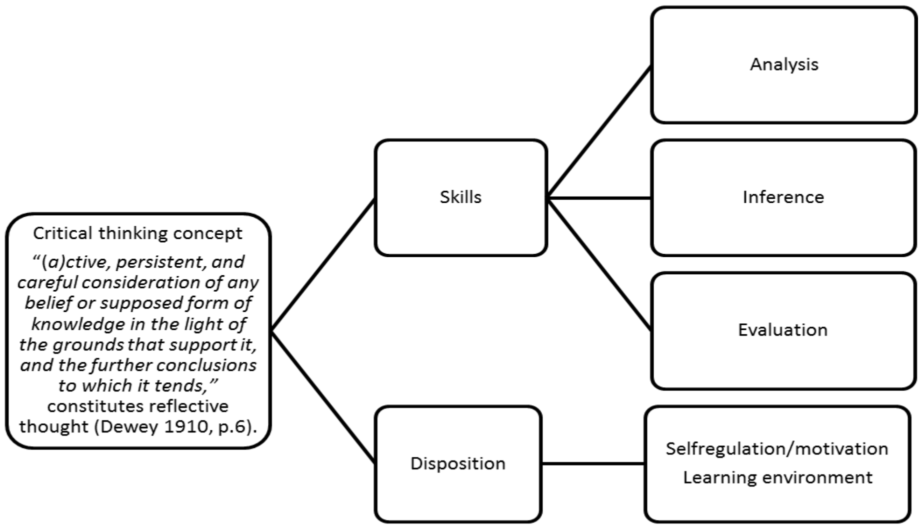


Figure 1: Selected CT skills and dispositions of the study

The lists of skills and dispositions, summarized in Table 5 by both Ennis (1998) and Facione (2011), explain skills and dispositions most relevant to both the construct of CT and the objective of this study; that is, to test the effectiveness of a CT skills instructional intervention. The CT skills that will be the focus of the study are analysing arguments, claims, or evidence, making inferences using evidence, judging or evaluating that leads to making decisions or solving problems. CT dispositions that are studied are motivational strategies for learning (these include motivation and self-regulation) and the learning environment. It should be noted that the skills and dispositions mentioned are not hierarchical in nature, but are interdependent, as opposed to Bloom's taxonomy in which they are described as levels (Ennis, 1993a).

2.2.2 Scope of the study in terms of testing, setting and transfer of CT skills

The study aims to test the effectiveness of a carefully designed CT skills instructional intervention to understand learning and instruction of CT skills. There are many other ways to engage with educational research to improve teaching and learning; testing not only provides an opportunity to observe particular aspects in detail but also brings more validity and credibility to the models. In addition, testing may reveal attributes that were not being tested yet might affect the quality of the intervention. The setting and environment of the place where the experiment is being conducted might have unique features with regards to the system, participants, classroom and institution level. Its routines may interfere with the proposed instructional intervention. Therefore, it is important to observe, explain and bring forward unique contextual aspects to understand the teaching and learning of thinking skills across various backgrounds.

The issue of transfer is important for critical thinking research studies. Defining the scope of transfer is critical theoretically for the design and the length of experiment, as well as the evaluation of the effects of CT skills instruction. It can be said that due to the small scale and the design limitations of the study, the aim of transfer is targeted as near, meaning that it is hoped that students will have a deeper understanding of curriculum materials and improved ability to use thinking skills in the teacher education curriculum (that is, near transfer). The wider aim of the study is targeted at improving the quality of teacher education programmes and teachers. Therefore, it can be said that the far transfer of CT skills is also the interest of the study. However, due to the study being one of very few efforts made in the field of research in CT and quality of teacher education in Pakistan, the nature of transfer can only be established after analysing the results of the intervention. For the wider scope of the study, based on the literature review there are gaps in educational research on thinking skills; for instance, the use of a theoretical framework, research-driven principles of instructional model, and a holistic research design to acquire a complete understanding of the phenomena understudy.

2.3 Theme 2: The learning and instruction of critical thinking skills

For CT skills instruction in classroom teacher, the learner and learning environment count as the core elements of learning process. Most classroom interactions are dependent on the type and requirements of the content to be delivered. Learning materials/content are part of learning environment in which learning outcomes are assessed. The quality of content and its delivery can affect that of the learning process. Teachers (mostly) plan and execute classroom activities based on the nature, complexity and individualistic features of the setting (e.g. group characteristics, discipline) and students (mostly) coordinate with other student and the teacher, participate and self-regulate themselves in order to learn particular skills. The coordination of these three (teacher, learner and learning environment) is important for any type of learning to take place. Essentially, teaching and learning of CT skills is no different. However, due to the very nature of the construct, it poses an extra layer of complexity to the design and delivery of learning materials and learning environment. Moreover, the role of teacher, student and the very interaction of these elements make it yet more complicated.

A plethora of literature is available on research on learning and instruction of higher-order thinking skills. The most promising meta-analytic studies on teaching thinking include Hattie, Biggs and Purdie (1996), Marzano (1998), Moseley et al. (2005) and more recently Abrami et al. (2008), Niu et al. (2013) and Huber and Kuncel (2015). The meta-analytic studies have helped to unravel some of the main areas of CT: 1) complexity of CT learning process; 2) the elements of learning environment; and 3) moderating variables involved in the learning of thinking skills and learning materials. It is important to consider these areas for a careful of thinking skills intervention design or in other words an instructional programme. In the following section the CT skills learning process, elements of successful or unsuccessful learning environments and moderators of the learning process are discussed, where appropriate with relevance to teachers and improvement of teacher education.

2.3.1 Critical thinking skills learning process

Learning CT skills is consciously practising strategies of thinking to become effective reflective thinker (Higgins, 2015). Historically, various approaches have been recommended by researchers for various types, disciplines, age/education level and purposes. For example, most research in 1970s and 1980s in the USA and Canada revolutionized teaching and influenced the development of thinking skills in schools (e.g. Lateral Thinking by de Bono, 1970; Project Intelligence by Machado, 1978; Instrumental Enrichment by Feuerstein et al., 1980; Advancement of Philosophy for Children by Lipman, Sharp, and Oscanyan, 1980). These programmes can be considered as pioneer influential programmes. Such ideas were then cross-fertilized with increased emphasis on the impact of various methods in developing CT skills in various parts of the world (Higgins, 2015).

Valanides and Angeli (2005) investigated the effects of CT instruction on college students' epistemological beliefs. In the past, there has been little discussion about the theoretical and curricular aspects of CT skills research studies in literature. One researcher – Marzano (1998) – has already drawn attention to the paradox in thinking skills instructional research and the lack of theory-based models/curriculum to teach thinking. Equally, Sipe and Curlette (1996) found that the curriculum interventions mean that the effect size was higher than in other educational treatment categories, although they also noted the dichotomy that the lowest and highest effect sizes were also most present in curriculum interventions. The meta-synthesis revealed that instruction (amount and quality) aptitude (ability, development, motivation) and environment (home, classroom peer and television) have a direct influence on learning (affective, behavioural and cognitive).

The consideration of a framework for thinking skills has been neglected in CT skills research study (Moseley et al., 2005a). The research has reported that CT, being a complex learning skill, needs a theoretical and principled approach so that systematic evidence can be established. This will help to unravel the ambiguities and the contextual, classroom-level variables that hinder or encourage the provision of CT skills. Moseley et al. (2005a) did the meta-analysis and represented theory-based results for thinking skills educational research. They reviewed fifty years of CT skills and instructional research in social, cognitive and metacognitive aspects. They included 42 frameworks that can be used to promote CT skills in classrooms thus, providing a wide range of possibilities suiting various needs of a local and institutional context.

The selected frameworks were evaluated under descriptions of intended use, and an evaluation and summary of the framework were provided. The frameworks for thinking have implications for practice and understanding such frameworks to plan the CT skills curricula. Their findings suggest that the domain, content, process and psychological aspects of thinking, teaching and learning frameworks, approaches and methods are important to consider when designing CT instruction (Chapter 4). Moseley et al. (2005a) concluded that for thinking, learning and teaching a consistent and explicit use of theoretical framework is required within an educational or training context. Consistent use will reveal the complexities, effects and improvement which will be then directly benefit the teacher and learners, as well as other stakeholders such as policy makers, parents, employers and educational researchers.

The processes of learning processes that are useful for complex cognitive skills can be used for selecting and designing CT skills instruction. Another way to understand thinking skills teaching and learning is how these can be taught across the curriculum. This work had been taken forward by Ennis' work, especially in teaching CT skills. These educational approaches can be grouped according to Ennis (1989), who suggested that CT skills instruction can be included in mainstream classrooms in four ways, presented in a list below.

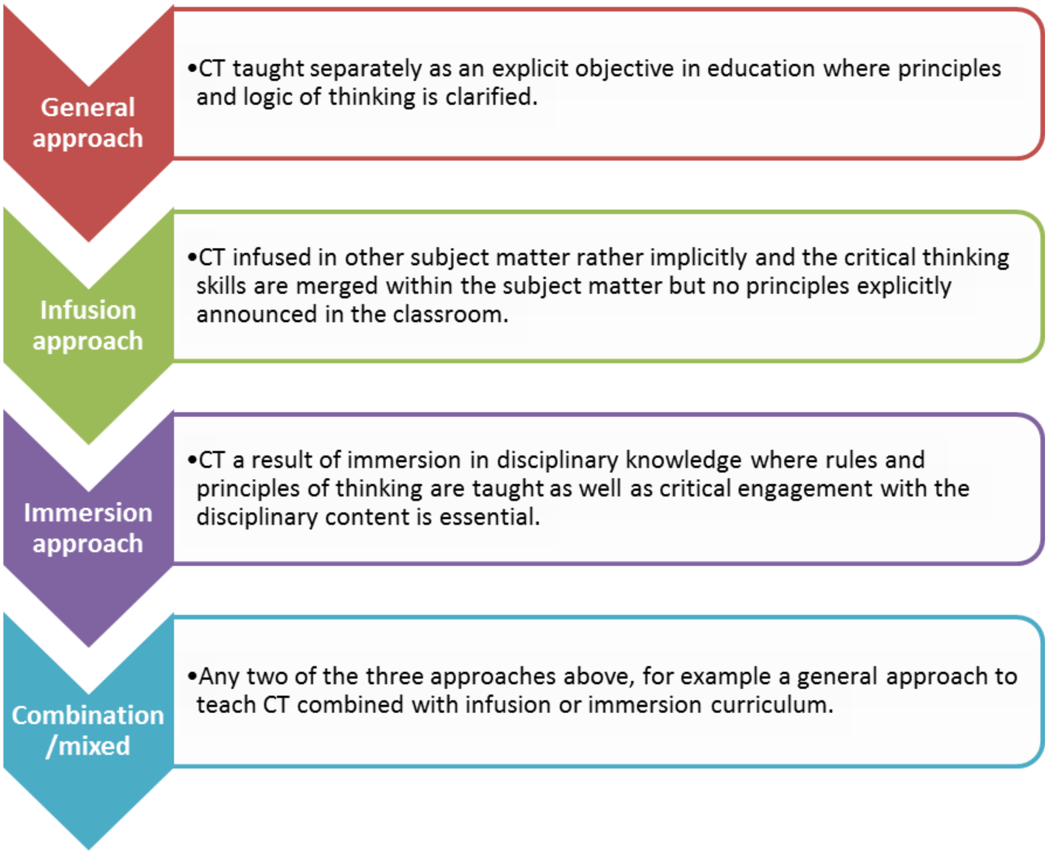


Figure 2: Educational approaches for CT skills instruction

Other researchers employed single or multiple strategies to enhance CT skills of individuals. Hattie et al. (1996) examined the structural complexity of instructional interventions and grouped interventions into four groups: uni-structural, multi-structural, relational and extended abstract (classification given in SOLO taxonomy). All four levels - classified as SOLO level - were used as independent variable. The dependent variables were classified into three domains: performance, study skills and affect-related interventions, in the meta-analysis. Furthermore, the studies were classified by complexity, based on the intended testing condition for near or far transfer of CT skills by the study outcome measures.

Uni-structural interventions focus on single strategy to teach CT skills, for example memory-enhancing strategies, rehearsal or verbalization strategies. The strongest effect (effect size mean= 0.84) was found in performance-based uni-structural near transfer studies. For example, in uni-structural near transfer studies student were taught using a single, very specific strategy (e.g. mnemonic keyword method for learning Russian vocabulary), and successfully developed expertise (near transfer) in comparison to a control group. However, for far transfer a decline in performance was found in uni-structural interventions (see Atkinson and Raugh, 1975; Klesius and Searls, 1990, in Hattie et al., 1996). This seems understandable, considering the narrow objectives taught directly, and the use of assessment measures aligned with learning materials.

Multi-structural interventions use more than one strategy to teach CT skills. Hattie et al. (1996) found that only near transfer interventions were found moderately successful (M= 0.45) in this group. They appeared successful in improving performance and positive attitudes to study. However, they were not effective in improving study skills in near transfer. Interventions that are multi-structural and aiming at far transfer seem to have a negative effect on near performance; opposing positive gains were observed on study skills in far transfer (Hattie et al., 1996). This means that the effect of multi-structural interventions is more positive for developing study skills among students in the long run. An example of multi-structural intervention is that of Schunk and Gunn (1986) with the objective of improving self-efficacy and performance. They used task strategies to solve division problems; a comparison of pre- and post-test scores showed a substantial improvement as well as large direct influence of use of effective strategies on changes in division skills.

Similarly, Hattie et al. (1996) reported that comparatively relational interventions were systematically useful for overall outcomes; for instance, performance, affect, study skills, and in far or near transfer. Relational interventions are those that try to change student attributional perspectives towards learning by using multiple techniques; for instance, Dendato and Diener (1986) used cognitive therapy, deep muscle relaxation and study skills training. They found that multimodal strategies are effective in improving performance, in their case in mathematics. However, relational interventions were effective only when outcomes assessments were closely related to the content, and in reverse were less effective when tested in areas far from the taught content (Hattie et al., 1996). A notable point is that multiple strategies to enhance cognitive skills should be relevant to the content of the discipline, and that the assessment of learned CT skills should be for near transfer. However, the results of other meta-analysis show that the effectiveness of multiple-component interventions is not clear, due to the variance in methods and assessment instruments used (Hattie et al., 1996).

The extended abstract interventions are programmes of learning for CT skills enhancement. One example is the Feuerstein's Instrumental Enrichment programme (FIE), which was first used in 1969 and later adopted by many researchers; for instance, Head and O'Neill (1999) in the USA, Ben-Hur (2000) in North America, and Soden et al. (2007) in Scotland. The reported effect size of FIE is 0.69 on enhancing the performance of the students. However, this programme had negative effects on study skills and no effect on dispositional change. The studies in this category showed an uneven pattern and established that the positive gains were perhaps due to 'teaching to the test', and raised questions about the programme quality, as one of the objectives of such extended abstract level programmes is to enhance motivation (Hattie et al., 1996).

In terms of categories of intervention outcomes, interventions aimed at improving performance, affect and study skills, Hattie et al. (1996) concluded that apart from extended abstract programmes, all three types (uni-structural, relational and multi-structural) interventions were most effective for performance, lower for affect and much lower for study skills (p.122). Moreover, the mean on testing conditions (far or near transfer) was higher for near (0.57, n=115) than for far transfer (m 0.33, n=91).

Another interesting finding was that the multi-structural interventions have their lowest effects in both near and far types. This could be due the non-relatedness of the tasks and lack of coherence with the content and objectives of teaching CT. On the other hand, relational interventions produce active strategy deployment and monitoring among the learners, which eventually produce satisfactory self-regulatory learning outcomes (Hattie et al., 1996). One criticism of meta-analysis such as Hattie et al.'s (1996) is that it is too generic in its categorization, therefore the implications are too broad to be of academic use.

2.3.2 Teaching critical thinking skills as a multidimensional approach

Research in on thinking skills was taken up with a caution in the UK, compared to North American and Canadian education systems. Inclusion of CT in National Curriculum in England and Wales was initiated directly by Department for Education and Skills (DfES, 2004a) and were made part of the developing Primary National Strategy aims (DfES, 2004b). Despite the recognition CT skills, there are no explicit programmes of study in the different subjects. It is still a challenge to resource subject-specific progression on teaching CT skills (Higgins et al., 2005), although efforts were made in post-16 education and training sector for CT skills development. In the UK, orienting and self-judging through implicit activities with specific tasks and within assignments or problems/modules for developing cognitive skills are common in post-16 education, but finding an approach to realize such aims in a structured and explicit way is rare (Higgins et. al., 2005).

Butler (1998b) used Strategic Content Learning (SCL) as an approach to improve students' ability to set task goals, and to plan, monitor and achieve those goals efficiently and effectively. In other words, Butler aimed with her intervention to enable students to achieve self-regulated learning through helping them to have the sense of what they are trying to achieve without telling them what to do. Being self-regulated is often summarized as self-regulated cognitive/thinking skills. The study used a pre-post-test design (N=34) with in-depth case studies including post-secondary students with learning disabilities. The intervention provided individualized SCL tutoring for two to three hours per week for at least one semester. The results showed improvement both quantitatively and qualitatively. Butler points out that rather than teachers modelling for students, engaging students in discussions about thinking skills and task-related strategies such as planning what, why, when, monitoring was in fact more beneficial to their achievement, regardless of the content and context of the subject domain. Successful instruction across disciplines is based on promoting context/context-related strategy use, engaging students in discussion strategies, explicit and structured teaching, providing assistance to students, and across-discipline application of skills. This implies the importance of self-regulation for thinking skills and a structured approach embedded in classroom teaching.

Similar to Butler (1998b), Masui and De Corte (1999) and De Corte, Verschaffel and Masui 2004) implied a well-defined and explicit intervention (approach) of enhancement of metacognitive knowledge through orienting and self-judging activities. The study used a module as an intervention that focused on teaching students how to orient themselves towards the course, content and course activities by learning to reflect and attribute constructively. An experimental study was designed with one experimental group and two control groups, each comprising 47 students. The intervention was applied through teaching over 10 class sessions to business students at a Flemish university, in a natural setting. For promoting transfer of cognitive skills of orienting and self-judging (self-regulated learning), the intervention group practised in all nine subjects of their first-year programme. One of the control groups was given similar tasks and the second control group was exposed to normal university teaching.

De Corte et.al., (2004) applied a multidimensional approach in the form of a CLIA (Competence, Learning, Intervention, and Assessment) for designing effective learning environments that foster literacy skills such as critical thinking, problem solving and self-regulated learning at university and school level. They asserted the importance of designing learning environments that require of teachers a range of competency skills (De Corte et.al., 2004). I think that this pays attention to the role of teacher training and the importance of providing such educational experiences as part of pre-service and in-service teacher education. On the other hand, the study invites thinking on what literacy skills are required and defined in different contexts; for instance, comparatively low-income countries will priorities literacy skills of basic competence compared to developed countries in which the focus will be on learning life skills and advanced forms of literacy, such as requiring students to be critical thinkers and self-regulated. Along with this, such ambitious teaching-learning environment calls for a change in learning culture. In terms of Pakistani teacher education, an awakened attention to improving the quality of education and quality of teachers in advanced literacy/competency skills has been explicitly in focus since 2009.

Studying the effect of approaches that require learners to identify, translate and evaluate thinking and learning that state not only what to be taught but also how it is taught can also help in understanding the complexity of CT skills learning processes. Higgin et al. (2005) concentrated on studying such influences and synthesized the literature on curriculum-based interventions. This, in my opinion, is particularly important for instructional research because it deals with both the design of the learning plan and its execution. Directly, it involves planning an instruction programme, learning materials, assessment and learning environment. Indirectly, it involves the interaction of teacher, learner, content and classroom learning environment, and the very interaction of these in general. One distinguishing feature of Higgins et al.'s (2005) review is their focus on the holistic nature of intervention design; that is, careful selection and implementation of thinking skills approaches (named thinking skills programmes), as well as providing precise information on the effectiveness and efficiency of such approaches, hence providing reliable information on 'what works' in education. This raises the question of observing the learning environment and gathering empirical evidence on the extent to which factors in learning environment influence the learning of CT skills.

Higgins et al. (2005) used experimental studies results only, with a lower limit of at least 10 subjects in each group control or comparison. Twenty-nine studies were selected, and effect sizes were calculated. The meta-analysis adopted a systematic approach to analyse research on CT skills interventions and included a study from Pakistan (Iqbal and Shayer, 2000) that will be discussed later in the context section. They reported on the results on studies (science, mathematics, and literacy skills) from a range of places around the world, with half set in UK and half in US, providing a balanced picture of 'what works' in different contexts and in schools (secondary level). However, one limitation of the analysis is that it included only studies that used specific CT skills programmes. Therefore, studies that were using curriculum interventions developed by researchers were not included, and many unsuccessful and diverse efforts may have been neglected.

2.3.2.1 Role of instructional techniques, metacognition and visual representation

Unlike Hattie et al. (1996), Marzano (1998) looked at educational research on instruction with a theoretical lens. The effect of instructional techniques was explored, categorized into systems of information processing theory. Student achievement and student competence were analysed as outcome variables in this study. The analysis determined how educators can make use of this research in classroom. The researcher asserted the need specifically to narrow down the teaching strategies based on theory rather than on broad narrative synthesis of research on instruction (cf. Hattie et al., 1996). The meta-analysis provided specific categories based on human information theory developed earlier in Marzano (1992), and McCombs and Marzano (1990). Marzano's (1998) objective was to develop categories functional enough for classroom practice yet do not bring too much generalization.

The analysis categorized instructional research into four domains; the knowledge, the cognitive system, the metacognitive system and the self-system. The first comprises information, mental processes and psychomotor skills. The cognitive system includes brain storage and retrieval, basic information processing, communication and knowledge utilization. The metacognitive system contains goal specification, process specification, process monitoring and disposition monitoring. The self-system is built on beliefs, self and others, the nature of the world, efficacy and purpose (Marzano, 1998, p. 65). According to Marzano (1998), human learning processes are based on these domains and their interaction, so it is important to synthesize instructional research theoretically and benefit by applying it to classroom practice. It is impossible for this study to discuss each domain and process of categorization, methods and analysis that Marzano adopted. The complete document can be consulted for details.

The knowledge domain, Marzano's (1998) analysis revealed, interacts not only with the subsystems of information, mental processes and psychomotor skills but also with the main domains of metacognitive and self-systems (see Marzano, 1998, chapter 6), because the mental processes include them. The overall effect of instructional techniques that used knowledge domain was .60 of the 2475 effect sizes (p, 87). Most interestingly, out of 2475 calculated effect sizes, more than half (1772 effect sizes) used processes for cognitive system; 556 effect sizes used instructional techniques rooted in metacognitive system, and 147 effect sizes for instructional strategies were based on self-system. This finding suggests that educators need to adjust their opinions on the role of metacognition (motivation, self-regulation) and self-system (e.g. beliefs, value system and self-efficacy) in classroom settings. Both systems were being downplayed and were thought of as an emphasis on metacognition by researchers in the past (Hattie et al., 1996; Bennet, 1992).

For the cognitive domain, the analysis revealed that there appears to be an interaction with self-system and metacognitive system. Most of the overall positive effect of cognitive instructional techniques seems rooted in those strategies that either use the self-system (effect size= .92) or metacognitive techniques (effect size= .75). The effect of strategies (e.g. storage and retrieval, feedback, reading and writing) that use the cognitive domain was not found as convincing as the effect of metacognition over cognitive system, metacognitive strategies and self-system. This implies that metacognitive system is the 'engine' (Marzano, 1998, p. 116) of cognitive system and overlooks the mental processes involved, although specific strategies such as techniques to retrieve previous knowledge with familiar topics, comparing and contrasting information, asking students for representational outputs (e.g. graphic/nonlinguistic format) had strong effect on learning (Marzano, 1998). Instructional techniques related to writing processes in studies were also found to use metacognitive systems; for instance, goal specification and process monitoring were most commonly implied, and such instructional strategies yielded an effect size of .71. It appeared that providing students with general heuristics was more effective than presenting them with steps to be undertaken in a rigid manner (Marzano, 1998).

Instructional techniques within the metacognitive domain and the self-system domain were targeted to enhance students' competence. There were few studies (only two) analysed in the meta-analysis that designed instruction specifically to activate students' metacognitive systems. However, 'the techniques of verbalization' produced an effect size of 1.38 (i.e. process monitoring function) and 'teaching students about the nature and function of disposition' produced an effect size .89 (i.e. also information specification and process monitoring).

It is noteworthy that both techniques were rooted in subsystems of metacognitive system and used process monitoring to enhance that very system (Marzano, 1998). This implies that making students aware of their own cognition and metacognitive systems through instructional techniques enhances their ability and competence in learning. This is consistence with Hattie et al.'s (1996) analysis that relational interventions that target student attributional perspective tend to have positive results and are more effective. The use of experimental inquiry was also encouraged to engage students in such tasks to stimulate both students' use of metacognitive system and to enhance the very system (Marzano, 1998). This means that experimental inquiries might be robust enough and complex enough to capture the instructional techniques that trigger learning of metacognitive skills such as CT

(Martinez, 2006).

The instructional strategies analysed under the domain self-system also showed a close relationship to metacognitive domain in their use of techniques of process monitoring function. Studies were available only in three of the five subsystems of the self-system domain: 1) self-attributes (beliefs); 2) self and others; and 3) efficacy. No studies or instructional techniques used in studies were identified as directly or indirectly addressing 4) world view or 5) belief about purpose within self-system (Marzano, 1998). Most interestingly, the act of verbalization of students' thoughts while monitoring and executing complex tasks, for instance critically evaluating the learnability of social values using computer games, activates monitoring process and gives them insights into the effect of their belief and performance (effect size=.99). Providing students with feedback and an overt setting of learning objectives by class teachers were found useful to enhance students' competence by activating the self-system (Marzano, 1998).

Instructional techniques of direct presentation and analysis of information were found effective in changing students' perceptions about themselves and others (effect size= .52). Similarly, instructional techniques that focused on presenting information about the importance of effort had positive effects in changing students' beliefs relative to efficacy (effect size=1.00). It can be deduced that such instructional techniques used information processing and process monitoring functions of the metacognitive system. The metacognitive and self-system combined produce favourable results for enhancing student achievement and competence. It is important to note that both seem to be most influenced by instructional techniques. This implies that teaching strategies can influence the awareness of the manner in which their minds work (Marzano, 1998).

One concern about Marzano's 1998 work is that it has not been peer reviewed, therefore the findings should be taken with caution. However, the conclusions that Marzano (1998) derived about metacognition or making thinking explicit are empirically sound, which is consistent with later findings that thinking techniques designed to develop students' self-regulation/metacognition are significantly better than those designed to be presented by teachers (Higgin et al., 2004). The impact of teaching approaches on CT skills learning processes and approaches can be traced later in the works of Abrami et al. (2008); Behar–Horenstein and Niu (2011), Higgins et al. (2005), Huber and Kuncel (2015), Lai (2012) and Moseley et al. (2005).

With regards to the impact of the implementation of CT skills, the intervention on metacognitive teaching and learning was analysed under three types of thinking skills programmes and approaches: 1) Instrumental enrichment (effect size=.58); 2) Cognitive acceleration (effect size=.61); and 3) Metacognitive strategies (effect size .96). Pupil attainment and achievement can be increased with CT interventions not only on cognitive but also on curricular outcomes, with an effect size of 0.62 (Higgins et al., 2005). Almost all approaches had a positive impact on students' learning, whereas approaches targeting metacognitive and cognitive acceleration had a relatively higher effect size than the direct instruction type intervention programmes. The higher effect sizes of metacognitive instructional approaches and programmes reinforce the evidence base; for instance, Marzano (1998). This encourages future studies to use and study metacognitive aspects of learning CT skills; for instance, motivation, self-regulation. However, the generalizability of this research is problematic with regards to CT skills research: a) it includes researches only utilizing CT/cognitive skills enhancement programmes that are general; and b) the analysis does not provide with useful strategies for future research use. Moreover, the studies included in the meta-analysis were tested at secondary school level.

> *The above discussion of the role metacognition raises the question that to what extent motivation/self-regulation influence the effectiveness of CT skills learning among students* (Research Question 1a).

Although distinctions between self-regulation and motivation have been made by psychologists, for teaching purpose the terms are cohesive because of the expected benefits for students to be able to manage their own metacognitive thinking to improve task performance using cognitive skills (Butler, 1998a and b; Masui and De Corte, 1999). In the following section, such multidimensional approaches are discussed.

Using computers in the development of cognitive skills and building independent learning environment in teaching-learning CT skills is an emerging trend. 'Cognitive tools' are instruments used to improve the cognitive powers of learners during their thinking, problem solving and learning (Pea, 1985; Salomon, Perkins, and Globerson, 1991). The use of visual portrayal (writing, argument maps, and concept maps) for thinking in the teaching/learning environment have an impact on students' learning, performance, educational attainment and problem-solving skills (Harrell, 2011; Liu, Chen and Chang, 2010; Van Gelder, 2003; Cheema and Mirza, 2013). Technology is usually seen as a tool that provides interaction and a student-centred focus to teaching/learning activities, and promotes active learning. Computer-assisted cognitive tools and techniques can help students actively to engage metacognitive and cognitive procedures to organize information in logical way.

Argument mapping (AM) is a technique that uses a visual representation of a text-based argument. The arguments are presented in a flow chart using boxes and arrows - the boxes are used to highlight the propositions, and the arrows show the inferential relationships that link different ideas together. The core part of an argument is the structure, where one proposition is the evidence for another, and the two are appropriately juxtaposed (Van Gelder, 2001; 2003; 2007b). According to Van Gelder and Rizzo (2001) and Van Gelder (2003), AM has been prepared with the explicit intention of decreasing mental load and to facilitate the learning and development of CT skills. AM uses dual modalities to represent arguments and Gestalt grouping principles of human visual perception in a hierarchical manner, all of which facilitate the organization of information in working and long-term memory for the purpose of enhancing CT skills.

The effectiveness of visual representation for the development of CT skills was researched by Harrell (2011). AM was used, in the context of an introductory philosophy course. The study concluded that students must be taught how to construct argument diagrams to aid them in the understanding and evaluation of arguments. The results of the study showed improvements in the CT skills of students (Harrell, 2011), although the study also noted that most of the AM software available has a too strong focus specifically on developing CT skills, and somewhat deficient with respect to other skills (Harrell, 2011). The study concludes that diagram mapping is useful for developing both general CT skills such as discipline-specific analytic abilities. Harrell (2011) suggested using argument diagramming in disciplines other than philosophy, such as English, history, mathematics and engineering, to build more on the applicability of AM software across disciplines.

In another study on understanding the relationship of cognitive processes and cognitive tools, Liu, Bera, Corliss, Svinicki, and Beth (2004) asserted that there is a positive relationship between practising specific cognitive processes and the frequency of use of related cognitive tools among students. This means that, instead of using only language to think and represent ideas, cognitive tools should be used to provide formalisms for students to represent what they know in ways that are more highly structured and visual. Liu et al. (2004) found that the relationship between students' metacognitive orientations and cognitive tools can be divided into non-computer-based teaching strategies as cognitive tools, and computer-based modelling tools. When learners use computers as partners, they offload some of the unproductive memorizing tasks to the computer, while the software requires the learners to use new ways to think about what they are studying (Jonassen, 1997). Teachers should select the formalism that is most effective for analysing and thinking about domain knowledge, rather than always relying on verbal accounts to reflect understanding. Both types can be considered as teaching strategies for their role in developing CT. The basic purpose of using computer-based modelling tools is to lessen the cognitive load and help students to practise content-based ideas to develop and practise CT skills - these comprise analysis, inference, and evaluation.

Cognitive tools are becoming prominent in the teaching/learning of CT (e.g. Harrell, 2011; Liu, Chen and Chang, 2010; Van Gelder, 2003, Cheema and Mirza, 2013; Wegerif et al., 1999) due to their potential to increase flexibility and to facilitate complex thought processes. Dwyer, Hogan and Stewart (2012) examine the effects of a CT e-learning course which was taught through AM in the discipline of psychology. The study adopts a quantitative approach using quasi-experimental methods, and after implementing an eight-week intervention, the CT ability of the students was measured using Halpern's CT assessment. The results showed a significant improvement in the AM-focused CT course, and a successful fusion of online learning and argument mapping at undergraduate level for the development of CT skills. The study also concluded that neither the need for cognition nor that for motivation was correlated to CT at the pre-testing stage, but that there was a significant correlation between these items at post-test level.

In conclusion, a variety of visualization tools are available to facilitate teaching/learning for students, and the selection of the specific type of visualization tool depends on the particular learning objective. For a chemistry lesson where the purpose is to visualize a chemical structure the choice of tools would for example be in the category of visual modelling tools, while for a teacher who wants to enhance students' brainstorming skills and their abilities in showing understanding and relationships among concepts, the choice of visual tools would be something similar to concept mapping or AM. This is relevant to the teaching and learning of critical thinking skills and AM and concept mapping seem to be an appropriate choice for practising CT argumentation skills.

2.3.3 Role of environment in learning and instruction of critical thinking skills

One aspect that is not discussed much in CT intervention studies is the relationship of learning environment, study features and CT measurement to the instruction and improvement of CT development among students at post-secondary education level (Higgins et al., 2005). Tiruneh, Verburgh and Elen (2014) undertook a systematic review (30 studies spread on a time span from 1995 to 2012) of the effectiveness of CT instruction in higher education. The analysis captured two important aspects of CT instructional interventions at higher education level. Firstly, ‘the study features’ specifically related to (1) instructional approach, (2) teaching strategy, (3) student related characteristics, and (4) teacher related characteristics, and secondly 'the effect of CT measurement' used. Their results showed that in respect of study features:

- Among approaches to teaching CT (Typology by Ennis, 1989) the 'general approach' was most significant, in second place was 'mixed approach studies' and in third place was 'infusion approaches'.

- For CT skills teaching strategies Tiruneh et al. (2014) divided studies into two categories: 'direct' and 'implicit'. Direct teaching strategies commonly included teacher-led explanation of thinking procedures, rules and guidelines, followed by instructional activities focusing more on student engagement in deep discussions and increased practice of thinking skills. Implicit instruction was where studies used various teaching strategies that embed CT but no explicit emphasis on teaching-learning CT skills was employed. The evidence on the effectiveness of implicit teaching strategies was inconsistent, with only the PBL teaching strategy having positive effect on CT improvement. The effect of direct instruction was greater on CT improvement.

- In respect of student related characteristics associated with CT development, analysis was limited due the lack of information reported in review studies, but the effect of academic performance and educational level (year level) was examined. There was limited evidence of students' previous academic performance (grade point average, or 'GPA'); this could conceal the effect of instructional intervention when students in control/experiment group have different previous scores. Year level analysis revealed that first-year student benefit more from CT instruction when direct instruction was employed, the immersion approach was more successful with second-year students but no data on CT approach and year level variance were available for senior year students.

- The effect of teacher characteristics on CT development was analysed under three conditions such as: trained or experienced, researcher implemented intervention, or classroom teachers with no previous experience or training assigned to teach CT. The analysis showed most improvement in CT outcomes when instructional intervention was taught by the researcher/researchers (60%, 9 out of 15 studies). For studies where regular classroom teachers were involved improvement was moderate (41%, 5 out of 12 studies). There were no data available on whether prior training of teachers in CT instruction made a difference. Interestingly, the influence of teacher

> characteristics on success or failure was null across mixed or general type approaches, but prior training of teachers did have some effect in the case of infusion or immersion approach.

Snyder and Snyder (2008) assert that CT is a skill that can be learned, and that in order to learn the skill there are three important steps that need to be taken, firstly focusing on instructional strategies to actively engage students in the learning process; secondly, focusing on instruction of the process of learning rather than on content coverage; and thirdly, using assessment techniques that provide students with intellectual challenges. They also identify several barriers to CT instruction such as lack of training, limited resources, biased perceptions and time constraints which can impede learning. In addition, they suggest that actively engaging students in collaborative activities can encourage students' CT skills.

Several researchers (e.g. Volkwein, 1991 and Volkwein and Lorang, 1996, also cited in Cabrera et al., 2001) have linked learning outcomes to teaching methodologies, but it is classroom experiences (the learning environment) which appear to have a stronger and more varied effect on student learning outcomes, both short term and long term. The quest for the optimal way to teach CT skills, therefore, has two theoretical foundations: first, the importance of improving student learning outcomes and achievements; and second the importance of teacher effectiveness and learner-centred teaching methodologies. This supports the idea that teaching CT to students has to be a two-way reflective process involving teachers and students equally. Outcomes may be more influenced by teachers' personal beliefs that their students are improving than anything else, which means that teachers' beliefs may need to change, which is problematic since in most cases teachers are resistant to changing their beliefs (Richardson, 1998).

The strongest motivating factor that helps teachers change their teaching is an improvement in student learning outcomes, and the most influential and motivating factor for students in improving their learning is classroom experience. Thus, unless teachers consider an improvement in student learning to be a priority, the instruction of CT in teaching/learning may not be successful. ITE students will most likely replicate what they learned in their own classrooms as students, thus any change in their teaching methods can be seen as the starting point of a long-term change of future teachers' beliefs - one can thus assert that pedagogical experiences and practices provided in pre-service teacher education are effective in improving teacher education and quality of education in general.

Student interest is also vital, and is an indicator of intrinsic motivation by way of sustained attention and effort that affects students' performance student response. Extrinsic motivation comes from the outer environmental factors such as performance and rewards can motivate students to learn something. However, it is quite possible for students to stop paying attention or stop improving their performance once the rewards are withdrawn (Sternberg, 1988; Bonney and Sternberg, 2011). An individual's thinking might appear differently in different contexts, not only because of the qualitative differences in situations but also due the background knowledge and familiarity or unfamiliarity with necessary principles of thinking in one domain or the other. Therefore, before students apply certain CT skills, they must attain a certain level of contextual knowledge and understanding of the topic (Bonney and Sternberg, 2011).

Modelling and problem solving involving CT activities based on a framework of thinking about thinking, the use of questioning for teaching CT, and the learning environment is suggested by researchers such as Hemming (2000), Broadbear (2003), and Lundquist (1999). Students learn more by active involvement in the learning process, and research confirms this helps cultivate CT (Brown and Kelly, 1986). Ladyshewsky (2006) and Facione and Facione (2007) also suggested that peer coaching and working in teams can encourage active learning and opportunities to think critically. Hou, Chang and Sung (2007) suggested that problem solving and collaborative project-based learning activities with the addition of peer assessments facilitate students' CT and metacognitive skills (seen in Snyder and Snyder, 2008).

Mathews and Lowe (2011) discussed the work of various researchers on the importance of CT dispositions, and in their conclusions advocate developing a classroom environment suited for CT dispositions. They stressed the importance of identifying, discussing and overcoming environmental factors that inhibit the development of a generalizable disposition for critical thought, and supported their ideas with empirical evidence from classroom practices where the classroom environment actually helped to foster a disposition for CT - according to them, CT dispositions in a classroom 'lead to learning environments that support not only the development of CT skills, but also a disposition among students and potentially teachers to think critically' (Mathews and Lowe, 2011, p. 71).

> *The above discussion of the role of learning environment (LE) raises the question that to what extent classroom learning environment influence the effectiveness of CT skills learning among students* (Research Question 1b).

2.3.4 Role of implementation fidelity in critical thinking skills intervention studies

One of the most significant discussions in CT skills intervention research is the scarcity of research data on the implementation procedures, factors influencing implementation or simply what happens when CT skills interventions interaction happens with teacher, students and learning environment. Higgins et al. (2005) also vocalized the limitations of included studies failing to report the characteristics of selected programmes, or aspects of implementation and use in classrooms, for example changes in teaching and learning processes. Therefore, for Higgins et al. (2005), extending the common positive features of intervention programmes 'how it is taught' was not possible. Despite the positive effect sizes, this area of characteristics of the executed programmes and the execution record is grey.

> *Information on implementation fidelity aspects might help in explaining the variance, the curricular reactivity within classroom context in different parts of the world. (Research Question 2a)*

Abrami et al.'s (2008) meta-analysis of 177 studies found that CT teaching brought largest effects when it was taught using a mixed approach, where CT instruction was apart - as an independent track - within the course, and the least effective was the immersion approach. Design-wise, little variation was found among studies. However, heterogeneity was high in 'type of intervention and pedagogical groundings', accounting for 32% of the variance (p. 1119). This means that, for CT instruction and learning, theoretical and pedagogical objectives must be made explicit. They also recommended that for successful provision of CT skills in mainstream education these must be included and pre-service and in-service teacher training.

Mixed instructional approaches merging the content and CT instruction (*Typology* by Ennis, 1989) appeared to have significant effect on development of critical thinking skills. Negative effects of CT skills interventions could not be explained fully. However, Abrami et al. (2008) asserted that in all positive results the improved CT skills and dispositions were associated with how the instruction is provided (p.1120). Variables that are largely associated with the effectiveness of CT studies were course content/curriculum and pedagogy and how it was instructed. Moreover, the researchers expressed that there were still questions that needed to be further explored and answered. These are related to methodological and substantive features; for instance, student characteristics, teacher characteristics, duration of treatment and quality of intervention, and the relationship of implementation fidelity to effectiveness (Abrami et al., 2008).

Abrami et al. (2015) focused on aspects of teaching critical thinking and explored if student achievement can be positively affected by integration of CT-linked content (Abrami et. al., 2015, p.305). However, strong effects of the use of effective instructional techniques were further required to achieve this goal. Abrami et al. (2015) explored mixed moderator variables; for instance, educational level, subject matter (Health education, STEM subjects and non-STEM subjects) and duration of treatment. No significant effect at course level was found. Positive effects of authentic instruction, dialogue and mentoring were found and the effect sizes were higher when a combination of these three instruction types was used. This is consistent with Hattie et al.'s (1996) and Marzano's (1998) analysis in which relational, direct and metacognitive instructional strategies had positive effects.

Another way to measure the effectiveness of an instruction (Halpern, 1993) is that an intervention can assess the fidelity of implementation. In curriculum interventions, this can be defined as 'the extent to which the project was implemented as proposed' (Loucks, 1983, p.5) and '(t)he extent to which teachers enact innovations in ways that either follow designers' intentions or replicate practices developed elsewhere,' or 'the extent to which the user's current practice matched the developer's 'ideal'' (Loucks, 1983, p.4). Educational research that is detached from practice may not account for the influence of the emerging and complex nature of context and outcomes, and may not contribute to knowledge about factors that are relevant for prediction (Robinson, 1998; Burden, 2015; Williams and Burden, 1997). Intervention fidelity is an important aspect to consider in designing and conducting rigorous intervention studies. It helps to increase the external and internal validity of the research undertaken. The research gap in the field of CT skill in terms of implementation fidelity is voiced by many researchers (for instance Abrami et al., 2008; Burden, 2015). The instructional intervention for CT skills in this study is integrated into the curriculum design. A study programme was prepared for CT skills and educational psychology, then handed over to the class teacher for delivery. To say to what extent the intervention was effective or ineffective, it is important to observe how it was implemented or delivered.

Research on the effectiveness of studies has noted that fidelity of intervention is likely to be related to research outcomes (NRC, 2004; US Department of Education, 2003). The fidelity of implementation can also be a moderator for curriculum effectiveness (O'Donnell et al., 2007). Most of the work is from the field of health sciences, and the concept is relatively new for intervention research in general and fairly scarce in CT skills learning and instruction (Burden, 2015; Williams and Burden, 1997). However, the history of programme evaluation as such goes back three decades (for a rigorous review, see O'Donnell, 2007 and 2008).

The literature conceptualizes that fidelity of implementation is important to both efficacy and effectiveness studies, and stresses that there are both overlaps and differences between the term and educational constructs such as curriculum evaluation, curriculum potential, teaching, and adaptation. It is close to the construct of intervention integrity, which determines whether a programme was ineffective because it was weak, poorly conceptualized/designed or poorly implemented, if for example the main elements were not implemented as intended (Leff, Hoffman and Gullan, 2009). Thus, systematically monitoring the integrity/fidelity with which interventions are implemented especially in interventions for teaching complex constructs provides insights into what does not lead to positive effects (Leff, Hofmann and Gullan, 2009). The meaning of fidelity of intervention in this study is close to that of instructional quality (how the elements of instructional plan are implemented and received by the teacher from a teaching perspective) (the amount of change that occurred in the teacher's practice and student learning after the CT intervention) (O'Donnell, 2008).

Moreover, it is argued that the statistical power of a study depends on reliable and valid measures, appropriate design and sampling, and careful assessment of fidelity that decreases as research moves from laboratory towards the field (O'Donnell, 2008). This becomes important when a researcher needs to establish whether poor outcomes are due to structure, complexity, dynamics of the programme, and lack of implementation or misaligned designed intervention with programme theory (Rog, 2012; Summerfelt, 2003).

2.3.4.1 Principles of implementation fidelity

The research literature on implementation fidelity has been discussed above. This discussion informs the study as to the importance of the implementation phase for effectiveness studies that are curriculum based interventions. In this study, the guidelines provided by O'Donnell (2008) were used to draw principles and establish measures to address the implementation fidelity of the study. The following principles were drawn from O'Donnell's guidelines:

1. Establish a priori programme theory /criteria

   The research undertaken in ITE for the development of CT skills in Pakistan has the support of organizational policy (NPST, 2009), as well as a theoretical basis in psychological, social and instructional frameworks as discussed in the literature review above.

2. Determine implementation fidelity for the study

   The implementation fidelity for the study is concerned with the relationship of planned/intended curriculum to implemented curriculum. This means that the fidelity of implementation will be measured solely by observing how much of the planned instructional programme was implemented by the interventionist in this study. Observation of the structural components of the instructional intervention was particularly emphasized in this study.

3. Define fidelity of implementation and variables/critical components for the intervention

4. The five components of classroom implementation fidelity listed by O'Donnell (2008) can serve as variables or critical components for this intervention; they are adherence, exposure, quality of delivery, programme specification and student responsiveness. In addition, the teacher as the interventionist as well as the students and learning environment interactions will be the focus of measurement.

   Develop separate instruments for measuring the critical components

   Separately developed instruments for classroom fidelity of implementation have been selected to be used, and field notes were taken for data collection on interactions related to teachers, students and learning materials inside the classroom.

5. Measurement of processes in both the experimental and comparison group

   The study should include observation for from both conditions so that comparisons can be made about diversion, similarities and programme differences between groups.

6. Fidelity variability to outcomes

   Treatment fidelity concerns the necessary training and feedback that is given to the teacher prior to the study or during the trial to ensure ideal conditions. In effectiveness studies, it may be related to training and delivery of materials for expected outcomes after implementation. However, since in effectiveness studies the implementation occurs in a natural setting, it is likely that variation in implementation will occur. Fidelity to critical components and processes should be captured so that later the fidelity can be related to outcomes. Outcomes of the effectiveness studies would need to be adjusted if fidelity falls outside the acceptable range (O'Donnell, 2008). The analysis of the study results must be conducted in relation to fidelity variables and study outcomes to estimate to what extent fidelity variations relate to outcomes.

7. Test for and report on reliability and validity of the fidelity data collected

A report on the reliability and validity of the fidelity data will be included in the Chapter 6 on data analysis and interpretation.

2.3.5 Qualitative inquiry of critical thinking skills learning and instruction

Qualitative evidence on the teaching and learning of CT skills is scarce and the need for studies considering holistic designs (Abrami et al., 2008), qualitative inquiry of intervention treatments (Niu et al., 2013), qualitative aspects of implementation fidelity (Niu et al., 2013; Burden, 2015), participants' experiences and context (Ennis, 1998; Facione, 2011; Moseley et al., 2005) has been noted by researchers. Apart from the multidimensionality of critical thinking, once the concept is defined tightly another reason for lack of understanding about overall low effect sizes, or negative or zero gains on students' CT skills improvement, is the non-availability of details on the multifactorial learning environment. One researcher has already researched this by way of using case studies to *capture what happens* or *how it is taught* in institutions.

Tusi (2002) researched fostering CT skills from an effective pedagogy research point of view. Data collected from four institutions using multiple sources such as classroom observations and interviews that led to findings about the differences in teacher beliefs, instructional pedagogies and how the interaction of constellation of factors are interrelated with the development of CT skills. The slight change in one factor or the absence or presence of another may influence a single factor or many other elements within the same learning environment, such as the impact of low, medium or high selectivity of institutions for admissions, staff's attitudes to students' abilities, classroom factors such as an emphasis on writing, discussions, feedback, safe environment, breadth and depth of subject matter and feedback (Tusi, 2002). The teacher, student, curriculum, instructional strategies and institutional culture seem to create a learning environment that, if aligned, fosters critical thinking skills and, if not aligned, impede CT development. However, due to the nature of the research being highly contextualized, the self-reporting data may be extendable only to the group of classes and teachers that were observed at that time in the research study. Self-reported data has a 'modest relative validity' (Anaya, 1999; Tusi, 2002), thus the improvement reported by students on their improvement of critical thinking skills cannot be fully reliable due to the absence of objective measurement. Tusi (2002) effectively utilized qualitative methods to explain the complexity of CT skills learning environments and how the uniqueness of contextual factors can obstruct, hinder or accelerate their improvement.

Although this research provides a rich description of the sites under study, some of the vagueness and ambiguity is unexplained. Therefore, I think more powerful description can be formulated by combining the strengths of mixed-methods research. Further research can be designed to benefit from the quantitative and qualitative inquiry of CT interventions, so that the questions not only of what is taught but also how and where it is taught may be understood. The differences or similarities will likely provide useful data for 'fuzzy generalizations' (Bassey, 1998; 2001) to build a theory of teaching and learning of CT skills elsewhere, in this regard in use of mixed-methods research study designs can be really useful (Abrami et al., 2008). As the instruction includes various complexities of classroom learning environment, I think studies should include observational data (snapshots) from classrooms to strengthen the validity of results and identify of not only what works but what did/did not work and how and why.

2.3.6 Assessment in critical thinking skills learning and instruction

Assessment of critical thinking skills is discussed in terms of as such CT skills as variables and moderator variables.

2.3.6.1 Measurement of variables

Beside the increased attention in CT skills, instruction of CT skills is still a complex area that needs exploring. According to Ennis (1993a and b), another related area that is perhaps even more neglected than CT instruction is CT assessment. Ennis (1993) warns against the fallacy of confining CT skills and dispositions to a narrow selection of skills and dispositions, along with avoiding attaching hierarchical sense to CT skills and dispositions. Halpern (1993) argues that determining effectiveness of CT instruction is difficult due to multiple complexities in CT skills instruction. In my opinion, not only causal measurements are needed to see development in CT skills but interpretation of the causal and non-causal links, to provide a complete picture of their relationship with what questions were researched and how the answers were looked for. In the same way, Ennis confirms that starting with a simple core set of skills and dispositions - keeping in mind that these are interdependent in nature - is a good foundation, because it would prompt one's thinking about what to assess and how to assess it (Ennis, 1993a).

The identification of outcome variables, design and selection of assessment instruments, ecologically valid indicators (for the setting), comparison groups, time of testing, and identification of classroom strategies that engender CT are aspects to be specified early on when selecting and designing CT measurements (Halpern, 1993). Facione (2000), on the other hand, suggests a rubric approach to assess or design the assessment of CT skills, asking two basic questions while selecting CT measure: one, what context of knowledge development (domain) look like; and two, making explicit reference to specific cognitive action (specific CT skill e.g. analysis). The forms of measurement may be many and thus need to be adopted according to the requirement of the specifications of the purpose and context. Ennis (1993) explained this variability in CT skills measurement and the nature and need of determining each study's own CT assessment which brings flexibility and credibility to attempting CT skills development through instruction.

According to Ennis (1993a), the summary of relevant purposes of CT assessment to this research study are listed below:

1. diagnosis of level of students' CT;
2. feedback about CT competency (strengths and weaknesses);
3. motivating students to be better at critical thinking;
4. informing teachers of success of their teaching (feedback on instruction);
5. doing research about CT instructional questions, issues and purpose;

6. and 7. are high-stakes testing related: not the objective of this study, therefore are omitted from discussion (for details see Ennis, 1993a, p. 181).

One way to assess the impact of instruction is student learning, thereby measuring the effectiveness of teaching and implementation. CT measurement is commonly by standardized or non-standardized tests. Studies that used the former reported more positive outcomes than those using the latter. Noticeably, studies that employed essay response-based measurements yielded more CT gains than those that required multiple choice. However, measurement of CT development as an area needs further attention (Tiruneh et al., 2014). Measurement of student learning also hints at the individual/group characteristics and implementation of instructional intervention that studies have indicated as environmental factors, for instance classroom environment and teacher-student interaction, as significantly affecting the learning of CT skills and dispositions (Mathews and Lowe, 2011; Halpern, 1993). Most of the research meta-analysis reported earlier used pre- and post- measurement of CT skills, hence basing the effectiveness and success or failure on only student attainment scores. This perception is a narrow view of CT skills instruction (Halpern, 1993) and needs to be modified or changed for a wider view.

2.3.6.2 Consideration of moderator variables affecting CT skills learning

Moderating variables, as such, have not been explored much in empirical research into CT skills. Learning materials, student and teacher interaction, the role of students and the role of context play a vital role in the learning of thinking skills (Bonney and Sternberg, 2011).

Learning materials and the teacher's role are inevitably involved in the promotion of CT skills (Paul, 2005). Just as students need know-how to manipulate information and how to think, a teacher's broad and deep understanding of subject matter and ability to represent that it in various forms or activities are essential (Wright, 2001; Grant, 1988, in Mayer and Alexander, 2011). Therefore, much of CT instruction depends on the teacher's role, interaction with students, subject knowledge and ability to make decisions which can be difficult, due to varying conceptions of CT (Wright, 2001). In my opinion, if researchers help in providing synthesized information to teachers about basic CT skills and what is relevant to the subject knowledge, this might help them to have a better-informed position.

Niu, Behar-Horenstein and Garvan (2013) reviewed education research on teaching and learning of CT for higher education students, examined the existing heterogeneity of research effect sizes and traced the factors explaining the variance. The results were drawn from 31 studies using pre-experimental, true-experimental and quasi-experimental data from 1994 to 2009. In general, interventions appeared to work better in social sciences than in health sciences, but wide variance in data suggests that the findings should be treated with caution. No single approach/method was consistently successful, although the collective effect of instructional interventions on students' score on CT tests was significant. The reported variance of the mean effect size was 0.071 (T2 statistics), leading to exploration of the role of moderators and predictors of the variance effect size. Abrami et al. (2015) explored mixed moderator variables; for instance, educational level, subject matter (health education, STEM subjects and non-STEM subjects) and duration of treatment. They found no significant effect at course level; however, the duration of the treatment seemed to affect the learning of CT skills.

Niu et al. (2013) used hierarchical linear modelling to explain variance across studies and found that treatment effect was explained by factors such as student discipline and treatment length. When treatment length was controlled, there was no effect on change in variance for either discipline (health sciences or social sciences). Controlling for student discipline, the effective intervention length for single studies was 12 weeks as compared to shorter and longer treatments. However, Niu et al. concluded that improvement was more likely when explicit and discipline-specific teaching of CT was used. The effective interventions depend on implementation, participants, experiment context and research design. Moreover, the development of CT skills was more dependent on environment, instructor training and instructor-student interaction (Behar-Horenstein and Niu (2011). Niu et al. (2013) asserted the need for methodological diversity of empirical studies and highlighted the need for research on the effectiveness of teaching CT to college students and exploring the qualitative aspects of implementing interventions.

In educational environments, the elements involved in promoting learning can be the same as those hindering learning (e.g. learning materials, motivation, self-regulation, quality of instruction, and the interaction/reaction of teacher and students within the classroom with learning environment) or acting as moderating variables. Examples include: teacher characteristics, content, pedagogy, knowledge, pedagogical content knowledge (PCK), teacher beliefs: theoretical and foundational orientations of the teacher, teacher readiness, interest, gender and years of experience. Student-related variables include students' interest and beliefs, individual characteristics and motivation/self-regulation. Learning materials that are structured and systematic demand extra effort and conscious awareness of the learning process from both teachers and students, and may become moderators of performance.

Moderator variables of the greatest relevance to effect sizes and instructional strategies were: intended user of the instructional technique, student ability, and reactivity (specificity) of dependent measures (Marzano, 1998). Taught content, relational complexity of the intervention materials, implementation or teacher pedagogical content knowledge might also influence the intervention results, but as yet little has been explored in this area. This analysis provided useful information about the multimodal/multi-structural interventions and what type of assessments work best to increase students' CT skills. CT skills assessments aimed at near transfer with performance, attitude and study skills as objective outcomes are more likely to be beneficial than multimodal far transfer type interventions.

2.7 Summary

Designing effective ITE can be one way to improve the quality of education (Hamers and Csapó, 1999; Hamers, van Luit and Csapo, 1999). As can be seen from the literature review above, the teaching/learning of CT skills is closely related to content approaches through teaching and therefore directly linked to instruction and learning. The literature review explained the intricacies involved in the learning and instruction of CT skills. Although a substantial body of research is available on many aspects of CT skills instruction and learning, many other aspects still require further work. In particular, CT in teacher education in Pakistan is currently under-researched. Some research (Ashraf and Rarieya, 2008; Cassum et al., 2013; Iqbal and Shayer, 2000) has provided useful data in the Pakistani context, but both the quality and quantity of evidence are limited. The research recommendations called for further research to understand students' expectation of what schooling involves, how 'radical change in teaching style by substantial investment both in pre-service training and professional development time for teachers in Pakistan' can be effected (Iqbal and Shayer, 2000, p. 272), and how reflective conversations with existing teachers might have the potential to bring improvements in teaching and learning practices in Pakistan (Ashraf and Rarieya, 2008). There is therefore a strong need to implement policy recommendations and bridge the gap between CT instructional theory and practice. The Pakistani context requires us to move beyond perceptional research towards evidence-based research in education, if practical changes are to be brought about in the quality of ITE. This research study is an attempt to identify problems and point to possible solutions in a humble attempt to address both national and international gaps in the research field. International research includes many successful attempts to address CT skills learning and instruction, but there are few empirical research studies that:

a) look at learning and instruction of CT skills using a multidimensional approach;

b) are rooted in a sound philosophically based concept and framework of CT skills and design and observation of the learning environment; and

c) have opted for a mixed-methods approach in order to attempt a broader and deeper understanding of the phenomenon.

We learned from the literature review that a holistic/multidimensional view would lead to the following conclusions:

- CT skills development is a two-way process that includes instruction as well as learner-related experience.
- Teacher, learner and design of learning environment are important aspects to be considered when planning intervention studies, demanding careful design of studies.
- Apart from directly influencing variables (e.g. learning materials, teaching strategies, feedback) there are various moderating variables that may substantially influence the learning of CT skills (e.g. motivation, self-regulation, learning environment).
- The strength of quantitative and qualitative methods should be used to build a narrative on what happens and how the participants experience the intervention.

- The other important aspect concerned with teaching/learning CT skills using instructional intervention is the measurement of the construct CT.

- Measurement of effectiveness should not focus purely on student improvement on CT skills tests but should also be required to provide a complete picture in qualitative terms of contextual variations (implementation procedures) in studying critical thinking skills and the implications of such studies for teacher education programmes at university level and for research on CT skills learning and instruction, and in particular how to bridge the gap between policy and practice, especially in struggling contexts.

Having reviewed the international and national research on critical thinking skills, the next chapter comprises the background of the study context; that is, teacher education and research in critical thinking skills in Pakistan.

Chapter 3: Context of the study

The context chapter elaborates on the educational aspects of Pakistan and especially the teacher education and research in critical thinking skills.

3.1 Pakistan: Background information

Pakistan is situated in the South Asia region and was founded as the Islamic republic of Pakistan on 14 August 1947, after the end of the British Colonial period in the region. Pakistan is adjoined by its neighbours India to the east; Afghanistan and Iran to the west; China to the north-east; and the Arabian Sea to the south. Pakistan is the sixth most populous country in the world, with a population of over 200 million people and covers an area of 881,913 km^2 (340,509 $miles^2$). Pakistan comprises four provinces: Punjab, Baluchistan, Sindh and Khyber Pakhtunkhwa (the North-West Frontier Province); and four territories: the Tribal belt, Gilgit–Baltistan (FATA), Islamabad Capital Territory (FANA), and Azad Jammu Kashmir (AJK). The official languages that are used in government/private offices and educational environments are Urdu and English. In addition to numerous local dialects and indigenous languages, four main regional/provincial languages (Punjabi, Sindhi, Balochi and Pashtu) are spoken in various parts. However, Urdu and English remain prevalent in official correspondence as well as in educational policies and curriculum delivery. According to UNICEF statistics (2007), the total adult literacy rate in 2008-2012 is 54.9 per cent. The youth (15-24 years) male literacy rate is 79.1 per cent, and the corresponding female literacy rate is 61.5 per cent. The public spending on education as a percentage of gross domestic product is 2.4 per cent.

3.2 General education programme structure

Pre-primary stage is from Year 3 to 5. Children attend playgroups, and the duration varies between one and two years in this stage.

Primary education is Class 1 to 5 with a duration of five years. Children aged 4 to 5 years are admitted to Class 1. Basic literacy, reading, writing, mathematics and social studies are taught.

Lower secondary/Elementary education is from Class 6 to 8 with a duration of three years. Children who have passed the primary stage are admitted to Class 6.

Secondary education is from Class 9 to 10 with a duration of two years. The secondary board issues the Senior Secondary Certificate (SSC) on passing the secondary exam. Science and arts are the two large subject groups for students to choose from.

Upper-secondary/Higher Secondary stage is from Class 11 to 12 with a duration of two years. The higher secondary board issues a Higher Secondary Certificate (HSC) on passing the higher secondary exam. Vocational, technical, science and arts education strands are offered at these stages.

College/degree Level: After passing the higher secondary exams students can gain admission to a college for a degree course, which now has a duration of three years.

The figure 3 below shows the general structure of age, grade and level of education in Pakistan. The figure is taken from UNESCO (2010), country profile report on secondary education.

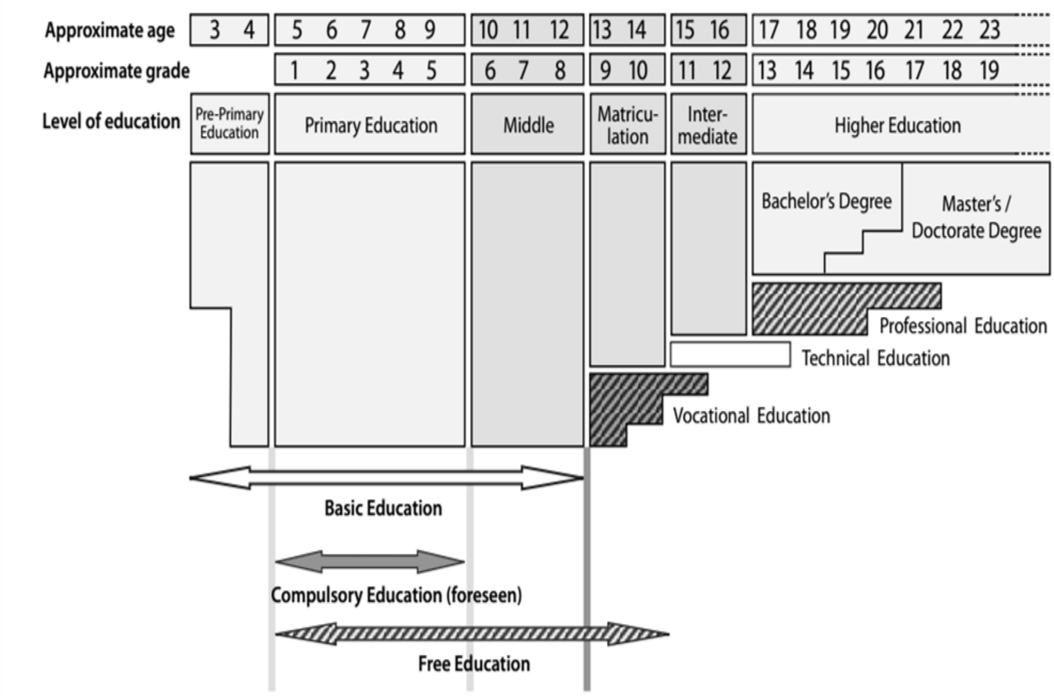


Figure 3: Education structure in Pakistan, source UNESCO, 2010 http://www.uis.unesco.org/Library/Documents/Pakistan.pdf

3.3 Quality of education in general in Pakistan

The education system of Pakistan is generally noted as being weak in terms of low capacity and participation rates, school administration, school facilities, girls' education, gender disparity, teaching posts and teacher training (UNESCO, 2005, 2006a and c, 2014, 2012; Komatsu, 2009; NEP, 1998-2010;2009 ; Lynd, 2007; Khan and Saeed, 2010; Khan, 2010). Even after more than six decades of independence the development indicators paint an unpleasant picture of the Pakistani education system (World Bank Development Indicators, 2016). The participation rate for higher education is low and the system faces problems related to staff quality, student quality, laboratories and libraries. In addition, the education system is also poorly related to social needs, poor in research facilities, and suffers from financial crisis, ineffective governance, weak examinations, and low academic results (Iqbal, 2004; Memon, 2007). All these factors contribute to an education system of low quality not at parity with international standards (Memon, 2007).

Pakistan is a unique case among the developing countries within its region (India, Bangladesh, and Sri Lanka). She lags far behind in achieving the goals of EFA and MDG (Jennings, 2009). Educationists, teachers and researchers are crying out at the lack of serious effort by the government to support education infrastructure and professional development (pre-service/in-service). However, universities and institutions involved in teacher training are now in the process of restructuring and institutions and government are working closely with national and international professional development entities to raise the quality of teacher education. Most of the development funding for teacher education reform comes from international agencies and donors from USA, UK, Germany, Netherlands and others.

A plethora of analytical reports, white papers, donor agency reports and other international reports have addressed teacher education in Pakistan at micro and macro level (Aly, 2007; Khan and Mahmood, 1997; National Plan of Action, 2013; UNESCO, 2008, 06a; Memon, 2007; Dilshad, 2010; National Report, 2011; Ali, 2011). Lack of commitment from institutional leadership, lack of readiness and cooperation from existing teachers to embrace new pedagogies and teaching strategies to enhance the quality of education in general are unfortunately everyday educational issues in a country like Pakistan (Ali, 2011). The situation in higher education institutions of Pakistan is described as unsatisfactory and quality of teachers as abysmally low (Ali, 2011; NPST in Pakistan, 2009). It is widely agreed that the quality of education in Pakistan is poor due to a large variety of factors but that at a fundamental level 'poor quality' is characterized by the ways in which students are made to learn and are examined (Hayes, 1987; Jaffer, 2005).

There is abundant research available that explores the education system in Pakistan from various perspectives, identifying causes and factors that contribute to low quality education (Ali, 2011; Aslam et al., 2012; Dilshad and Iqbal, 2010; Tahir and Taylor, 2013; Snilstveit et al., 2014). Ahmed (2012) analysed the situation of ITE in Pakistan with reference to policy, reforms and expansions over time, and concluded that all previous policies recognize the critical role of education for social and economic development but unfortunately all of extensively researched data and recommendations have suffered from poor implementation. The education system of Pakistan has been the target of experimentation and still is; moreover, political instability coupled with low economic growth creates a complex and challenging context in which to implement any recommended action.

3.4 Teacher education in Pakistan

Teacher training institutions cover general education, as do as specialized universities and colleges, again public and private, at which mainstream teacher training programmes are held. Recently, in the wake of 18 amendments to the constitution (explained later), many changes are being made in the field of education. After the 2010 devolution of powers plan, much is left to be decided at individual province level. All provinces now have their own Higher Education commissions for example, Punjab Higher Education Commission (PHEC), Sindh Higher Education Commission (SHEC). There is now, for example, one main regulatory university in Punjab that deals with teacher training, with several training colleges and ten subsidiary university campuses. However, the process of standardization of curriculum and steps to ensure a consistent quality of education such as revised curriculum, infrastructure for teachers and students, campus facilities (library, internet, and computer labs) are underway but not fully incorporated.

Since 1990, various government initiatives can be taken as positive signs for the improvement of teacher education in Pakistan. The government initiated an explicit emphasis on improving teacher education in Pakistan through National Education Policy, 2009, by formation of Higher Education Commission (HEC) and National Curriculum Review Committee (NCRC), development of regulatory institutes; for instance, National Accreditation Council for Teacher Education (NACTE) and Quality Enhancement Cells (QEC) to monitor and improvise uniform standards throughout the country. It is also important to note that most of these standard based initiatives are a result of pressure from international bodies and of national, international and regional agreements to improve the quality of teachers to enhance student learning and achievement (Ahmed, 2012).

A number of education policies (National Education Policy (NEP) 1947, 1959, 1970, 1972, 1979, 1992, 1998-2010; 2009 in Ahmed, 2012) and education reforms had been proposed, each covering the spiritual/religious, social and vocational dimensions and focusing on basic primary-secondary education, women's education, agricultural, industrial and technological modern-day developments. All policies accepted the importance and centrality of teachers but it was not until NEP 1998-2010 and 2009 that standards for teacher education and training, accreditation, merit based progression and posting and professional development were introduced (Huma, 2013; Tanveer-ul-Zaman, 2000; Shah et al., 2011; UNESCO, 2012). According to reports (UNESCO, 2006a; USAID, 2005), there are almost 270 (in some data sources 277-280) teacher training institutions in the country (NACTE, 2010). Of these 227 are public institutions and 53 are in the private sector. The breakdown of teacher education institutions by province is presented below in the form of a table.

Table 6: Distribution of teacher education institutions in Pakistan

Province	**Total**
Punjab	
Public	75
Private	7
Total	82
Sindh	
Public	56
Private	24
Total	80
NWFP	
Public	39
Private	8
Total	47
Baluchistan	
Public	28
Private	2
Total	30
FATA	
Public	5
Private	
Total	5
FANA	
Public	3
Private	2
Total	5
AJK	
Public	13
Private	3
Total	16
Total Government	**227**
Total Private	**53**
Grand Total	**270**

Source: Academy for Educational Development (2005). Directory of Teacher Education/Training Institutes in Pakistan. Draft, USAID, 2005.

Types of teacher education institutions

There are four kinds of institutions providing teacher education training (pre-service and in-service). The first two can be said as mainly providing ITE and the other two mainly provide in-service professional development courses.

1. Universities (Faculty of Education or Institutes of Educational Research)

2. Public Colleges (Government Colleges for Elementary Teachers (GCET), Government Colleges of Education (GCE))

3. Bureaus of Curriculum (BoC) in provinces or Directorate of Staff Development in Punjab

4. Provincial or Regional Institutions of Teacher Education (PITE or RITEs).

Other certificates, diplomas and degrees are also awarded by a number of private sector institutes and distance learning universities such as Allama Iqbal Open University (AIOU), University of Education, Departments of Education and Research at universities; for instance, University of the Punjab. In addition to this, there are about 300 teacher resource centres (TRC) established under the Education Sector Reform Programme (ESRP).

It should be noted that while writing about the context of teacher education structure and policies and programmes a challenge was the lack of any official statistics or figures from the Ministry of Education and Training and Standards in Higher Education (MET and SHE) on the number of teacher education institutions, enrolment, student-pupil ratio, programme structure, assessment and accreditation and certification of teacher training (pre-service and in-service) programmes. Therefore, most of the information that I gathered was sourced from individual studies; for instance, articles, doctoral theses, donor agency reports on teacher education in Pakistan (for instance: UNESCO, World Bank or USAID).

Until 2009 the major ITE programmes were the CT and PTC programmes and a BSc, B.Ed. at primary and secondary level. In these courses the students were expected to use their content knowledge from previously obtained degrees and only teaching foundational curriculum was being taught to them. The admission criterion was simply anyone who passed the 12 years of schooling in the second division (i.e. 45-50 %). In terms of assessment, students have to appear and pass a comprehensive exam in addition to semester exams at the end of the course.

Table 7: ITE programmes between 1980 and 2009 in Pakistan

Programme	**Teacher for (School/College/University)**	**Offered at**
Primary Teacher Certificate (PTC)	Primary level (School)	Public Colleges (GCET, GCE)
Certificate of Teaching (CT)	Elementary level (School)	
Bachelors in Science Education (BSc, BEd)	Secondary level (School)	
MA Education - Early childhood - Primary - Elementary - Secondary - Science - Special education	College level appointment but also for schools	Universities (FE, IER)

At present teacher education institutions run the following basic initial teacher preparation programs that are the same in most parts of the country. There might be variations or subject-related differences in the names of the degrees. The major changes have been in the primary and elementary level programmes. The duration of initial teacher training has been increased from 6-month or one-year certificates to two- to four-year professional degrees. However, the admission criterion remains the same. This change was accompanied by simultaneous changes in curriculum, content and pedagogy and the introduction of NPST.

Table 8: ITE programmes changes 2010 to present in Pakistan

Programme	**Teacher for (School/College/University)**	**Offered at**
Associate Degree in Education (ADE) *2 year programme of study*	Primary	Public Colleges (GCET, GCE)
Bachelors in Education Honours (B.ED Hons.) Elementary/Secondary *4 year programme of study*	Elementary and Secondary	Public Colleges (GCET, GCE) and Universities
Masters of Arts in Education (MEd) *2 year programme of study* - Early childhood - Primary - Elementary - Secondary - Science - Special Education - Other	Secondary and Higher Secondary	Universities FE, IER

The ADE two-year degree and the BEd Honours four-year initial teacher preparation course are mainly replacing PTC and CT certificates. For the ADE and BEd Hons degrees, 12 years of education is the entry criteria and the aim of the programmes is to provide a blend of pedagogical learning and content and extensive teaching practice at schools. The MEd is a two-year advanced degree and requires 14 years of education. Standards for ITE have also been introduced in addition to these new degrees to equip future teachers with knowledge, pedagogy and skills of the teaching profession. The curricula for all programmes have been revised and approved by NCRC. These programmes were launched in 2010 and some research shows that there was already a difference in the outlines given at HEC website and the enacted/implemented curricula (Huma, 2013). However, the definitive measure of the success of these improvements will be the design and delivery of the programmes.

At federal and provincial level, the basic features of programmes are similar, with a uniform curriculum and consistent structure for teacher education. The schemes of studies are similar, not only within one single province but across provinces as well. This is because the NCRC under the HEC approves the curriculum (Huma, 2013; Tanveer-ul-Zaman, 2000; Shah et al., 2011; USAID, 2008; UNESCO, 2006). PITE are responsible for devising provincial sub-policies and action plans related to teacher professional development for both pre-service and in-service training. For many years, the teacher education system in Pakistan suffered inconsistencies in policies and planning. One researcher noted that teacher education programmes in Pakistan lack consistency with school curriculum, adequate resources, admission standards, and quality control (Levine, 2006).

Generally, the administration of education is neither fully decentralized nor fully centralized; it is delivered by federal and provincial administrative units (Huma, 2013). Whilst this could provide an opportunity for good governance practice (Fullan, 1993), the setting remains mainly bureaucratic. The country had a devolution of powers plan in 2001 (part of the enactment of the 18th amendment to the constitution) and until 2015 was still in the process of gradually passing on responsibilities to provinces. Many of the changes arising from the decentralization of power process have been completed but some are still in progress. For example, the former University Grants Commission (UGC 1947-1974) later became the HEC (2002-2011) and now has devolved into each province's own Higher Education Commission (PHEC, SHEC). Universities and colleges will now work under provincial HECs but will also be linked to a central federal governing body.

Pakistan previously had a federal ministry that centrally regulated education regulations, standardization and policies, namely, the Ministry of Education. The HEC worked autonomously prior to the enactment of the 18th amendment, but the centralized regulation was merged into the Ministry of Education. The name Ministry of Education and the decision to absorb the HEC into it have been changed three times in a year by the government. It was at first the 'Ministry of Education', then became the 'Ministry of Education, Training and Standards in Higher Education' by a government memorandum in 2013 with the HEC under the federal ministry, and then again in 2014 the name changed to 'Ministry of Federal Education and Professional Training'.

All these changes reveal two very obvious issues with the Pakistani governance system that have been present since the inception of the country:

1) lack of clarity; and

2) inconsistent implementation.

At a national level, this has resulted in the failure of reforms, action plans and education policies. At the institutional level, this has resulted in subsequent confusion, instability and inconsistency during delivery and implementation. Against this background, research that focuses on the day-to-day realities of the classroom and the education system is much needed.

Teacher education is the process of training and educating individuals for the classroom teaching/learning environment, and other related professional tasks. Teacher education as described by Encyclopaedia Britannica can be divided into two stages: pre-service and in-service. Pre-service education includes all the stages of education and training that precede the teacher's entry to paid employment in a school. In-service training is the education and training that the teacher receives after beginning his or her career. Teacher education encompasses teaching skills, knowledge and practice of sound pedagogical theory and professional skills (Kumar and Parveen, 2013). Teacher education is a programme that is related to the development of teacher proficiency and competence which enables the teacher to meet the requirements of the profession and empowers them to face the challenges therein (Hasan, 2013).

Teachers remain the cornerstone for quality and implementation of reforms in classrooms (Malik et al., 2014; Parveen et al., 2011). Studies by Cheng Cheong and Mo Ching Mok (2007) showed that teacher paradigm shift was correlated with 18 indicators of student learning where more student-teacher centred globalized, localized and individualized approaches used by teachers were positively associated with enhanced learning, attitudes of student learning more towards reflective thinking, satisfaction with opportunities and performance in schools in Hong Kong (26 schools and over 7000 student sample). However, in Pakistan, low levels of teacher competence, lack of classroom-based support, poor quality of learning materials, lack of systematic student assessment, insufficient governance and management are merely a few of the deficiencies of public sector education in Pakistan (Malik et al., 2014; UNESCO, 2006).

According to Commonwealth education hub data, the proportion of upper-secondary trained teachers is 79%. However, no data on the quality of teacher training have been made available, to date. It is worth noting that, overall, teacher education universities produce more than 40 thousand teachers, and at one University of Education urban campus the enrolment in tertiary teacher education programmes such as Masters and PhD is approximately 2000 to 5000 graduates. Teacher education students enrolled here spread out afterwards to work across the country. An interesting fact about these high enrolment figures is not that young people are interested in teaching, but that mostly those entering teaching have no other choice (Siddiqui, 2007, p.81).

The low status of teachers and an entirely theory-based approach to teacher training are two of many problems associated with teacher education in Pakistan (Nawaz, 2013). World Bank Report (2014), UNESCO (2006a,b and c) and USAID (2004) reported the poor conditions of teachers and lack of competency skills of teachers especially in primary and secondary education as a key reason for the poor quality of education in Pakistan. Teacher training institutions train approximately 40,000 teachers a year but the result is a glut of 'trained teachers' in the market (Hoodbhoy, 1998). Unfortunately, this poor teacher preparation due to low quality teaching at higher education institutes leads to poor classroom practice, a low quality of education in Pakistan in general, and poor teacher education and student learning in particular.

For developing countries with lower-middle incomes, it is worth paying more attention to the quality of ITE (Ndaruhutse, 2009). This becomes vital in a developing country, where resources are low and one cannot put much into CPD, and furthermore, maturity of years can become a hindrance in changing teachers' beliefs. The short, quick and logical solution can be to fix this problem and change beliefs from where they are likely to be nurtured; that is, ITE. Research has proven that most student teachers replicate in their classes what they have themselves experienced (Ben, Andrés and Steffen, 2012; Kennedy et al., 1999; Prestage and Perks, 1999; Stanovich and Stanovich, 2003). Quality learning depends on quality teaching, so the cohorts being trained as future teachers are the immediate key to increasing the quality of education (Ndaruhutse, 2009).

The focus of the government initiatives has been to help develop policies and action plans. The investments have been to hire more teachers and increase enrolment to achieve universal primary enrolment and improvement of secondary education. Part of the implementation of the millennium development goals was to address the lack of teachers in countries that were lagging behind in achieving universal primary education, such as India, Bangladesh, Sri Lanka, Nepal, Pakistan and Bhutan in the south Asian region. For tackling the shortage of teachers, pre-service/ITE reforms and goals were the focus of the national education policy and donor agencies support agendas for Pakistan. The poor quality of students' attainment is related to the teaching quality as much as to other infrastructural elements. Teaching quality is most influenced by the quality of teacher training programmes that the universities provide at tertiary level. Evidence from international research has shown that the more developed the country, the longer the pre-service teacher training. This show there must be some direct link between the quality of teacher education programmes in raising the quality of education and socio-economic growth of a country.

To improve Pakistan's education, quality of teachers' basic professional competencies, skills and knowledge about the profession must be raised first. This requires fundamental paradigmatic change in how pre-service and in-service teacher education is currently perceived (Iqbal and Arif, 2011). Research has also shown that teachers' professional performance and quality is likely to be affected by their qualifications, recruitment/merit, teacher accreditation, incentives and in-service professional development for growth (Malik et al., 2014). The importance of quality teachers in low-income countries was addressed in a report by USAID[1] on teacher supply, training and cost in the context of rapidly expanding enrolment in developing countries. Tanzania and Ethiopia, especially, are facing same problem. Such countries also have to work on improving the quality and effectiveness of existing and new teachers (Nordstrum, 2011), and ITE and fostering CT skill can be a way to address both problems. However, the process has to be a consistent and gradual increase in teacher motivation and incentives (Ndaruhutse, 2009; Nordstrum, 2013; Parveen, Rashid, Iqbal and Khan, 2011). International research has established that teaching CT improves teacher quality and makes a major contribution to being an effective teacher (Hager and Kaye, 1991; Hager, Sleet and Kaye, 1994).

Most of the educational concepts (e.g. methodologies, school effectiveness and quality in higher education, teacher education standards) are borrowed from international contexts, and CT has been introduced in Pakistan as a basic literacy and life skill in order to improve the quality of teacher education system. In the wake of such standards there is a pressing need for the provision of CT skills in teaching and learning situations, and researchers need to contribute, yet at the same time research is required to build a solid database to check the

[1] *Effective Teaching and Education Policy in Sub-Saharan Afric*a by Lee Nordstrum, 2015 https://globalreadingnetwork.net/eddata/effective-teaching-and-education-policy-sub-saharan-africa

benefits for teacher quality and the feasibility in the contextual and systems environment.

Research in international contexts, for instance from Hong Kong and Europe, has developed a significant relationship between the way teachers teach (teacher development and teacher quality) and the way that students receive knowledge and information (students' learning) (Coe, Aloisi, Higgins, and Major, 2014; Cohen and Hill, 2001; Caena, 2011; Hill, Rowan and Ball, 2005; Baumert et al., 2010; Voss, Kunter and Baumert, 2011; Barrett et al., 2007; Nordstrum, 2011). Poor quality professional training, inadequate subject and pedagogical knowledge and a low level of knowledge of professional skills and attitudes of practising teachers have contributed greatly to the poor quality of education in Pakistan, and the recruited teachers are often blamed (Ali, 2011; Kanu, 2005; Tajuddin and Khan, 2012; UNESCO, 2012).

Better-quality teacher education, a requirement to teach problem solving, inquiry-based methods and a shift of teacher education pedagogy towards CT skills as a way to increase quality and effectiveness of teachers were explicitly stated in NEP 1998-2010 and again in NEP 2009. A next step is a standards- based approach to the development of teachers and other professional educators. According to the standards recommendations that NACTE has been working on since 2010, NACTE will look after matters regarding the accreditation of institutions and their departments, faculties and disciplines by giving them appropriate ratings and evaluating their objectives, functions and duties to be performed. This can be seen as first step to standardizing the quality of ITE in Pakistan. Post-education policy (2009), the scenario for teacher education is emerging as hopeful. The Ministry of Education was dissolved and decision powers were transferred to provinces, which may result in more efficient working. The central Ministry of Education is now named 'Ministry of Education, Trainings and Standards in Higher Education, Government of Pakistan', established in July 2011 in the wake of the 18th amendment (taking up education for all as a universal human right).

Standards for quality assurance emphasize the development and implementation of NPST 2009 for new teachers, accomplished teachers, subject specialists, educational leaders and teacher educators as priority to reform teacher education in Pakistan. This shows an optimistic future of better policy, planning implementation and assessment criteria for teacher education. Standards for teacher education and an education policy acknowledging the emergency situation in teacher education in Pakistan makes this a good time for progressive teachers and researchers to bring practical insights from real-life scenarios that can add to knowledge on which improvement plans can be build.

Standards for professional development of initial teacher preparation are explained in NSPT 2009 section 2C: Performance and skills and 4A: Knowledge and Understanding that initial teacher preparation must engage teachers in activities that 'promote critical and creative thinking, problem solving and decision-making skills while emphasizing inquiry based methods, hypothesis testing and standard evidence within the discipline' (NPST, 2009, p.11). Furthermore, section 4A emphasizes the 'availability of appropriate resources, materials and instructional technology for instructional planning, and the use of instructional technology to promote students' 'attention and thinking' (NPST, 2009, p.12). Instructional planning and strategies, learning environment and human growth and development are the important areas of the standards that include CT and technology as core competency standards for ITE (NPST in Pakistan, 2009).

However, little is done practically by teachers, researchers or institutions to explore and experiment in such teaching/learning situations. There is a visible gap in educational research when it comes to use of various inquiry/pragmatic teaching methodologies, use of innovative ways to improve student learning and achievement and the projection of higher-order thinking skills in Pakistan. One reason can be that lack of institutional support and encouragement keeps teachers away from research activities. But the worst scenarios can prove to be motivating, igniting a drive for reforms and bringing about small-scale innovation and changes.

3.5 Research in critical thinking skills in Pakistan

In the field of educational research, Iqbal and Shayer (1995) found gaps between school children's cognitive learning level and science curricula demands at secondary level. Their results show that students need cognitive acceleration programmes that can provide them with strategies to boost thinking and achievement. In response to the results of their previous study, Iqbal and Shayer (1995, 2000) used an intervention programme, Cognitive Acceleration through Science Education (CASE), in three secondary schools in Lahore over a period of two years to see its effect on student cognitive development and the long-term effect on students' school achievement in mathematics and science. The study not only claimed a successful replication of the intervention programme that earlier had shown substantial effects in British schools, but also discussed the implications for a developing country with a conservative cultural view on teaching science in schools.

No differences in cultural attitudes towards science and CT skills were found in Pakistani and British school students, although Pakistani students had fewer or no opportunities to experiment at school. The study found teacher variations (teacher characteristic, teaching style) in grasping the underlying philosophy and methodology of CASE, institutional variations (administration and teachers' response), student characteristics (interest, participation) as favourable or non-favourable conditions for such intervention programmes. For the quality of student learning to be improved, Iqbal and Shayer (2000) found that changing or at least bridging the low-level activity (reception learning) through improved teacher practice and teaching skills can be enriching. Moreover, the school ethos need to be shifted from rote-learning models of teaching and learning towards a deep learning and cognitively productive learning environment (Iqbal and Shayer, 1995, 2000).

One way to promote a cognitively productive environment could be promoting motivational and self-regulatory learning strategies among students in a planned manner. Motivation/self-regulatory skill has been found closely related to the development of high cognitive skill such as CT skills (literature review, Chapter 2). These are found to be closely related to research into effective teaching using the process-product approach and as one of the key skills of teachers' professional learning. The influence of motivation on student achievement and learning has deep roots in educational research. However, its relevance to emerging new research on teaching for metacognition and thinking skills (Marzano, 1998; Hattie et al., 1996; Zimmerman, 2002) has not been explored in the Pakistani higher education context for CT skills learning and instruction.

Another effort to promote CT in Pakistani teacher education was made by Ashraf and Rarieya (2008). Reflective conversations can be made to change existing teachers' views about teaching styles so that their performance can be improved and become more CT rooted, and shift from existing teaching practices (Ashraf and Rarieya, 2008). Teacher development through reflective conversations was attempted using an action research approach. Two teachers from one school participated in the study. In-house academic support and out-of-school workshops, seminars and reflective conversations were used in three phases – pre-intervention, intervention and post-intervention – to change teachers' professional practice. The study reported positive contributions to enhancing professional practice by identifying gaps in their knowledge, skills and attitudes, and improving their knowledge of subject content and pedagogy, as well as their personal disposition to engage in reflective practice (Ashraf and Rarieya, 2008).

A slightly different focus is taken in a study by Cheema and Mirza (2013). The effects of concept mapping on academic achievement were studied in Pakistan. Here, Information and communication technology (ICT) tools were seen to be effective in improving students' performance in general science. Other studies reported no significant result of gender on learning with concepts maps, for example, Abimbola (1997) on the subject of biology and Olufunke and Blessing (2014) on psychics, both conducted at secondary school level. However, these found a positive relationship between the use of concept maps with student learning. Technology can be helpful, as an add-on in learning cognitively complex skills, such as CT skills. International research has found positive links between the use of computer tools and CT skills (details in Chapter 2, Literature review). The role of visualization tools in facilitating learning of CT skills in tertiary education has not been used before, but may help in reinforcing the practice of CT skills during the intervention. This has been included in the design of the intervention for teaching and learning of CT skills.

A more recent investigation to find consensus on what teachers understand of the meaning of CT in Pakistan was made by Cassum et al. (2013). The study collected data through qualitative interviews of staff in the faculty of health sciences and education, and the results were drawn after content analysis. Their perceptions of the nature, acquisition and application of CT were similar and they acknowledged its multidimensional nature, however they were not clear on how to acquire these skills or the applicability of such skills in classrooms. These perceptions were in line with international literature on the definition of CT skills. However, the staff in education saw CT applicability more in health sciences than in education. This led to the conclusion that more effort is needed to implement CT in mainstream education, and both institutional and curricular efforts are required to apply CT and promote a culture of critical thinking in higher education in Pakistan (Cassum et al., 2013).

Participants across disciplines stated that although the principles and strategies to promote CT remain the same, the context, content and assessment of the learners vary (Cassum et al., 2013). An interesting difference was found in Cassum's data about the perceptions of staff in the education faculty. They preferred to use terms such as good thinking, effective thinking and positive thinking to describe the same concepts, skills and attributes that other disciplines faculty associated with CT. They perceived the importance of teaching CT as more vital to the healthcare field due to its dealing with human life and death, whereas education to them only concerns developing students' mind in the classroom (Cassum et al., 2013). No details were provided in the study on the reasons are behind this thinking.

On the basis of this consensus on basic CT principles (analysis, evaluation, decision making) and the availability of equivalent vocabulary in Urdu that was used by many participants to describe the concept (bilingual accounts) what the term CT means, Cassum et al. (2013) concluded that most of the terminology and the process of thinking critically are understood in the same way by higher education faculty members in this study. They perceive CT as a multidimensional concept that involves the use of both skills and attitudes/dispositions.

Although these findings are encouraging, in that the idea that CT teaching and learning experimentation seems accepted as the right step forward, it must be noted that this study had a highly purposive sample (12 educators from a single university). Therefore; most opinions will be homogeneous due to sharing the institutional culture. These basic principles have not been taught to students systematically in instructional programmes before in Pakistan. It would be beneficial for educational research to see how these may be taught through instruction. By contrast, Cassum et al. (2013) also found that faculty members had a limited view of the meaning of 'critical', considering it as 'critique '(Judgement and evaluation) only, and were unable to elaborate beyond the meaning of judgement and evaluation. This shows general knowledge of the concept, but also limited knowledge, lack of exposure and little understanding of the applicability and scope of CT. One way to enhance teachers' or staff's awareness of the concept could be an experiment in the educational environment to study its interaction and effect. Such efforts will be beneficial in starting an empirical database for CT skills learning and instruction-related discussion.

A learning and instruction research gap in CT skills in the Pakistani context can be seen from the few studies cited above. The limited perceptions and expectations by education staff on the applicability of these skills may also be connected to the lower status of teaching profession compared to health professionals in Pakistani society. Looking at the perceptions of education staff as an example, it can be said that there is an immediate need to initiate research in the discipline of education for CT skills, especially due to its wider role in society in terms of teacher education and training, connecting it to almost every walk of life.

These skills can be said to be essential to fulfil the demands of the workplace and to participate in society as active/enlightened citizens (NEP, 2009). One of the reasons that may have hindered consistent application and follow-up of educational policies and goals could be the socio-economic and political instability in the history of Pakistan (Haider, 2008) and many others, as mentioned in Chapter 3 briefly.

CT skills are among the core competencies or standards for teachers, and are recognized by education ministries and teacher accreditation departments. Both areas are under researched in teacher education in Pakistan. Therefore, I feel, it is part a responsibility as a teacher educator and part as a researcher to look into this field to find innovative ways to merge both for the improvement of initial teacher education (ITE) programmes in Pakistan. This accentuates my own motivation to combine professional knowledge and understanding with performance and skills. The meaning behind this study is to go beyond perceptions and opinions and undertake a practical study that looks at CT skills teaching and learning in mainstream teacher education programmes, so that we can start building empirical knowledge in this field in the Pakistani context. Although the interaction of learning and instruction is broad and complex, the investigation into learning and instruction for CT skills is limited in this study to only the teacher-student-classroom environment.

Conclusion

The brief review of the contextual realities, policy and implementation gaps related to research, quality of teacher education programmes; a need for research on critical thinking skills arises that may help improvement in teacher education programmes at university level. The literature review and the background of the study then lead us to the following research questions.

(1) If using a carefully designed instructional intervention increases learning CT skills among students?

(1a) Do students' perceptions about motivation/self-regulation influence the learning of CT skills?

(1b) Do students' perceptions about classroom learning environment influence the learning of CT skills?

(2) What are the participants' experiences about how a specific instructional model helped or did not help in the learning of CT skills?

(2a) To what extent implementation fidelity influenced the effectiveness of a carefully designed CT skills instructional intervention to increase students' CT skills?

(2b) What are the experiences of students and the class teacher about the experience of a carefully designed CT skills instructional intervention?

These then lead towards the conceptual framework of the study based on the literature.

Chapter 4: Working towards a conceptual framework

This chapter consist of two main sections: first, there is a discussion of the theoretical multidimensional frameworks that are linked to the design of the learning and instruction environment for CT skills. Four frameworks from Moseley et al.'s (2005a) handbook for teaching and learning are discussed for their suitability as designing learning and instruction of CT skills in an ITE programme for this study. The second presents the synthesized design principles for learning and instruction of CT skills for this study.

4.1 Working with theoretical basis of critical thinking framework

For students to learn CT skills in mainstream education (face to face), instruction in CT skills needs to be designed thoughtfully, considering the curricular, instructional, individual and learning environment elements. The CT skills instruction should be based on principles and elements of teaching/learning sciences, as well as on the work of scholars who have found strategies corresponding to the complexity of teaching/learning of CT skills.

Deducing features of CT skills instruction or principles from research literature on CT, I now selected four instructional frameworks from the Moseley et al. (2005a) thought as the theory behind teaching-learning of CT skills, preparing an intervention (instruction) and a model for my research study. This is used in conjunction with a holistic approach to teach CT skills. The instructional frameworks were selected for their relevance to philosophical, psychological and educational aspects of teaching-learning CT skills. The definition of CT that I chose for the discipline of education is that of Dewey's reflective thinking. Therefore, it was important to reflect on the theoretical as well as practical features of the study. The selected frameworks are tied to theory and research-based evidence.

For understanding the multidimensional nature of CT skills learning and instruction, the writings of Mathews Lipmann, Diane Halpern, Paul Pintrich and Anderson and Krathwohl's were read and understood in detail. The frameworks and individual research studies were scrutinized and common features were observed for successful learning and instruction of CT skills. As the interest of this research study is at classroom level, I argued the learnability of CT skills and provided a detailed account of instructional frameworks and research literature on teaching/learning of CT skills from various viewpoints. Then the possible useful connections were drawn and to construct the theoretical framework.

Reflecting on the positive evidence over the past forty years and these well-established frameworks of thinking, I derived a combination of easily understood and simply designed CT skills learning and instruction design principles, as discussed below. The purpose was to reduce the complexity of theory and make it easier to understand even for a teacher/person who has not read extensively on the field. Finally, the design principles of learning and instruction for CT skills are explained.

4.1.1 Halpern's CT framework

Diane Halpern is a well-known researcher in the field of cognitive psychology and research on CT for adults, and her influential publication on CT is *Critical Thinking across the Curriculum* (Halpern, 1997). She did not publish her research in the form of taxonomy, but rather as a framework for learning and practising thinking. She uses five categories of skills to improve thinking, namely: verbal reasoning; argument analysis; thinking as hypothesis testing; using likelihood and uncertainty decision making; and problem solving. The unique aspect of Halpern's framework of thinking is that she wants her readers to 'use' thinking - she suggests the use of metacognitive monitoring of one's own thinking so that one can improve its regulation. Her framework prompts the user to ask four main questions:

1. What is the goal?
2. What is known?
3. Which thinking skills will get you to your goal?
4. Have you reached your goal? (Halpern, 1997, p. 16)

Recognizing these needs, Halpern believes that teachers must provide numerous opportunities for students to develop these skills. She also suggests a number of CT dispositions that are necessary in an individual who wants to improve their CT skills. These including willingness to plan, flexibility/open mindedness, persistence, willingness to self-correct, being mindful (metacognitive monitoring) and consensus seeking (Moseley et al., 2004).

Halpern's (1997) framework focuses on the cognitive processes involved in thinking; she believes in the conscious efforts of a 'plan-do-review' or 'plan-decide-act-monitor-evaluate' cycle for all thinking skills, and for symmetry uses of skills. This means that students regularize their cognitive activity and continuously reflect on goals of an activity and thinking. She is interested in the 'application' of CT not as a separate category in one specific area, but generally, due to the importance of the 'skill' (Moseley et al., 2005a).

To illustrate Halpern's categorization of CT skills, one can use the image of a coin, as both sides represent the value of the same entity - for her CT has two sides, the cognitive and the concrete. One side is the view of CT as a metacognitive process, and the other the explicit, conscious practice of the skill in all areas of life. Halpern has a strong inclination for practising rational methods, and her belief is that teaching and assessing CT will improve the quality of teaching/learning at colleges, which will lead to improving the quality of education in general.

Halpern has also emphasized the importance of visual representation of the metacognitive process by writing, producing information trees and making lists, graphs and tables. This indicates that she takes into account the mental processes directed to action or change; that is, the conative aspect. It seems appropriate to consider deconstructing or channelling mental processes into concrete actions, so that thinking becomes alive, and can be practised, polished and assessed.

Another distinct feature of Halpern's framework that increases its communicability and practical relevance is that she has prepared a range of activities, exercises and problems, all general in nature, so that the maximum transfer in various fields is possible. This makes her framework applicable for a variety of disciplines. It enables the framework to be taught either within a particular discipline or on an interdisciplinary basis, or as a part of free, stand-alone CT (Moseley et al., 2005a). However, her work could be criticized for not being complete in the sense that she does not provide the reader with either a definition of CT or a comprehensive list of thinking skills. Occasionally in her writings we see the 'plan-do-review' aspect missing, for example in her problem-solving skills section (Moseley at al., 2005a).

The following figure 4 has been prepared using Moseley et al.'s (2005a) work, and briefly illustrates the framework of Halpern's categorization (Halpern, 1994; 1997) of CT skills. It is here represented in a consecutive pattern, because each skill is adjoined to the next, and in some situations the user may depend on skills cross-sectional in the diagram to accomplish a task. For example, to apply or practise argument analysis, memory skills and deductive logic will be important. It is possible that development in one skill or sub-skills may be faster or slower than others, depending on differences in classrooms, or cognition-related factors of students, teachers and environments. What needs to be considered is that as many opportunities as possible to think and practice need to be provided to the students.

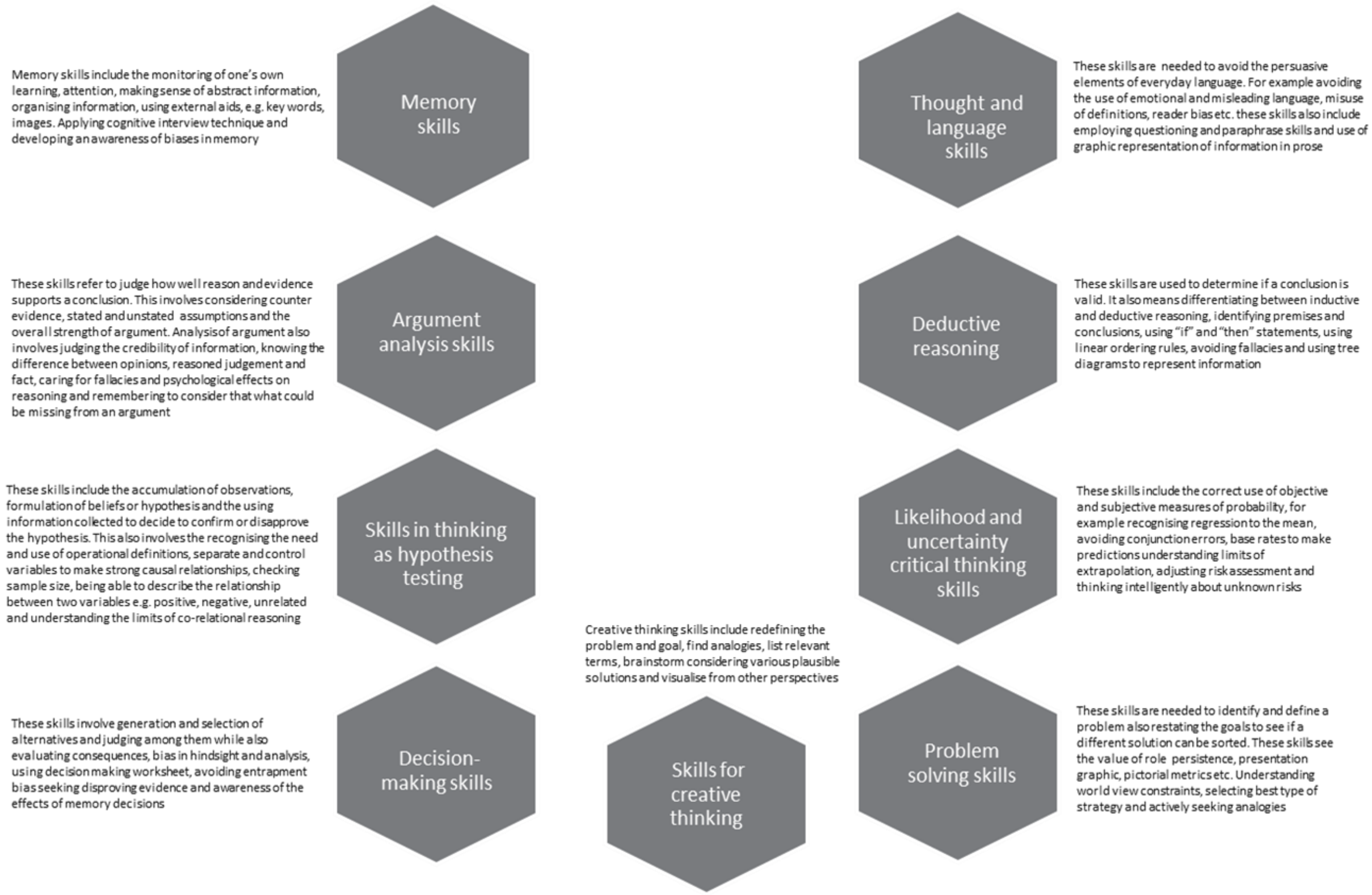


Figure 4: Halpern's categorization of CT skills

Criticism of the framework

Although Halpern's' framework offers a simple and easy-to-follow approach for teachers, three objections can be listed on Halpern's review of CT: a) her treatment of affective aspect is unclear, for example she is strong on the rational aspects rather than the affective; b) the categories are overlapping, however because she does not claim it as a taxonomy it is a rather broader and deeper concept of CT; and c) although she elsewhere accepts the role of visual representation, being a cognitive psychologist she has not considered the regulation of cognition, metacognitive and self-regulation visual representations in her framework for thinking (Moseley et al., 2004, in Learning and Skills Research Centre (LSRC) 2004).

4.1.2 Lipman's framework of community of inquiry (CoI)

Lipman's work in the field of philosophy dates back to 1972 when he first established the Institute for the Advancement of Philosophy for Children. He put forward the idea of children as philosophers and most of his work is related to the development of logic, mainly in children. His work includes studies on the development of thinking skills and logic among K12 students. Lipman's work has become a centre of attention since the 1990s, and his community of inquiry (CoI) framework has been used as an authentic strategy to develop CT skills in students in other recent works (e.g. Arbaugh, et al., 2008; Buysse et al., 2003; Swann, 2010).

Besides Lipman's (1991) *Thinking in Education*, other research has explored the utility of the CoI (e.g. Gardner, 1996; Gregory, 2007; Burgh et al., 2006; and Garrison, Anderson, and Archer, 2001; 2010). Most of the recent work on Lipman's framework has been used in online and blended learning, even though initially developed for a traditional classroom environment. According to Lipman (2003), a CoI is in every sense a social experience, but while one can say that inquiry is founded upon community, the same may not apply in reverse, namely that all community is built on inquiry. It is the practice of inquiry that glues a community together. CoIs are used for reaching a settlement or judgement. To understand the CoI it is important to know that first this is a process that aims at developing a product (e.g. a judgement, conclusion, or exploration of various aspects of a problem), that second the process goes in a particular direction where the argument takes it, and that third the process is dialogical and has a specific structure (Lipman, 2003).

Another important feature of the CoI as discussed by Lipman (2003) is the process of presenting subject matter in the form of problems arising in the experience of the child. This means that for an argument or dialogue to take place it is essential that there is some content and subject matter of instruction present. There has to be an initial situation, because inquiry is unlikely to happen if no situation is present. In such classes the role of the teacher is also important, and a teacher in such process would be a ‘cultivator of judgement’ (Lipman, 1991, p.219), the one who possesses the capacity to present subject matter in the form of problems (Lipman, 2003).

One other related concern when practising CoI for the discussion of a problem is the natural human tendency work towards solutions or bring closure. Various scholars (for example, Dewey, 1958 and Buchel, Schlatter, and Scharnhorst, 1997, in Lipman, 2003) warn that we must be careful not to confuse the purpose and aim of CoI; that is, the process of developing a product that is driven from intellectual motion. This does not mean that participants should look for ‘assertive answers’, but that they should enjoy the process of intellectual activity; there may or may not be a certain answer at the end. Thus, students must be ready to embrace the feeling of curiosity and understand that not all questions have direct answers and conclusions in a CoI. The quest here is to compel people to think differently (Lipman, 2003). The goal is to develop a ‘product’ that is built from every participant’s input for the solution of a problem or to pursue a cognitive quest.

Learning from the experiences of others is a feature of a CoI. This enables students to learn together and value the shared experience. This happens often in college, when one of the students starts talking and the others stop to listen. In other words, the inquiry involves appreciating the efficiency of the learning process and bringing this realization to students - who tend to think that learning is something one does by oneself - and thus teaching them how much they can use and benefit from others' learning experiences.

Lipman (2003) proposes a five-stage framework for classrooms as a CoI. He claims, however, that this framework is intended merely to give an idea of what can go on psychologically and pedagogically in classrooms, and to show how it can be used for better learning, teaching and thinking.

Stage 1 involves offering text in a variety of areas of human interest, including history, culture, psychology and philosophy. This can be done by reading aloud or taking turns, since alternating the roles in reading and listening will enable the learners to begin a classroom CoI.

Stage 2 involves offering questions, recognizing the contributors, constructing agendas, mapping student interests, with the cooperation and collaboration of teachers and students to begin discussions.

Stage 3 is related to the socio-cultural inquiry of education. This stage involves building cooperation and cohesion in the classroom community; a community which includes the teacher. Other aspects are: developing understanding for quest and welcoming disagreement; familiarizing oneself with cognitive skills and learning to apply reason, criteria, concept and rules; building on each other's ideas; internalizing the overt activity of cognition; becoming sensitive to contextual differences; and finally following the argument where it leads.

Stage 4 involves the practice of employing questions from the academic tradition and teaching students the methodology of discipline, the opening to philosophical alternatives, and using specific problems to make practical judgements and bring about inquiry for ideas such as truth, community, person-hood and goodness.

Stage 5 encourages further responses in the form of cognitive expressions, recognizing the collective value of the critical and the creative, the individual and the communal, ending at celebrating the deepened sense of meaning as a result of strengthened judgement.

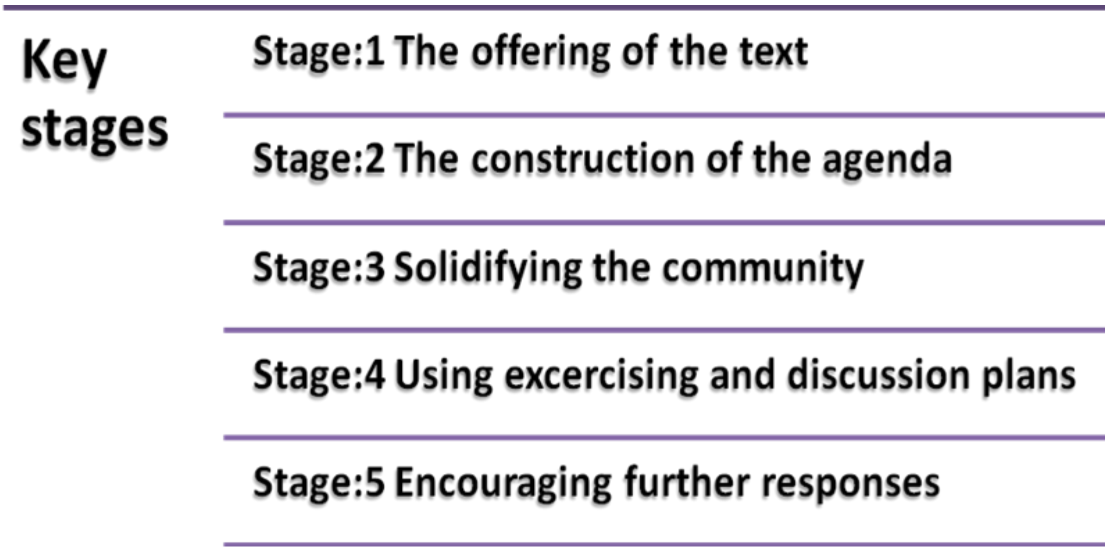


Figure 5: Key stages of Communities of Inquiry

Green, Condy and Chigona (2012) have expressed the CoI as a theoretically reasonable and teacher-friendly strategy to develop thinking skills in students. In their study, qualitative data from 47 pre-service teachers were analysed, and it was found that classroom discussions in the form of CoI are beneficial in terms of personal and professional development, changes in learners, contextual concerns and curriculum links. The researchers conclude that this approach is a valued addition to the pedagogical strategies of pre-service teachers. Similar results were found in a study by Kucuk and Sahin (2013), who looked at an online learning environment for pre-service teachers in Turkey; and also by Papanikolaou et al. (2014) who combined teachers' technological, pedagogical, and content knowledge (TPACK) and CoI frameworks to propose a design rationale for blended learning scenarios for pre-service teacher training as an authentic process involving participants in learning design activities.

Moreover, recent work and developments on the CoI have been extended from collaborative classroom group discussions to the use of online technological places for providing opportunities to practice intellect and logic. The relevance and authenticity of experience provided by CoI in various teaching-learning scenarios, especially in teacher education, make the framework worth consideration for use in developing pre-service teachers' CT skills.

To sum up, classrooms where CoI is practised become hybrid places for argument and logic, where one argument or reason leads to build another, and so on. Dewey rightly stated that inquiry is a form of dialogue that cannot be separated from logic, and that one should not be deluded about the occasional settlement of inquiries, as 'there is no belief so settled as not to be exposed to further inquiry' (Dewey, 1938, p.16, quoted in Lipman, 2003, p. 93). The group dynamics of a CoI let each participant bring in their unique contribution and collaboration, and leads to the benefit of shared learning. This way they continuously stay in an intellectual motion of looking for explanations and conclusions that might not be the end of the inquiry.

Criticism of the framework

Lipman's framework puts a socio-cognitive aspect of learning at the forefront, but bear in mind that in a classroom social and cognitive presence would actually be dependent on the teacher's presence and leadership role to ignite such socio-cognitive learning space both in face-to-face and online learning (Xin, 2012). Second, it would also require expertise and practice on the part of both teachers and students to follow the structure in order to receive the fruits of community's discussion for enhancing cognitive expressions such as CT skills. Third, collaboration is the key; though it is not impossible, here the group's dynamics could be a barrier to achieving collaboration and enabling students to stay independent and responsible, at the same time encouraging, participatory and supportive of ideas, opinions and group tasks.

4.1.3 Anderson and Krathwohl's revised version of Bloom's taxonomy

An extended and revised version of Bloom's taxonomy of educational objectives was presented by Anderson and Krathwohl in 2001. Bloom's taxonomy dates back to 1956; its applicability as a learning taxonomy has a long history and has acquired a life of its own (Felder and Brent, 2004). It has been widely used for developing classroom objectives, planning instruction and developing skills among students. Originally it had three main domains: cognitive, affective and psychomotor, with the cognitive the most widely used domain in educational settings. The cognitive domain has six categories: knowledge, comprehension, application, analysis, synthesis and evaluation. Excluding knowledge, all others are labelled ‘abilities and skills’, and to reach each level the previous categories are understood to be a prerequisite. Knowledge, on the other hand, is a prerequisite for each of these categories, which are thus perceived to have a cumulative order in which each category builds on and comprises more advanced skills than its forerunner (Moseley et al., 2005a).

In their revision of the taxonomy, Anderson and Krathwohl (2001) have replaced Bloom's nouns with verbs; ‘application’, as a category, for example, was replaced by the verb ‘applies’. This is viewed as a major shift from the original taxonomy, and Anderson and Krathwohl (2001) think that this modified version provides more practice and more extensive examples for both elementary and high school teachers. In addition, they renamed two categories of the original framework: ‘comprehension’ has become ‘understand’ and ‘synthesis’ has become ‘create’, and the position of ‘create’ has changed to the highest and final category of the cognitive domain, taking the place of ‘evaluation’. There is new emphasis on the alignment of course planning, instruction and assessment. The sample task designed has extensive descriptions of the various subcategories of the taxonomy that makes it richer for the reader (Moseley et al., 2005a). Another feature is the breakup of the cumulative hierarchy - the development in the taxonomical areas is no longer linear; originally the learner could not reach the next level without achieving all the levels below it. Anderson and Krathwohl claim that one can achieve any level in any combination, depending on the nature of the situation and task. However, they clarify that the revised framework is still hierarchical in its overall complexity (Moseley et al., 2005a).

The knowledge subcategories are now presented as four types of knowledge: factual, conceptual, procedural and metacognitive. The writers have not provided an explanation of how they see ‘metacognitive’ as a knowledge type and its inclusion as a separate knowledge type seems to be an attempt to combine the affective and cognitive domains (Anderson and Krathwohl, 2001; Krathwohl, 2002). Mayer (2002) comments that its inclusion emphasizes the role of cognitive processes such as self-regulatory and motivational aspects, particularly within the categories of ‘create’ and ‘evaluate’ (Moseley et al., 2005a).

On the other hand, when metacognition is addressed within the dimension of knowledge in earlier Bloom’s taxonomy versions, the writers provide a rationale for the inclusion as well as examples to define three types of metacognitive knowledge (monitoring, control, and regulation of students’ cognition), but Bloom et al. do not address these, saying that it involves different types of cognitive processes dimensions (Anderson and Krathwohl, 2001, p.43). Moreover, the examples provided do not seem sufficient, consistent with the evaluation of Anderson and Krathwohl's work in Moseley et al. (2005a). Motivation and self-regulation as aspects of meta-cognition are two aspects of the knowledge dimension and key cognitive processes to achieve the four questions of successful classroom instruction set by Anderson and Krathwohl (2001). However, in their revision the authors have turned the metacognitive dimension of knowledge, which was implicit in Bloom's work, into an explicit feature (Moseley et al., 2005a).

The structure of the taxonomy has changed; rather than a one-column hierarchy, it now has two columns with a separate box comprising the knowledge dimension and its extended types. A series of examples of research evidence from classroom practice demonstrates that increased use of the framework can result in improved classroom instruction and increased understanding of complex levels of thinking for students. However, this cannot be achieved without encouraging teachers to include more complex categories and tasks in classroom instruction. Figure 5 below shows both the original and the revised structure of the framework of Bloom's taxonomy.

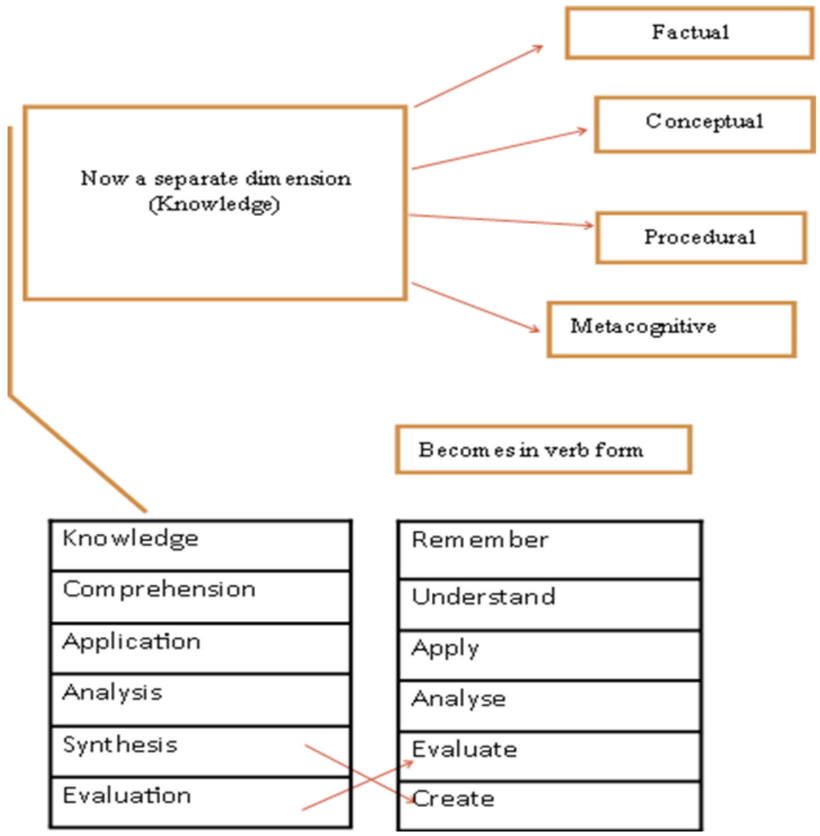


Figure 6: Bloom's revised taxonomy, Anderson and Krathwohl (revised framework), adapted from Moseley et al. (2005a), p.23

With reference to the applicability of the taxonomy for educational settings, the taxonomy and framework can be widely used. In their evaluation, Moseley et al. (2004) mention that although they claim that the revision is intended for the use of elementary and secondary school teachers, the present framework with its metacognitive dimension and entirely new knowledge dimension is useful still at post-16 levels. One reason for this might be that the framework has really changed little in terms of form from its original version, and the original version was of course developed for adults, and it is for that reason that it is still it is workable at a higher education level. Another reason might be the authors' use of four orderly questions to show teachers how the framework could work for classrooms; these questions are general and to an extent follow the inquiry approach along with an assessment of learning which makes it workable at almost any stage of development in students. Anderson and Krathwohl's questions are as follows:

1. The learning question relates to the assessment of realistic answerable questions. This includes determining what is important for students and what can be learned in school and in the classroom time available. It is asked in order to decide the 'what' dimension of tasks and time.

2. The instruction question deals with the 'how to' of the learning process and covers tasks related to the planning and delivery of instruction; the 'how' question also deals with ways to design instruction that can reach a larger number of students and higher levels of learning in classrooms.

3. The assessment question addresses how to design assessment instruments and procedures that ensure the acquisition of accurate information about how well students are learning.

4. The alignment question concerns the issue whether objectives, instruction, and assessment are appropriate to the task presented and learned, and to judge whether these three aspects are aligned enough to complement each other and be consistent.

Anderson and Krathwohl's 2001 revised version of Bloom's taxonomy provides a good theoretical and practical basis to consider teacher education and training. It has been used widely for classroom instruction for over five decades. A slightly modified, improved version could be beneficial for planning instruction in a CT skills intervention, and w for preparing a framework for CT in teacher education. Its applicability has increased as a framework in various fields - the authors claim that it is value-neutral and so can be used by teachers and researchers operating from a variety of philosophical positions (Moseley et al., 2005).

Criticism of the framework

Anderson and Krathwohl's 2001 framework is an improved version, yet organizing principles of learning and relation with direct instruction (Hattie et al., 1996), lesson planning and classroom learning are not accommodated, which leaves a sense of incompleteness when it comes to how it works in the classroom. Moreover, metacognition is described as a type of knowledge, whereas it is a more cognitive process than a described type of knowledge, yet they offer only a pragmatic justification. The same is true of the categories that are structured by complexity level, but are allowed to overlap on judged complexity. The framework is aimed at improving standards, but is rather weak on motivation and self-regulation of teaching (Moseley et al., 2004, in LSRC, 2004).

4.1.4 Pintrich's self-regulated learning

Self-regulation and motivation are two closely related constructs that can influence an individual's performance in any learning environment. There are various theories and perspectives that address the issues surrounding these traits - both self-regulation and motivation have dimensions of cognition, behaviour and context attached. Pintrich's work on self-regulated learning (Pintrich, 2000) has become a school in itself - he synthesized major works in this field and provided a structured outline to develop or promote self-regulated learning in students. Pintrich defines self-regulated learning, or self-regulation, as:

> an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour guided and constrained by their goals and the contextual features in the environment. (Pintrich, 2000b, p. 453; quoted in Schunk, 2005)

Pintrich's framework of self-regulation comprises phases and areas of learning self-regulated learning; for instance, motivation and goal orientation. Moseley et al. (2005a) summarized these stages and areas in their work related to the LSRC.

The four main phases of self-regulation are forethought, planning and activation; monitoring; control; and reaction and reflection. There are also four areas of regulation that are linked to thinking skills, and play important roles in self-regulation as a disposition, namely cognition, motivation/affect, behaviour, and context. The following (Table 9) offers a brief description of Pintrich's framework, showing each of the four phases of self-regulation in relation to the four linked areas of regulation.

Table 9: Areas of regulation according to Pintrich (2000), p.454, from Moseley et al. (2005a)

Phases	Cognition	Motivation/affect	Behaviour	Context
Forethought, planning and activation	Total goal setting, prior knowledge activation and metacognitive knowledge activation	Goal orientation adoption, efficacy judgement, ease of learning judgment,; perceptions of task difficulty, Task activation, Interest activation	Time and effort planning, Planning for self-observations of behaviour	Perceptions of task, perceptions of context
Monitoring	Metacognitive awareness and monitoring of cognition	Awareness and monitoring of motivation and affect	Awareness and monitoring of effort, time use, need for help, self-observation of behaviour	Monitoring and changing task and context conditions
Control	Selecting and adaptation of cognitive strategies for learning, thinking	Selection and adaptation of strategies for managing motivation and affect	Increase/decrease effort. Persist, give-up, Help seeking behaviour	Change or renegotiate task, change or leave context
Reaction and reflection	Cognitive judgement, Attributions	Affective reactions, Attributions	Choice behaviour	Evaluation of task, evaluation of context

Regulation of cognition

The area of cognition in Pintrich's framework deals with the processes of target setting, activation of prior knowledge, and awareness and monitoring of cognitive strategies. Pintrich has extended and used the work of major theorists and pulled it together to develop a framework for self-regulated learning; for cognitive regulation, for example, his framework is a synthesis Zimmerman's work from 1998 onwards.

Cognitive 'forethought, planning and activation', as the framework proposes the activation and planning phase of cognition to be, involves four general types of planning:

1. Target goal setting - once specific targets have been identified, it is easy to guide the monitoring processes, though goals are adjustable during next phase or reflection process.

2. Prior content knowledge activation is the phase where a learner actively searches their memory for prior relevant knowledge, both of content and metacognitive, before even performing the task.

3. Metacognitive knowledge activation deals with understanding the on-task cognitive demands, knowledge of strategy variables that might help in the cognitive processes

such as memorizing and reasoning. The activation can be either automatic, prompted through a given task or context, or can be employed in a more precise and attentive manner (Moseley et al., 2005a).

4. Cognitive 'monitoring and awareness' involves an awareness of one's own metacognition. It is different from the metacognitive knowledge activation in the sense that it requires judgements of learning during the task achievement process. The learner becomes aware of the feeling of knowing.

Cognitive 'control' refers to metacognitive activities that the learner employs to adapt and alter their cognition. Various cognitive strategies for monitoring memory, learning, problem solving, reasoning and thinking are closely tied to the process. Specific methods of note taking, summarizing points or use of visual imagery can be used as strategies to regulate the cognition. Indeed, the learners can employ any strategies that can help them with learning, though as Pintrich indicates these can be both cognitive and metacognitive. Cognitive 'reaction and reflection' relates to the process of personal reflection and attribution. It means taking a step back and evaluating one's own performance outcomes. This stage explains how good self-regulators make more internal and controllable efforts to judge failure than simply assuming that one has a lack of ability to perform.

Regulation of motivation

'Forethought, planning and activation' of motivation involves beliefs related to the likely success in a task undertaken. The success or the chances of likely success in a task are also related to how much value the learner puts on the task, their personal interest in the task or the content of the task, and fear of failure; all these can be termed part of self-efficacy according to Bandura (1977), and Pintrich has synthesized his work and connected it to motivational planning and actions that help regulate individual learning, and improve quality of the learning (Moseley et al. 2004).

Literature on the motivational 'monitoring and awareness' phase is limited, but we can conclude from Pintrich's writing that monitoring motivation means that one engages effectively and actively in control and regulation of efficacy, value interest, and anxiety. Learners first need to aware of the beliefs and feelings of their efficacy habits, and then will be able to monitor and subsequently change and adapt mal-behaviours to productive ones (Moseley et al., 2005a; Schunk, 2005).

The motivational 'control and regulation' phase involve methods and strategies that students can use to increase their motivation. The belief in self-efficacy, that you can succeed in a task, is such a method to improve control and regulation of motivation. Extrinsic reinforcements, for example rewarding yourself with a gift, a certain food, some time with friends or having your favourite drink at a pub can also prove helpful in heightening motivation. Similarly, intrinsic reinforcement like restructuring the task and thus overcoming the likelihood of avoiding work can be used to avoid feelings of poor performance and of a lack of natural ability (also known as self-worth protection) (Covington, 1992; in Moseley et al., 2004). Pintrich bases the motivational 'reaction and reflection' phase of self-regulation on the work of Weiner (1986), and suggests that individuals will try to understand the reason for success and failure on the basis of skill, luck and effort. Believing that failure occurs due to a lack of ability will affect motivation negatively, and therefore the action and reflection phase in the motivational aspects emphasizes how to replace a student's unhelpful explanation about their academic performance with explanations that will sustain motivation (Zafft et al., 2006; Moseley et al., 2005a).

Regulation of behaviour

As for 'forethought, planning and activation' of behaviour, although Pintrich understands that planning one's behaviour in a purposeful manner is purely a cognitive process, he holds the position that it seems appropriate to direct students' efforts to plan their behaviour in an intentional way. Strategies can be used as activities to plan student behaviour; and strategies such as time management activities (e.g. chalking out revision times and submission times), as well as self-observation and monitoring plans for oneself (e.g. how many new words learned, how many articles read or words written) can be helpful in further planning and action. 'Monitoring and awareness' of behaviour involves monitoring one's effort and level of achievement in parallel. For instance, a student might set aside two days each week to work on a subject assignment, but might find this insufficient to finish tasks on time. Therefore, he might consider putting in either additional time or greater effort to accomplish the task. 'Control and regulation' of behaviour relate to knowing when and from whom to seek help in case of problems. A skilled self-regulated person does not want to depend overly on others, but neither does he refrain from asking for assistance with difficult tasks. Behaviour 'reaction and reflection' concerns the students' evaluation of their current behaviour. Students consider their study habits and may react by changing their time management, level of effort, or the path that they are following to reach their goals.

Regulation of context

'Forethought, planning and activation' of context is important in order to consider one's perceptions about the learning environment, such as students' perceptions about collaborative learning, the types of answers to be expected or the classroom climate. These perceptions may not be completely accurate, but can influence teaching strongly (Moseley et al., 2005a). 'Monitoring and awareness' of context relates to the awareness of the effects of changing college or schools, or moving away from school education to university education. Many students in schools do not realize that there are different requirements for adult learning, and, if they do not adjust themselves through monitoring, how the changing context might affect them or their achievement. They might need to change routines and become aware of rules, criteria and the like (Moseley et al., 2005a).

'Control and regulation' of context involve the students' realization of the classroom environment, engaging in the activities concerned, and regulating their study environment. Less confident students seem to take a passive role in such environments. This stage demands that students take responsibility for their learning environment, regulate their study pace and avoid distractions. Contextual 'reaction and reflection' refers to evaluating aspects of a given task or classroom environment. The evaluations can be related to feelings about engaging in activities or aspects of learning and achievement. These reflections can have an important influence on motivation and cognition (Moseley et al., 2005a).

An important point to keep in mind is that although Pintrich presents the framework in a heuristic manner, he does not claim its linearity or propose equal growth in each phase or aspect. He recognizes that all four phases can operate simultaneously side by side, but can also be consecutive. There has been some criticism of Pintrich's framework regarding the inclusion of a contextual section, and there is also little evidence that the monitoring phase and the control phase are separate; yet the framework has been considered to be quite valuable in its discussion of motivational factors included in self-regulatory skills.

In conclusion, we can assume the importance of self-regulatory and motivational skills for academic as well as real-life success. Individuals involved with learning environments such as classrooms should be trained in the issue and made aware of the phases in order to achieve maximum goals. With reference to CT skills and teacher education, Pintrich's framework can be used to prepare students to regulate both their learning and their life. This framework can also be considered important for ITE in order to prepare well-self-regulated individuals. In terms of importance of metacognitions role in the teaching and learning of CT skills Pintrich's framework has much potential in educational settings. It would be interesting to look at the extent of students' self-regulatory skills in mediating the learning of CT skills in a classroom.

Criticism of the framework

Pintrich's 2000 framework is highly student oriented, which means it requires students to be actively set to learn (this may not be the case all the time), and extrinsic motivation, teacher and learning environments can make a difference. Although the framework seems conceptually coherent, many of the phases again overlap and it does not acknowledge implicit learning, which can make the assessment of regulation contestable. However, Pintrich synthesizes current thinking and self-regulation body of research considerably (Moseley et al., 2004, in LSRC, 2004). A constant struggle would be between teacher's own regulatory abilities and giving direction on day-to-day teaching and learning activities to students.

4.2 Working towards a conceptual framework

4.2.1 Basis for critical thinking skills holistic intervention design

The instructional frameworks revealed that for teaching CT skills, certain elements would be essential to consider, for example the CT skills course should cover a variety of topics across course domains. Moreover, classroom learning environment, student interactions and teaching strategies make a difference to the learning of CT skills. Dispositions such as motivational and self-regulatory skills towards thinking were also suggested as important attributes that can help or hinder the learning of higher-order thinking skills. In the literature, some researchers refer to them as attitudinal and intellectual habits of thinking, while others call them motivational features associated with a positive disposition towards CT.

The concept of CT has many dimensions and it is a multifaceted construct, therefore it is also hard to teach due to the cognitive, social and psychological aspects involved. On the other hand, teaching CT skills to student does have a positive impact on students' academic achievement and lifelong learning. Research has also shown that when teaching such complex skills, visualization tools (literature review); that is, technology, can be used to facilitate and guide the learning and interest of learners.

There is a need for cognition, since it was suggested by the research that the dispositional need for cognition is significantly correlated with CT performance (Marzano, 1998; Hattie et al., 1996; Facione, 2000). The level of engagement is also important in the teaching/learning of CT skills and positive engagement can lead to higher levels of motivation for the improvement of CT skills among students. Approaches such as AM and concept mapping have been proved beneficial for CT skills teaching/learning in various disciplines and can meet the need for cognitive engagement as well as visual facilitation when dealing with complex thinking. Research suggests that the number of hours of practice on software has a significant correlation with CT performance (Van Gelder, Bissett and Cumming, 2004).

The teaching/learning of CT is a complex phenomenon that requires mindful thought of cognitive, sociological, psychological and instructional aspects of learning and learning environments. For example, to design a CT classroom intervention it was necessary to keep in mind the dynamics of classroom instruction, learning, teacher-student relationship, student-student relationship, the individuals' self-related factors that influence learning - cognition, and not least the behavioural and social sides of teaching/learning CT itself. The frameworks selected have a common thread that pulls together the instructional, cognitive and social aspects of learning by recognizing the key role of the participants of action (students and teachers).

Research studies suggest that classroom instructional design based interventions that keep in mind how the students deal with them, rather than how the teachers deliver those, bear the more encouraging results. The best use of classroom time is that which is best designed to enhance teaching/learning to its full potential. What helps to increase students' interest in learning is a mix of individual and group learning opportunities, and disaggregating cognitively complex tasks, or at least visualizing them using various tools such as information trees, diagrams, writing exercises, brainstorming, oral explanation and argument building.

Both the teacher’s and the students' roles in the classroom also influence the extent to which CT skill will be learnable. The teaching of CT requires a role as facilitator and guide for the teacher, which may pose a challenge for traditional, teacher-centred approaches and would require a considerable shift in a teacher's pedagogical knowledge. On the other hand, the learning of CT also requires learners to take responsibility for their learning as independent learners. The learning of CT may become complex and difficult for learners who lack independent learning dispositions and skills. Learning CT and designing its learning environment demand much attention, focused effort and time from its participants as well as its designer, and this may be the reason for a lack of effort in teaching/learning CT.

Among these elements assessment is another area that is closely related to the empirical research for CT skills. There are two aspects of assessment that need consideration: one is the assessment of the CT skills teaching and learning process because of its direct influence on the quality of the experience and outcomes hence its eventual effect can be important one, and the amount of effort and instruction as part of the teaching programme (this is to motivate, reinforce, and model to learn CT skills) can influence the learning process. The second is the assessment of the accuracy within which the intervention was being implemented and the outcomes, measured with relevance to variables distinct to each study. This can help in gauging the outcomes and the process of learning and instruction of CT skills. Assessment and evaluation in the form of observations and participant feedback also appeared as an aspect that is less focused on in CT research.

The research on various aspects of CT also shows what dimensions of CT are important to these authors. It is no surprise to discover that the most successful frameworks are related to the area of instructional design in teaching/learning CT (Moseley et al., 2004), and that most work is discipline specific. These CT frameworks are not free of the limitations of field, discipline or territory in which they are used. When teaching CT skills, the nature and scope of learning need to be understood.

Considering the increased attention on the subject of thinking skills in teaching/learning environments, a practical and rationalistic framework for the teaching/learning of CT skills was needed. However, no single framework fitted the requirement of this study. For this reason, the dynamics of the thinking skills instructional intervention and learning were addressed by coming up with a design principle-based approach. This served the need of careful design inn which intervention had strong theoretical foundation as well as links to all aspects of the study design and study variables at the same time. Following the theoretical conclusions derived from the literature review and theoretical frameworks for thinking, the study moved towards the formulation of conceptual framework of the study.

As an educator, I think that the field of research in CT skills lacks research in the full circle approach to teach, test and evaluate the learning of CT skills in a given context. The time is ripe to try teaching CT skills and evaluating the process as a whole to address real issues and problems related to the low effectiveness and gains on CT skills interventions, rather than debating 'what ifs'. After discussing the CT skills field and setting the boundaries of the construct for this study, the next section now discusses the conceptual framework of the study.

Due to the diverse continuum of CT skills research, it can be observed that the task for educators and researchers to select and use theories, teaching methods and approaches has become difficult, since numerous authors in the field of CT have contributed to enhancing the understanding of CT skills and dispositions by providing a variety of perspectives on the construct. The literature on cognitive psychology, instructional design and metacognitive perspectives about CT is plentiful, and a sizeable part of it was discussed above in the literature review. The different theoretical frameworks discussed in previous sections merged with research-led principles to provide sound thinking principles that can be used for developing a curriculum for CT skills intervention for Pakistan's ITE programme and elsewhere. The conceptual framework provides a bridge between literature review and research design, as well as between the literature review, teaching/ learning and implementation design of the instructional intervention.

The close analysis of the educational research on the topic brought in ideas for development and assessment criteria essential for a CT skills instructional intervention, as I have done here. The analysis provided principles and guidelines for the design, implementation and methodology of the study. Based on a synthesis of research studies and an analysis of CT skills instructional frameworks, a conceptual framework for the study of teaching/learning CT skills in initial teacher education (ITE) was developed. It is a challenging task to decide what to include in this teaching CT framework, and a possible framework was reached by synthesizing and using elements for teaching CT skills suggested by other research studies. The literature discussed in Chapter 2 aligned the study towards an explicit intention - that to test a hypothesis it needs to be grounded in knowledge and in pragmatic research studies that seek to solve problems by experimenting and understanding of phenomena. Figure 7 shows how the conceptual frame was derived with the help of literature review and principles from pedagogic research in CT skills as explained previously.

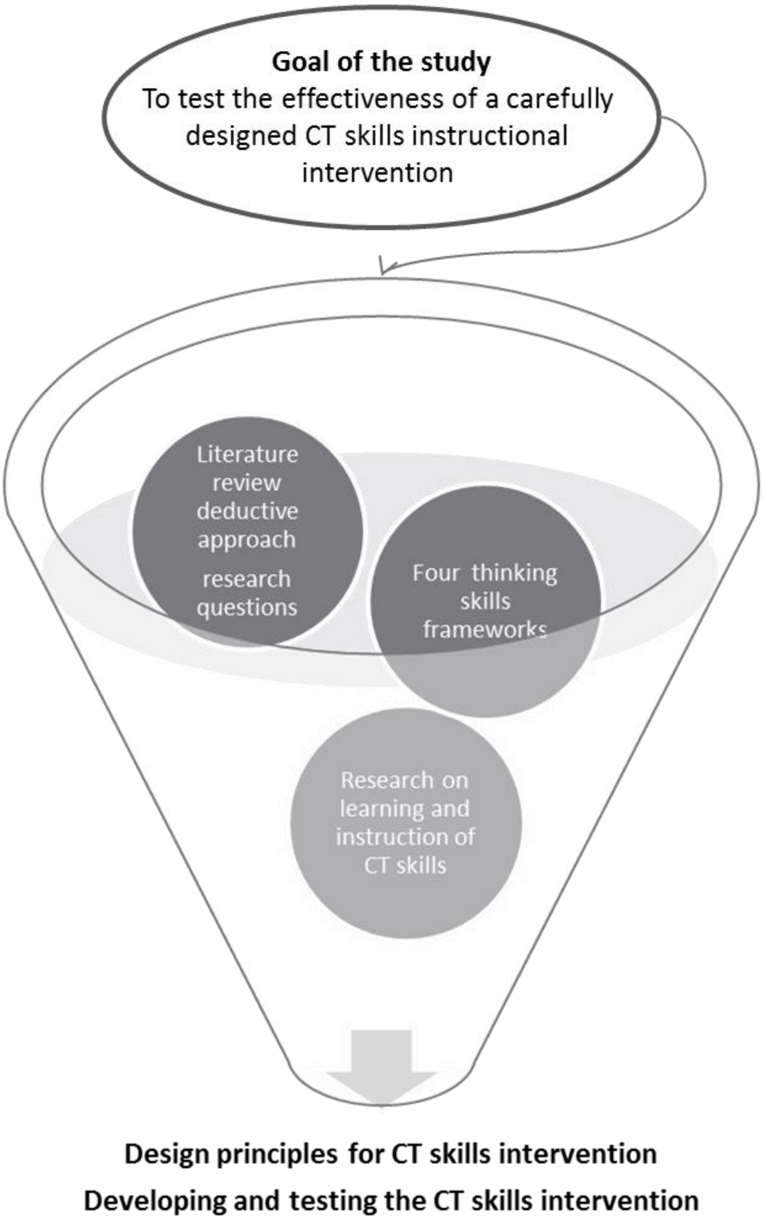


Figure 7: Conceptual framework of the study

4.2.2 Design principles for learning and instruction of CT skills intervention

This section on the discussion of the conceptual framework will look at the literature review in context of intervention characteristics and choices that were made for a carefully designed CT intervention to foster CT skills for students. The issues reflected on in this section are: 1. subject specificity and transferability; 2. instructional approaches to the teaching of CT skills; 3. CT dispositions; 4. collaboration and group work; 5. reinforcement and encouragement feedback; and 6. visual representation. These help to design an intervention that is useful for the aim of the study and would help ITE students to learn CT skills in the educational psychology module.

1. The issue of subject specificity and skills transfer to various contexts appears as an area of considerable importance in the relevant literature (Halpern, 1998; Ennis, 1989, 1990; Duron, Limbach and Waugh, 2006; Renaud and Murray, 2008). Various pieces of research validate the idea that the discipline and nature of the content influence the teaching/learning of CT skills. McPeck (1990) argues that CT cannot be applied independently; in other words, there needs to be some sort of conflict or disputed aspect present in the content, topic or question that will ignite a student's cognitive senses and encourage them to think, argue and present their own views and conclusions. In such situations we can strive for teaching CT skills and train students' cognition and ability to think critically.

i. **Design principle *Subject Specific***: The CT intervention should be subject specific, and contents must present a debatable topic, question or situation.

2. The issue of selection of instructional approach to teach critical thinking skills is related to the question of transferability and the generalizability of CT skills. There are conflicting views in this field (see Davies, 2006; Flores, Matkin, Burbach, Quinn and Harding, 2012). Research has shown mixed results for the issues of transferability and the effect of various approaches to teaching CT skills. Measuring the transferability and potential for generalization is thus a complex matter (Willingham, 2009). One group of experts suggests that CT is general in nature - Gelder argues that CT is 'instinctively general in nature' (Gelder, 2005, p. 43) which, paradoxically, is why CT skills and abilities are notoriously difficult to transfer to new contexts (Davies, 2006), though CT as a general course can be taught in any discipline. On the other hand, Ennis (1989), Perkins and Salomon (1989) and Halpern (1998) as well as Lai (2011), Marin and Halpern (2011) and Fisher (2011) are of the opinion that instruction that makes the structure of thinking clear can have positive results. This means that if students are taught effectively *how* to think, and provided with opportunities to practise this in a subject-specific curriculum, both general ability in CT and its transfer, as well as subject-specific CT and transferable skills, can be taught. Besides, the transferability of skills depends on many other social, contextual and cultural factors - various research attempts have yielded opposite findings, and resulted in both successes and failures depending on what, when, how and where the teaching of CT skills and dispositions took place. To date, most of the research evidence is in favour of teaching CT through infusion and mixed approaches, where CT skills are explicitly coupled with classroom objectives and integrated into the subject-specific content for concrete practice (see Halpern, 1998; Abrami et al., 2008;

Lai, 2011; Tiruneh, Verburgh and Elen, 2014). A consensus can be that both types of opportunities should be provided to students to maximize the possibility of a long-term or even permanent acquisition of CT skills.

ii. **Design principle *Mixed Approach*:** Based on the above, a mixed approach will be implemented for the delivery of CT intervention. A mixed approach is confirmed as the most outcome-friendly approach to teach CT in various research overviews (Lai, 2012; Ennis, 1992; Niu et al., 2013), as well as in independent research studies (Hatcher, 2006). The instruction must include explicit teaching of how to think and the principles and steps involved in doing so. Therefore, part of the instruction and guidelines will be providing practice in how to develop an argument, addressing questions such as what the components of rational thinking in writing or while presenting one's point of view are and so on.

3. Critical thinking dispositions have been proven to be an important part of CT as a construct (Ennis, 1982; Facione, 2001; Halpern, 1998; Paul and Elder, 2006; Profetto-McGrath, 2005). Without CT dispositions, the teaching/learning of CT skills is possible, but it may be substandard. Dispositions are often studied as factors that affect learning of CT skills development (see Giancarlo and Facione, 2001; Halpern, 1998; Purvis, 2009). One can describe these as the characteristics of an individual, such as motivation (intrinsic and extrinsic) and self-regulation. As Facione, Facione and Giancarlo (1996) stated, 'we characterize the overall disposition towards CT as the consistent internal motivation to engage with problems and make decisions by using CT' (in Facione, 2000, p. 65). In line with this, in his study of the effects of motivation on student's learning of CT skills, Dwyer (2010) finds that motivation is positively associated with improvement in CT skills. Likewise, Pintrich and Zusho (2002;2007), exploring the effect of self-regulated learning and motivation in college education, found a positive relationship of these parameters on students' achievement and learning performance. Self-regulated learning is proven to instil CT skills and academic achievement in students (Pithers and Soden, 2000; Cheng, 2011). Motivation has been studied as an important influence for developing a self-regulated learner and a habit of self-regulated learning (Pintrich, 1999). Studies have also found positive links between the development of CT skills and the mediating effect of self-regulated learning and motivation in this process (Lai, 2011; García and Pintrich, 1992). It is therefore important not to overlook the importance of overall CT dispositions.

iii. **Design principle *CT Dispositions*:** Motivation (intrinsic and extrinsic) and self-regulated learning are the more educationally important dispositions. In other words, motivation and self-regulated learning can be said to be predictors of the development of CT skills. Both will be studied here to examine to what extent these have an influence on the learning of CT among students.

4. Collaboration and group work are two student-centred constructivist instructional strategies that are considered to enhance students' learning experiences in higher education (Biggs, 1996). Collaborative learning has also been found effective in the teaching/learning of CT skills - Gokhale (1995), for instance, finds that if the purpose of instruction is to enhance CT and problem-solving skills, then collaborative learning is more beneficial. Moreover, students who participated in collaborative learning performed significantly better in the CT test than students who studied individually (Gokhale, 1995). García and Pintrich (1992) found similarly that collaboration and classroom experiences are positively associated with the learning of CT skills. The research reviews on the effectiveness of CT instructional interventions also found that collaborative work was positively associated with students' learning of CT skills (see Abrami et al., 2008; Lai, 2011; Niu et al., 2013). For the most part, one can say that collaboration and group work are positive strategies for enhancing student participation, interest and engagement in classroom learning.

iv. Design principle *Collaboration and Group Work*: In the design of instructional activities and classroom instruction, a collaborative environment will be promoted. For promoting self-regulated learning, individual tasks and for collaboration small group activities will be designed and included in the instructional intervention.

5. Reinforcement and encouragement in the form of formative feedback have positive effects on students' learning and achievement. In addition, formative feedback enables them to become more active in consciously monitoring their own learning, and thus helps them to become self-regulated learners (Shute, 2008; Nicole and Dick, 2006). Formative assessment has been positively associated with increased learning achievement, motivation and self-regulated learning among students (e.g. Black and William, 2004; 2009, Cauley and McMillan, 2010, Paris and Paris, 2001). Therefore, it is logical to include these as intervening factors in the study. Based on the available literature and research, one can say that formative feedback, motivation and self-regulated learning as characteristics of students and learning environments would be an interesting dimension to look at in the field of CT interventions.

v. **Design Principle *Formative Feedback*:** In this study, formative feedback will be made part of instruction in order to enhance students' engagement in the learning process and guide their learning to make them meta-cognitively, motivationally and behaviourally active participants in their own learning (Zimmerman, 1989).

6. Visual representation of concepts and complex ideas makes them concrete and easy to understand (Ainsworth, 2006). For instance, visual representations of mathematical equations, science experiments or philosophical ideas in the form of brainstorming sketches, pictures and graphs, or in written form on paper or a screen makes it easier to form connections between cognition and actions, hence make thoughts and practices clearer (see Bokhove and Drijvers, 2010; Chin, Dohmen and Schwartz, 2013). Research has been conducted to see the effectiveness of visual representation (also referred to as 'mind tools') in making complex constructs with the help of building arguments, and constructing mind maps and concept maps to break down complicated structures (Jonassen, Carr and Yueh, 1998; Jonassen, 1999; Davies, 2013), and the effectiveness of visual representation tools has been proven through research from various disciplines in the fields of education, nursing and the sciences (Wheeler and Collins, 2003; Gelder, 2005). For visual representation, plenty of computer-based software programmes are available on the market, either free or purchasable for various uses in business, classrooms or specific disciplines. AM and concept mapping tools are also being used in the field of teaching/learning CT skills. Gelder (2005), Davies (2009), Butchart et al. (2009), Harrell (2007) and Dwyer et al., 2012, 2015 have concluded that positive results and improvement in the ability of CT skills can be achieved through practice for transfer, practising theory and by mapping the thinking process out. However, there is little research in the field of ITE in which the effectiveness of these mind tools has been tested. In order to examine the usability of these tools to increase the learning of complex constructs such as CT, tools like AM and concept mapping will be made part of the intervention.

vi. **Design Principle *Visual Representation*:** Considering the effectiveness of argument maps for developing CT skills in terms of lessening the cognitive load and facilitating structured thought process, these maps will be made part of the CT intervention. Students will be taught how to build an argument and encouraged to practise this skill. Along with the curriculum of the CT intervention, AM is the most suitable support tool for teaching CT skills for the purpose of this study. Students will be provided with lessons, tasks and activities in which they will practise via AM on a computer.

The conceptual framework of the study defined the outline for the design of the intervention and the research design to achieve the aim of the study. The next section of this chapter provides a brief summary of the intervention design and development and piloting. The decision to put this section in appendix was based on two strategic reasons 1) the inevitable length of the main thesis needed to be balanced, and 2) intentionally avoiding readers to misunderstand that the study is about intervention design and development whereas the purpose is to put a holistic lens on the entire procedure of CT skills learning and instruction of CT skills for teacher's professional development as explained in previous chapters 1, 2, 3. For complete details on study intervention design and piloting results see Appendix.

4.3 Intervention design and development

Once the design principles were derived, the next step was to design a realistic intervention that was suitable to serve the needs of the study. The chapter on the design of the intervention explained in detail the blueprint of the intervention, how carefully it was designed and the steps taken to ensure its credibility within the constraints of site, resources and timeline limitations. The design includes description of the instructional intervention materials and the mixed approach to teach CT skills is explained in two parts. These provide a brief detail of the content of each lesson that were designed with the mutual help and approval of the faculty, class teacher and researcher collaboration. A total 12 lessons were planned to be delivered during four weeks of intervention, with the intervention interviews (Research Question 2b) planned for the fifth week. A pre-implementation plan was also included in the intervention chapter (see as discussed in Appendix C), and the observational protocol was kept in mind and is explained as implementation fidelity protocol as part of intervention design. For details, see Appendix B.

4.4 Piloting of intervention and instruments

Once a careful design of a CT skills intervention was ready, it was piloted to check the flow and pace of lessons and learning materials (if they could be done in 30-40 minutes class time). A full pilot to trial the intervention and test the reliability of the questionnaires at the original place of the study was not possible, due both to the access permissions from the place of study and the PhD time line. A pragmatic approach was taken to show the rigour and manner of a researcher, so the intervention was tested with some postgraduate and undergraduate students, who had either experience of teaching and learning in higher education or had a Pakistani background as a student. Such a combination provided useful insights into the design and flow of the project, as well as some rationality from the feedback. A combination of online and face-to-face approaches was used to maximize the piloting of instruments and to achieve the purpose of testing the lesson plan design. The lesson plan flow and suitability were limited by the sample available, and the instrument testing was limited to the available participants and resources. Only the classroom learning environment questionnaire was tested for reliability, mainly because some of its items were changed for use in this study (for detail see Appendix C).

In the next chapter, the research methodological issues of the study are described and discussed in detail.

Chapter 5: Research methodology

This chapter comprises the research design adopted for this study. It consists of six main sections on the research paradigm, the mixed methods research approach to the study (sequential explanatory design), the sampling of the sequential explanatory design, data collection, analysis methods, and its ethical consideration.

The first section reflects on the research paradigm as an important consideration in undertaking research, the debate on competing paradigms, pragmatism as a conciliation point for varying paradigmatic debates and, lastly, declaring the paradigm of my study as pragmatic mixed-methods research.

The second section elaborates on the central nature of the research question that I was primarily interested in asking, therefore the suitability of a mixed-methods research approach. Third section proceeds in detail on the methodology as mixed methods sequential explanatory research design and deals with the methodological discussion of the two-phase study, and briefly on its validity and reliability (quantitative component) and trustworthiness (qualitative component).

The fourth section provides information on how the sample was accessed and selected, complementary to the nature of the research questions and study design. The fifth section explains the data collection and analysis methods for each component, and provides a plan of how the data in the quantitative and qualitative strands is analysed in order to answer the research questions.

The sixth section provides information on access and the ethical issues of the study in terms of how the sample was approached and the research was conducted in the actual field.

5.1 Research paradigm

Undertaking research and producing knowledge in educational research carries with it dealing with different forms of knowledge and value judgement on how the knowledge was created (Punch and Oancea, 2014). While these differences can be deep and creative approaches to educational inquiry, at the same time they can be fiercely disputed and bring conceptual complexities to the research work (ibid.). One such conceptual complexity is inherent to the topic of research philosophy/ paradigm in educational research.

A paradigm describes the 'observed and scrutinized', the type of questions asked or probed to answer the observed and the scrutinized, how these questions were structured, investigated and interpreted. Paradigms are view points and rules on how to look at a particular field's problems and how to solve these (Kuhn, 1970). A paradigm may also be defined as a 'world view, complete with the assumptions that are associated with that view' (Mertens, 2003, p.139, also in Creswell and Plano Clark, 2007, p.4). For example, positivism, constructivism and pragmatism are world views that are associated certain type of research methodology movements; for instance, quantitative, qualitative and mixed methods respectively.

Educational researchers often embrace the discussion about the distinctions between quantitative- qualitative world views/theories and research practice (Mackenzie and Knipe, 2006). The philosophies differ in their ontological, epistemological and the axiological elements. The ontology of a research world view mainly deal with questions about the nature of reality. The epistemology of research philosophy asks about what knowledge and ways of knowing, the researcher and what is being researched. The axiology of a research philosophy deals with the role of values (biased/unbiased) in research (Crotty, 1998; Creswell and Plano Clark, 2007). A brief introduction to main world views is described below, according to Creswell and Plano Clark (2007).

Positivism was replaced by post-positivism after World War II (Mertens 2005), and a sense of the world appeared as ambiguous, variable and multiple realities aligned towards constructivism (O'Leary, 2004; cf Mertens, 2005). Post-positivism or quantitative perspective aims at testing a theory or describing an experience, also referred to as scientific method (Mertens, 2005). The research epistemology holds the position that the social world can be studied as the natural world using a rationalistic, empiricist approach that 'reflects a deterministic philosophy in which causes probably determine effects or outcomes' (Creswell, 2003, p. 7 also in Mackenzie and Knipe, 2006, p. 2). Both positivist and post-positivist research is associated with quantitative methods of data collection (e.g. questionnaires, standardized tests) and quantitative analysis approaches (Creswell and Plano Clark, 2007; Creswell, 2003).

Interpretivist/constructivist or qualitative position looks at the research problems by way of understanding 'the world of human experience' (Cohen and Manion, 1994, p. 36) and that 'reality is socially constructed' (Mertens, 2005, p. 12). Interpretivists do not start with a theory/deterministic philosophy; rather, they generate theory or a pattern of meaning by relying upon participants' views of the situation, as they are studies throughout the research process (Creswell, 2003). The interpretivist research is associated with qualitative methods of data collection (e.g. interviews, observations) and analysis (grounded theory, content analysis). The interpretivist paradigm also saw a shift towards transformative paradigm (Creswell, 2003).

The third research philosophy/ world view emerged as a revolt against the highly compartmentalized research practices of positivist and interpretivist paradigms (social justice and issues of marginalized people and political agenda), mainly due to ignorance of sociological and psychological theory in educational research. The world view advocated collaborative, change-oriented empowerment issues and the use of multiple methods of inquiry (Creswell and Plano Clark, 2007; Creswell, 2003).

The fourth world view, known as the third research path/paradigm, is also associated with third methodological movement (Johnson and Onwuegbuzie 2004; Tashakkori and Teddlie 2003; Tashakkori and Teddlie, 2010). Pragmatism looks at reality and knowledge as a consequence of actions. It is associated with a problem-centred approach to inquiry and advocates for a pluralistic, real-world practice-oriented world view (Creswell and Plano Clark, 2007; Creswell, 2003). The pragmatic research philosophy advocates singular and multiple realities, and the researcher tests hypothesis to provide multiple perspectives. The research epistemology is based on 'what works', practicality and use of as many methods as are required to answer research question. Multiple stances also prevail in data collection tools and the values of the researcher, and both biased and unbiased perspectives are accepted in pragmatism.

5.1.1 The paradigms debate or paradigm wars

The paradigm debate is the conflict between competing paradigms, mainly on philosophical and methodological issues in the scientific world views of positivism and its variants such as post-positivism and constructivism, and its variants such as interpretivism (Guba and Lincoln, 1994; Denzin and Lincoln, 2005). During the 1970s and 1980s, the debate came up regarding stances on the dichotomy of quantitative and qualitative research philosophies. There were two main groups: the purists (paradigms cannot be mixed); and the situationalists, who believe multiple paradigms can be used to address research problems (Rossman and Wilson, 1985). The 'paradigm wars' debate first coined by Gage (1989) led to scholarly discussions on philosophical and epistemological role of methods in research. These led to a procedural development period during the 1980s and evoked the advocacy of the separate design period (for instance, Greene, Caracelli and Graham, 1989; Brewer and Hunter, 1989; Morse, 1991; Creswell, 1994; Morgan, 1998). Although the dialogue continues, the debate has moved on with the emergence of a third paradigm. It is during this period that a pragmatist world view became the key philosophy for mixed methods research. In the following section, the rise of mixed-methods research is addressed, also referred to as paradigms lost and pragmatism regained (Morgan, 2007), advocates the compatibility thesis of a peaceful coexistence and the end of paradigm wars (Teddlie and Tashakkori, 2009; Creswell and Plano Clark, 2007).

5.1.2 Pragmatism, mixed-methods research: End of paradigm wars

As way of ending paradigm polarization and coming to a mid-way, mixed-methods research emerged in which paradigms meet or at least peacefully co-exist. During the past twenty years, the debate on paradigm dualism and contrast (constructivism and positivism) evolved as an incompatibility thesis; that is, it is not appropriate to mix quantitative and qualitative methods due to philosophical differences between the paradigms (Teddlie and Tashakkori, 2009; 2010).

The purpose of pragmatism was to find a middle ground between constructivism and positivism. Johnson and Onwuegbuzie, 2004 (p.18) claimed:

> The project of pragmatism has been to find a middle ground between philosophical dogmatism and skepticism and to find a workable solution… to many longstanding philosophical dualism about which agreement has not been historically forthcoming.

5.1.3 Research paradigm of the study

Pragmatism in research philosophy means giving priority to the questions asked for the purpose of the study, focusing on solving problems and seeking understanding of the phenomena as far as possible. Such is the intention of this study, which is conducted to understand to what extent a carefully designed CT intervention works or does not work, and what happens when an intervention is implemented in a mainstream classroom. Answers to this issue will be found by analysing research outcomes; observation of intervention implementation procedure; and participant experience. The need to test the effectiveness and the consequent explanation of the phenomena for a fuller understanding led the study towards a pragmatic approach of inquiry, taking a mixed-method path that consists of both quantitative and qualitative data collection and interpretation strategies.

Pragmatism is closer to existential reality, which in Dewey's words means a focus on consequences (Dewey, 1925). Thus, it advocates a pluralistic orientation towards ‘what works’ and practice (Creswell and Plano Clark, 2011, p. 41). Pragmatism asks to look for the truth/reality, regardless of o the boundaries of methods, theories and other factors. By 'truth/reality', it means that truth/reality can be objective and subjective both: a single truth or a relative truth with multiple single realities. A pragmatic researcher is not apprehensive about whether a quantitative or a qualitative approach is dominant.

The pragmatism is associated as a typical philosophy for mixed-methods research (Creswell and Plano Clark, 2007). Pragmatism as a research philosophy has found considerable support among mixed-methods researchers over the past decade or more (Feilzer, 2010; Johnson and Onwuegbuzie, 2004; Maxcy, 2003; Morgan, 2007). Pragmatisms and mixed-methods research were formally linked by Tashakkori and Teddlie (2003) and Teddlie and Tashakkori (2010). Pragmatic philosophy informs mixed-methods research on how to balance multiple methods to answer research questions in the best way possible. Mixed-methods research is popular with researchers who want to investigate a phenomenon in detail for understanding them fully (Johnson, Onwuegbuzie and Turner, 1995), and the dictatorship of research questions (Creswell and Plano Clark, 2007; Teddlie and Tashakkori, 2010). In addition, they ask for a responsibility of being informed and aware of the risk of researcher's bias as an observer as well as an objectivist (Feilzer, 2010; Johnson and Onwuegbuzie, 2004).

Long-time researchers who do not associate with a particular camp/world view struggled to make their voices heard. However, the writings of James, Dewey, Wittgenstein, Quine and Kuhn and, more recently, Rorty and Bernstein and many others) reject the forced choice between interpretivist and positivist paradigms and advocate the 'stop asking' and 'move beyond' the very questions about objectivism versus relativism, towards the third path, also referred as third paradigm (Creswell and Plano Clark, 2007; Teddlie and Tashakkori, 2009; Onwuegbuzie and Johnson, 2006).

The philosophical orientations of the study are based in a pragmatic world view (Teddlie and Tashakkori, 2009, p. 84; Creswell and Plano Clark, 2007, p. 21), that emphasizes the consequences of research, the primary importance of questions asked rather than methods used, and the use of multiple methods of data collection that inform the problem under study.

The theoretical derive and design specifications of this study also lead to using mixed/multiple methods (Morse and Niehaus, 2009). For example, an explanatory research question might require collecting questionnaire data and making observations and interviews, either in two phases or simultaneously, to triangulate responses. This may or may not be considered as mixed-methods research, depending on the use of data and the interpretations and inferences that the researcher wants to draw from the data (Creswell et al., 2006; Creswell, 2009b).

Moreover, a pragmatic world view takes into account various roles of the researcher (as observer, manager, mediator/assessor, resource person, and analyst) when collecting data (Feilzer, 2010). The pragmatic world view thus provides the flexibility to move from one role to the other, with an awareness of risks and pitfalls involved in such situations. This research study asks for the researcher's role as a developer, researcher, observer and resource person simultaneously, and this would have not been possible without taking a pragmatic approach to research.

5.1.4 Conclusion

A research paradigm is the philosophy of research that starts with the selection of a topic/research question and guides the framework, beliefs, values and methods of research (Mackenzie and Knipe, 2006). The beliefs about knowledge and knowing influence the design, methods, analysis and interpretation of data, therefore are important to clarify prior to the research. Therefore, the rhetoric of research also differs, depending on the world view. In the systematic investigation or inquiry of phenomenon in social sciences, prevailing research paradigms are positivism/post-positivism, interpretivism, advocacy and participatory and pragmatism (Creswell and Plano Clark, 2007; Mackenzie and Knipe, 2006).

It can be seen that the research philosophy, theoretical framework or epistemological stance guides the path of methods, analysis, interpretation (research design), knowledge contribution, and the implications of the research undertaken (Creswell and Plano Clark, 2007; Creswell, 2003; Mertens, 2005; Cohen and Manion, 1994). The choice of paradigm depicts the epistemological stance of the researcher. For example, the choice of research questions decides the path of research design and research methods, and sets the inquiry undertaken on its course of action (Mackenzie and Knipe, 2006). In the next section, the research design of the study is discussed.

5.2 Research questions and research design of the study

The research questions are repeated below. They have been explained with sub-questions in the introduction chapter. The development of research question to was in part gradual. Specifically, the research question 2a was included later after piloting and noting the complexities of instructional intervention process. This gradual development of research questions also shows the pragmatist flexibility, importance and refinement of research questions over time.

1. Does using a carefully designed instructional intervention increase learning CT skills among students?

    (1a) Do students' perceptions about motivation/self-regulation influence the learning of CT skills?

    (1b) Do students' perceptions about the classroom learning environment influence the learning of CT skills?

2. What are the participants' experiences of how a specific instructional model helped or did not help in the learning of CT skills?

    (2a) To what extent does implementation fidelity influence the effectiveness of a carefully designed CT skills instructional intervention to increase students' CT skills?

    (2b) What are the experiences of students and the class teacher of the carefully designed CT skills instructional intervention?

5.2.1 How the research question, methodology and methods are justified as a pragmatist?

The data required to answer the main and subsidiary research questions could only be collected with the help of quantitative and qualitative tools. By analysing the questionnaire and observed environment, I was able (or at least could attempt) to infer the fuller picture of the effectiveness of the CT skills intervention in this study. The integration of both types of analysis helped to explain, spot exaggerations, and confirm or reject the hypotheses that were formulated about this research.

The research is interested in the outcomes of the research while applying as many rigorous methods and tools as are needed to obtain useful data that best answer the research questions asked. The research questions determine what and how much emphasis will be given to certain paradigms or tools for the purpose of data collection (Feilzer, 2010). The interest in the effect of carefully designed CT skills instruction dictated the choice of quantitative methods, and the interest in participants' experience of teaching/learning process guided the choice of qualitative methods.

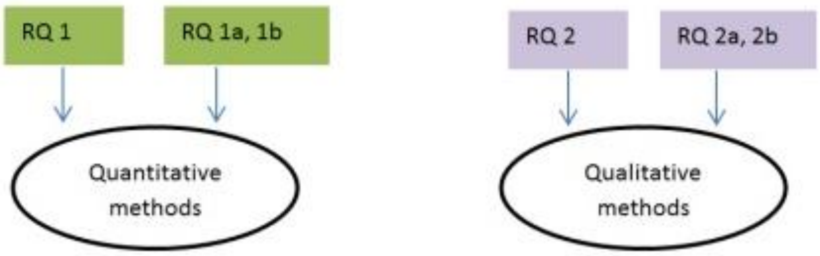


Figure 8: Research questions leading to choice of research methods used in the study

In order to know the many faces of reality and forms of knowledge, it is important to look at educational phenomena in various situations as fully as possible, so that eventually one can come to explain what remains unexplained and uncover what stayed hidden due to the limitations of each paradigm. With the help of a pragmatic approach, it was possible to use both quantitative and qualitative methods as required.

The main research questions lead to which mixed-methods research approaches would be dominant, supplementary or even equal in weightage. How the researcher theoretically sees the process of data collection in order to find out explanations for the research questions asked drives the design and sequence of methods, as well as the dominance of methods. In my study, the theoretical drive to test to teach CT skills led the study to tests based on principles in a systematic, multidimensional approach to teach critical thinking skills (the deductive design approach). Research Questions 2, 2a and 2b, however, inquire about a deeper understanding of the phenomena – that is, qualitative theory – yet are still theoretically driven to inquire into the effectiveness of a CT skills intervention, best be understood through qualitative methods. The overall measurement, observations and participant views provided a rich description of the testing the effectiveness of carefully designed CT skills intervention.

5.2.2 Conclusion

The research design of the study has two phases or components: the quantitative and qualitative. For the first main quantitative phase, the research followed a quasi-experimental (two group) pre-test/post-test design to look at the effectiveness of an instructional intervention on the students' learning of CT skills. During the implementation, observations and journal notes were made to observe the implementation fidelity of the intervention. In practice, it started when the intervention was being implemented. The second qualitative phase consisted mainly of qualitative interviews, but the observations were used as supplementary to understand and explain the outcomes at the study site. These are described in detail in the next section.

5.3 Mixed-methods research approach: Sequential explanatory design

The ‘pacing’ or synchronization of the core and the supplementary component has an important implication for the mode of interaction of both components (e.g. parallel, embedded or sequential) for sampling, and for the point of interface (Morse and Niehaus, 2009; Creswell and Plano Clark, 2007; Morgan, 1998). In this section, the mode of interaction of the two components and the point of interface of each type of data are discussed. The implications for sampling according to the mode are clarified in the sampling section.

5.3.1 Component 1: Quantitative inquiry

In Component 1, quantitative research method was a non-equivalent two-group quasi-experimental. This inquiry design was adapted to answer Research Questions 1 and 1a, 1b through using pre- and post-test and questionnaires as its data collection tools. Quasi-experiments work well in natural settings (Schoenfeld, 2006) and this research design suits the educational setting of the study, because a randomized allocation of groups was not practical and the overarching goal was to answer questions such as ‘Does a treatment or intervention have an impact?’, and ‘What is the relationship between programme practices and outcomes?’; that is, effectiveness of intervention (Dimsdale and Kutner, 2004).

The first phase was conducted with a two-group quasi-experimental design or approach. A non-equivalent control group design was adopted, choosing the natural groups to be as alike as possible, controlling for group differences by using matching cases on as many variables as possible (Gribbons and Herman, 1997). The quantitative part consisted of two groups, intervention (A1= experimental) and non-intervention (B1= control). A1 and B1 both undertook pre-tests to measure the existing CT skills of students. In this study, the terms intervention and non-intervention are used interchangeably with experimental and control groups. There is no particular reason, apart from thinking that in educational settings no complete control over undesired factors or intervening variables is ever possible. Therefore, I prefer using intervention and non-interventions as soft terms in educational settings over rigid experimental and control conditions.

Then, the treatment (an instructional intervention) was implemented for four weeks to group A1 only. The B1 group was occasionally observed particularly to see the teacher’s behaviour while teaching. For the intervention groups, during the implementation observations of the implementation process were made and recorded. The classroom learning environment and students' motivational learning strategies were measured through questionnaires from the experimental post-test group A1 only. The post-tests were undertaken by both groups A1 (Intervention/experimental) and B1 (non-intervention/control) at the end of the fourth week. This is when the quantitative data collection component finished.

A simple test score marking, as well as an independent t-test), of the two groups' performance was undertaken to obtain the average scores on whether the carefully designed intervention instruction had had an effect on students' CT skills learning or not. The results showed that the intervention had had no effect on students' learning ability of CT skills, statistically. Because the motivation and learning environment were added as variables due to their significance (apparent in literature) to influence CT skills learning indirectly, these were analysed in detail after the data collection was complete.

5.3.1.1 The treatment (Intervention)

The intervention comprised a mixed approach to teaching CT skills. The mixed approach means combining two of the four approaches described in Ennis (1998). The intervention combined the approaches of explicit general teaching of CT skills and an embedded in subject (educational psychology) teaching CT skills by way of instruction. The intervention was based on the theoretically driven principles (from the conceptual framework of this study). The lesson plan materials were selected using the module course outline. A blueprint for the lesson plans was prepared by the researcher through building on previous research and, with the help of the subject teacher, by reaching the university (site of study). The six principles (conceptual framework) were used to prepare the lesson plan drafts, which were then shown to and discussed with the class teacher for content validity. The teacher agreed these to be appropriate for the requirements of the curriculum (educational psychology), as well as for basic CT skills provision.

The treatment intervention consisted of lessons delivered to Masters education students by their class teacher. The treatment lessons were prepared as a systematic way of presenting instruction that included listening to and watching audio-video lessons on CT skills, preparing paper-based concept maps on course topics, discussions using a CoI format and discussion preparing computer-based argument maps. The whole process can be said to lead to practising general and embedded CT skills in a systematic way using a multidimensional approach for CT skills over a period of four weeks. The intervention design and a blueprint for the lesson plans, procedure and schedule are included as Appendix A.

5.3.1.2 Mode of interaction of components: Sequential explanatory design

This study used a mixed-method research approach that specifically fits a sequential explanatory mixed-method design (Creswell, 2009b; Creswell, Plano Clark, Gutmann and Hanson, 2003). Creswell (2009b) explains that methods can be mixed either with equal emphasis on both quantitative and qualitative aspects, or with a maximum focus on either one, while giving less focus to the other. If the purpose of such a mix is the need to test or advocate a theory or worldview, the researcher can choose - depending on the nature of the research questions and theoretical drive - to follow one type of inquiry predominantly and put supplementary emphasis on the other. For example, the figure below shows the weighting given to each type of inquiry in this research.

Figure 9: Mixed-method research design, adopted from Creswell (2009b)

For this study, the first quantitative phase/component comprised of a quasi- experimental approach, and the qualitative phase involved a follow-up investigation of results from the quantitative phase. Such design is recommended when a study needs qualitative data to explain significant, non-significant or surprising results (Morse, 1991; Creswell and Plano Clark, 2007). It is also suitable for studies in which the researcher wants to use quantitative participant characteristics (in this study, I needed to have experience of the intervention) to guide the purposeful sampling for the qualitative phase (Creswell, Plano Clark, Gutmann and Hanson, 2003).

Because of the mixed-methods research design, I was able to observe and identify what worked and what could go wrong to explain to some extent possibly why. These are important concerns when testing the effectiveness of a carefully designed instructional intervention for the provision of CT skills in this particular setting. This is particularly important for research in thinking skills, in which much unexplained variance is due to lack of rich description of participants' experiences, implementation fidelity and classroom-level interactions of elements of learning process (teacher, students and learning environment) with the CT skills curriculum (Abrami et.al., 2008, 2015; Burden, 2015).

The study collected quantitative data as pre-test, observations (field notes and structured observations) for implementation fidelity data. Then quantitative questionnaire data were collected on students' perception of learning environment and motivational strategies, and again qualitative observations were made and at the end post-test quantitative data were collected. This is where the main quantitative data collection phase finished. An initial analysis of the pre-and post –test scores was undertaken and the interventions results were followed up by the second explanatory phase of the study, in which qualitative data were collected from selected participants.

A unique feature of this study was observing and reporting on the implementation while applying a CT skills intervention. For this purpose, an observation component was needed during the data collection. This was one of the challenges to keep the design's integrity together, and not to mix or change the research design theoretically, as that would have been a major threat to design validity.

5.3.1.3 Procedural issue of the quantitative component

The quantitative component finished after the post-test. Then the two groups of data were analysed and based on the results of the first phase, and the qualitative phase was planned and executed in detail. Although phase one (that is, the main quantitative data collection phase) was completed, data in the form of a) pre- and post-test, and b) questionnaire data on motivation and learning environment were collected. Before the second phase of the study, the core analysis of RQ1; that is, the test scores of students on CT skills performance, were analysed for both groups. The results showed that the intervention failed to increase students' CT skills in the experimental group. Yet, the quantitative data from learning environment and students' motivation questionnaires were not analysed before conducting the qualitative component of the study.

I can offer two reasons for not being able to eliminate this weakness. These are due to the lack of time and feasibility for resources for the design. It was ideal to finish the quantitative analysis, yet not possible due to the short time between selecting the interview participants and conducting the interviews. Also, for data on the implementation fidelity (an ongoing evaluation of implementation for intervention effectiveness) in this study, I was conducting classroom observations and taking notes about how the intervention was being implemented until the post-test was conducted. Therefore, although the motivation and learning environment questionnaire data were collected at the end of the third week, there was barely any time to analyse it straight away.

Before the project started, this was something that I could not foresee as a limitation of being a solo researcher conducting this intervention study. Therefore, I had to make an informed choice on the priorities and vital to the investigation; that is, students' CT test scores for the main research question, to move on to the second component. Based on those scores, the second phase of data collection was carried out in which data on the interventions experiences were collected. Nonetheless, this is a limitation of the study design that future researchers must take into account in planning interventions based in mixed-methods research design.

5.3.1.4 The evolution of mixed-methods research design and implementation

Sequential explanatory designs, though seemingly simple and straightforward, are said to be one of the most difficult designs in practice, especially in mixed-methods intervention studies (Morse and Niehaus, 2009; Song, Happ and Sandelowski, 2010, pp. 725-741). Morse and Niehaus (2009) state that fitting a qualitative part into quantitative research can be challenging when writing quantitatively driven sequential designs, because the quantitative core component is deductive and the qualitative supplementary component is inductive in approach. This difficulty is increased when the type of study is theoretically quantitative dominant or is an intervention in which implementation fidelity is an essential aspect for testing the effectiveness (Ivankova, Creswell and Stick 2006; Morse and Niehaus, 2009). These types of designs are sometimes referred as intervention mixed model framework and are mostly utilized in health service research (Fetters, Leslie, Curry and Creswell, 2013).

Moreover, the initial emphasis on the quantitative-dominant approach and a supplementary qualitative weighting changed to an equal weighting for explaining and supporting why the intervention did not work. Therefore, the explanatory sequential design is intact, yet has a more equal quantitative-qualitative partnership of methods of inquiry.

The study built the data collection sequential points to keep the integrity of the sequential data collection design. It also shows the balance between both strands as a mixed-methods research study. Figure 10 below was developed from Creswell, Plano Clark, Gutmann and Hanson (2003), and Creswell (2009b) explains the sequence of mixing methods in this research.

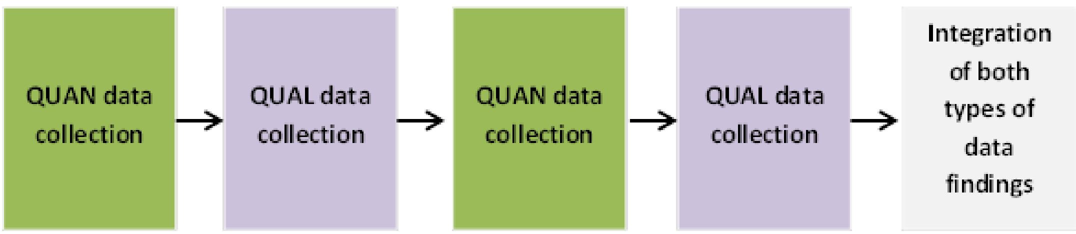


Figure 10: Sequential explanatory design, adapted from Creswell, Plano Clark, Gutmann, and

Hanson, 2003, also in Creswell, 2009b, p. 209

As can be seen from the above figure, quantitative and qualitative data were not collected simultaneously at any given point in this study. Rather, the data were collected sequentially, one type at a time, and with one type of inquiry following the other in a sequence of pre-test – field notes/observations – questionnaires – observation – post-test – interviews. In practice, it is straightforward to include observations when an intervention is being implemented, but it becomes challenging to adjust writing about it in a sequential explanatory design, where in theory each data collection phase finishes before the next starts. For this, Creswell (2009) explains that theoretically sequential data collection design needs to remain sequential as long as researcher manages to keep the balance in weight, yet adjustments might be made to difficult situations when it may seem that the design is embedded rather than sequential.

Once again, in this research study, the implementation fidelity data collection tools were posing a challenge to the design's integrity; however, it is more a theoretical constraint/explanation than a practical one. The reason why it is not embedded is as follows. The main phase (intervention) that was being observed remained quantitative therefore, the quantitative dominance was not compromised. Moreover, the observations were mainly researcher-led and the intervention was implemented by the class teacher, so at no point did the researcher switch roles or disturb the natural setting.

Furthermore, no two types of data were collected simultaneously, and the quantitative phase was either dominant or complete at each stage of the qualitative data collection. Theoretically, each quantitative data collection point was leading (or dominant) and the qualitative data collection point was supplementary throughout the data collection. Therefore, the study had a sequential explanatory mixed-methods design, even though sometimes it may seem that the data collection was embedded rather than sequential.

5.3.1.5 Point of interface

The point of interface, or integration for the two types of data collected and the inferences, was at the point of writing the results narrative (Morse and Niehaus, 2009). It was anticipated that the intervention effect (results of pre- and post-test scores) might not completely explain the gap and inadequacies due to the core methods limitations, and the supplementary component was conceptualized to make the project comprehensive in explaining the effectiveness of a CT skills intervention (Morse and Niehaus, 2009). In this study, the qualitative data were kept as qualitative and, after performing some content analysis; the insights were incorporated into the result narrative to understand the tested effectiveness of CT skills intervention.

5.3.1.6 Validity and reliability of the quantitative research

The validity and reliability of a study are related to taking into account the weaknesses and strengths of the methods chosen, as well as to taking every possible measure to diminish the weaknesses. Quasi-experimental pre-test/post-test control group studies are open to many validity and reliability issues, including internal validity issues due to the design, such as history, maturation, regression, selection, mortality and external validity issues related to generalizability of the study results due to treatment selection, setting selection, history and treatment interaction (Plano Clark and Creswell, 2008, Creswell, 2009, 2013; Mitchell and Jolley, 2012). Reliability issues are usually related to the credibility of the research procedure, the data collected and results interpreted with prescribed research ethics, and the researcher's responsibilities.

The research design and instruments used in this study have been derived from the research-based literature in this field, and the design of the intervention is deduced from the recommendations in the relevant literature. In addition, possible validity and reliability issues involved in the overall process, from planning to execution to interpretation and dissemination of results, were observed keenly. In conclusion, it is possible to say that nothing is perfect, and that the validity of the causal conclusions drawn must be assessed on a case-by-case basis (Remler and Van Ryzin, 2010; 2011). For the current research study, the validity and reliability issues of the design of the study have been addressed, but this does not absolve this research design of the limitations inherent in quasi- experimental research in the field of education.

Another way of achieving validity and reliability is through triangulation of data findings and interpretations both within the method and between methods (Jick, 1979; Creswell and Plano Clark, 2007). The students' experience of the intervention and learning outcomes are triangulated with their accounts in interviews with the researcher consisting of semi-structured questions, a self-reporting questionnaire on motivation and learning environment in the classroom, and the researcher's observations in this study. For the quantitative component, the methods include the pre- post-test difference and the observation sheets of implementation fidelity (within-methods triangulation). Combining the analysis and inferences from both types of data and conclusions, it was possible to look at how and whether they complement each other and are in line with or extend the existing literature (between methods triangulation) as well as the inherent weaknesses of a quasi-experiment (Mitchell and Jolley, 2012, pp. 588-589).

5.3.2 Component 2: Qualitative inquiry

The use of qualitative data extends mixed-methods research and develops a model to explain a process (Creswell et al., 2006). After a simple comparison of the both groups' pre-test and post-test scores (no effect of the intervention), a qualitative follow-up was conducted to obtain an explanation of the unexpected results of the intervention on student learning and to enhance the description and understanding of the phenomena. The Component 2 qualitative phase of this study is in sequence with the quantitative. The data were collected in a case study manner using the data collection methods of qualitative interviews and direct observations (field notes and structured observations) of intervention A1 group. According to Yin (2003), a case study design should be considered when the focus of the study is to answer a 'how and why' question (Baxter and Jack, 2008, p. 545).

For a single case study design at classroom level with an embedded unit of analysis such as observations, participant interviews were used to explanation building of the inadequate intervention effectiveness outcomes. Comparison with the quasi-experimental phase implementation fidelity and pattern matching were undertaken to build an explanation of how and why the intervention was ineffective in developing students' CT skills on this occasion (Yin, 2014). The qualitative data were used to build the case about a set of causal links for the non-effect of CT skills intervention in this sample. The interviewees were selected purposefully; two of the students were selected on the basis of their declining scores from pre-test to post-test, as extreme cases from the first phase to investigate directly the experience, in this instance the negative effect of intervention, while the rest of the four students were those who had volunteered to participate in the interview. The data were analysed with the objective of pattern matching to find out why and how the intervention had this inadequate effect on students' CT skills learning. The case study data were also used to see if any rival explanations arose in general about the careful design and the intervention itself (Yin, 2014)

The purpose of the single case study analysis of qualitative data was to find explanations of the quantitative results and provide rich descriptions of the classroom context in which the study was set (Yin, 2003, 2014). The qualitative data were collected from purposefully selected participants from the intervention group. The class teacher was also interviewed in his capacity as a key person in the intervention delivery and implementation process. Together, they were analysed as a case for this classroom in which the effectiveness of a carefully designed CT skills intervention had been tested.

The qualitative component helped to gather information to explain, compare and confirm, and justify the results of the quantitative inquiry. However, without previous quantitative results, the qualitative data would not have made much sense (Yin, 2014) and, without the qualitative part, the quantitative CT skills intervention results could neither be explained fully nor educationally useful. This includes gathering information about questions such as 'Was it implemented as intended?', 'What happened inside the classroom?', 'Did the participants find it useful, and were they responsive towards the instructional method proposed?', and, in general, 'Was it effective?' None of these questions could be answered with precision, therefore legitimated the need for a qualitative phase. The qualitative component was used to reflect on the effectiveness of the intervention comprehensively (Yin, 2014).

This study observed both the experimental and control group in order to observe the learning environment. The experimental group was observed for confirmation of contradiction of what was planned for the intervention and what was executed. Structured as well as unstructured observation were used to gather data on implementation fidelity. Semi-structured interviews were used because they provide the flexibility of both open-ended and structured questions, with the benefit of keeping the conversation purposeful while allowing the interviewee to express themselves freely about the experience of the phenomena. Case studies in teaching and learning allow the application and observation of theoretical concepts, thus bridging the gap between theory and practice.

All cases were selected and analysed purposefully on an information-oriented basis to explain the outcomes of the first phase. They included two extereme cases to strenthen the explaiantion and the outomes of the first part. Moreover, they might potentially provide additional information on the unsuccessful results of the quasi-experimental phase. In this way, two extreme deviant cases - from high pre-test scores to low post-test scores - were selected and interviewed to find out additional information about the unexpected results of the study. The questions asked were same as for the other students and the analysis was undertaken with a focus on gaining the perspective of students mostly in terms of the challenges and their feedback on the intervention anlaysis.

Case study reporting formats can be grouped into four categories: 1) a single case study, that is, a single text to describe and analyse the case; 2) a multiple case study, that is, multiple case version of the single case study; 3) an option for either a single or multiple case study with a question-answer reporting format; or 4) option for multiple case study only, that is, cross-case analysis in one entire report case report (Yin, 2014). The report style of data analysis in this qualitative component can be said to be the third type of reporting format in which a single case study with a question and answer format narrative is adopted. This type of reporting style is also considered to be a non-traditional narrative format (Yin, 2014).

This single case study provide data that are experience driven and help in finding out information about how an intervention is used in real life (Yin, 2014). It also provides the opportunity to encourage expert use of various research methods on this field. The qualitative phase served two purposes in this study. It explained the quantitative component by reflecting on what happened and how it was taught and experienced, and enriched the description of effectiveness of the CT skills intervention by pointing out interpretive causal links and inadequacies. This truly depicts the usefulness of sequential design, in which each is incomplete without the other.

5.3.2.1 Observations, field notes and semi-structured interviews at classroom level for intervention effectiveness

Observations are a way of generating data to achieve an understanding between the researcher and the researched (Crang and Cook, 2007; Mulhall, 2003). Observations are designed for targeted note-taking for specific objects, people, events or places that occur naturally, and hence observations capture a social setting (Blomberg, Giacomi, Mosher, and Swenton-Wall, 1993; Mulhall, 2003). The structured observations to observe implementation fidelity and field notes provided the flexibility needed to overcome the limitations of the pre-test–post-test design by filling the gap created by the issue of how the way in which an intervention is implemented may also influence the effectiveness of the results. On the other hand, implementation fidelity observation sheets mostly address teacher actions in the execution of the instructional programme in the classroom.

The researcher's journal/field notes are a log of researcher's role as an observer. It is important for the evaluation of the implementation process that the observation points are predetermined and explicit, because a great deal goes on in a classroom and it may not be immediately relevant to the researcher's objective for being in the class. The dimensions of observation notes are mainly about observing if the lessons are delivered as planned, whether the teacher prepares or familiarizes himself/herself with contents before coming to the class, whether the resources required for effective delivery of lessons are set up and present, what level of engagement the students have during the lesson and, last but not the least, the researcher's personal feelings. The last is undertaken with the intention of being mindful about researcher's personal bias on the perfect delivery of the intervention or any other feelings related to environment power relationships among researcher, teacher and students in a dynamic classroom environment.

The data from observation sheets were analysed using simple descriptive analysis. The rating options were used to count the occurrence of a particular behaviour or component in the classroom. The number of occurrences of each component determined the level of adherence, exposure, quality of delivery, programme specification and student responsiveness. The NCRTI fidelity tool provides flexibility in rating a learning environment. For example, other than yes, no and sometimes, one can use examples, additional notes or reasons for a particular behaviour, reasons seen or not seen.

This study used semi-structured interviews in response to the demands of the quantitative data already collected (Schmidt, 2004). Interviews are conversations with a purpose, and provide direct access to the experiences of the people interviewed (Silverman, 1998). Interviews can be structured (planned to follow prescribed procedures, mostly close-ended questions), semi-structured (few questions/topic to be discussed, both open-ended and close-ended types of questions) and unstructured (open-ended with no planned topic) (Brannen, 2005). Semi-structured interviews offer participants the chance to explore issues that they feel are important (Longhurst, 2003). These interviews have a predetermined order, but also keep a degree of flexibility so that the informant (interviewee) can openly respond in their own words (Gill, Stewart, Treasure and Chadwick, 2008). Semi-structured interviews are selected for this study as they suit the objective of the exploration of participants' perceptions and opinions on the instructional intervention.

5.3.2.2 Trustworthiness in qualitative research

The trustworthiness of a qualitative research ensures believability and genuineness in the path taken for research purposes. Trustworthiness includes credibility, transferability, dependability, and confirmability of the study methods and interpretations. Several studies (Silverman, 2001; Lincoln, 1995; Lincoln and Guba, 1985, 1986; Miles and Huberman, 1994) have demonstrated how qualitative researchers can incorporate measures to deal with these issues (Shenton, 2004). This study will use Guba's four constructs of credibility, transferability, dependability and confirmability, known for explaining and ensuring transparency of the qualitative path.

Credibility

This refers to the consistency of the findings with reality (Merriam, 1995), and a researcher should make provision to promote confidence that they have accurately recorded the phenomena under scrutiny (Shenton, 2004). For this study, participants will receive the instructional intervention and the researcher will make observations only of the procedure, allowing the participants to interact with learning materials as naturally as possible. Only after the experience of learning CT is complete will the participants be asked to express their opinion about the experience in semi-structured interviews.

It should be noted, however, that the mixed-methods approach does not eliminate inherent biases, implicit or explicit, surrounding discussion of the measurement of teaching/learning (Desimone, 2009). For this study, the researcher made a preliminary visit to the organization and was consistently in contact with the institution head, programme director and faculty members, a process which helped to build trust between parties. Moreover, to build trust with the potential interventionist (class teacher), a presentation of the project was delivered to all members of the faculty of education.

This eliminated the pressure of gaining consent from teachers who did not want to participate in the study. Frequent debriefing sessions (Shenton, 2004) were used to discuss perceptions and seek collaboration from the class teacher. Virtual online meetings via Skype as well as telephone conversations were conducted before the start of the intervention to become familiar with the interventionist (class teacher) and the teaching-learning culture of the site of study. The interventionist was asked to introduce and familiarize the researcher with the two groups or participants at the time of actual data collection.

Triangulation of qualitative may help in increasing the credibility of qualitative data. For example, the use of observations and journal notes together with individual interviews can help to eliminate some common methodological shortcomings, and the distinct characteristics of each method help in balancing the weakness of the others.

This study has opted for a mixed-methods approach that itself, as a study design, helps to overcome inherent limitations of one method or another. The use of different methods within one type inquiry and the use of wide range of informants also impacts on the credibility of the study (Shenton, 2004); in this case, the accounts and observations of the class teacher, the students and the researcher will also help to enhance the credibility.

The study's qualitative data from interviews, observations and logbooks helped to achieve consistency in answering the research questions of the study. When asking individuals for information, an opportunity to refuse the interview was given to some students, though not all (in case the accounts of extreme cases were needed). Participants from the experimental group who were genuinely willing to take part and share data on their experience were approached for interviews. They were encouraged to be frank by the researcher's establishing rapport at the start of the interviews and indicating that there are no right or wrong answers to questions. The use of probes to elicit detailed data and iterative questioning may also be used to uncover concealed information from participants on how they viewed and experienced the instructional intervention (Shenton, 2004).

At different stages of the study, peer scrutiny of the research project was welcomed. Peer scrutiny of the instructional intervention design was part of the pilot of the study (see Appendix C). Moreover, presentations at conferences and reviews, questions and observations from such occasions also helped the investigator to revisit and reassess the methods and research design, and strengthen her argument.

In addition to outside scrutiny, the researcher's own reflective commentary on her work experience and on the evaluation of the project can serve as inside scrutiny to establish the effectiveness of techniques applied, record of initial impressions of data collection sessions, and patterns and themes emerging from data collected (Lincoln and Guba, 1986; Lincoln, 1995). Here, the background qualifications and experience of the investigator were especially important (Maykut and Morehouse, 1994). In this study, the researcher is familiar with the programme, institution and cultural context. The researcher also has experience of teaching, evaluating and conducting research in educational settings. The experience of teaching, evaluating teaching practices and conducting programme evaluations both independently as well as in team projects has the advantage of having analysis and verification skills from the field. This can be helpful, in particular when trying to making sense of the data, as one simply cannot gather information without regarding what each item of information represents in terms of possible contextual meaning (van Mannen and Barley, 1983).

A thick description of the phenomena under study will help in promoting the credibility of the study. It also assists the presentation of the actual situations that have been investigated and, to some extent, the context that surrounds them (Shenton, 2004). The researcher's field notes of the daily lesson plans are a way to include thick description from the site of the study and help in determining to what extent the findings of the study 'ring true' (Shenton, 2004, p. 69). Examining previous research studies' findings and comparing the consistency of the results with past studies is another criterion for evaluating a qualitative inquiry (Shenton, 2004; Silverman, 2001).

Transferability

Transferability of qualitative research refers to the external validity of the research study and is concerned with the question to what extent results can be applied or transferred to other situations (Merriam, 2009). The findings of a qualitative study are drawn from a specific qualitative project, a small number of participants and from a particular environment, and thus it is impossible to demonstrate that findings and conclusions are applicable to other situations and populations, meaning that stating generalization is never possible (Shenton, 2004).

This study's aim is not open generalization; however similar populations and teaching/learning situations might benefit from the results. Efforts will be made by the investigator, for example in field notes, information about the site and subject of the study, to provide sufficient contextual information and detailed descriptions of the phenomenon and fieldwork sites to enable the reader to allow comparisons or make such a transfer, if possible (Lincoln and Guba, 1985, 1986; Firestone, 1993).

Dependability

Dependability refers to the in-depth methodological description of the study, which allows replication or repetition of the study, and the opportunity for the reader to assess to what extent proper research practices have been followed. In this, a thorough understanding of the methods and their effectiveness is established. Dependability of a study includes details about research design and its implementation, commentary on what was planned and what was executed at a strategic level, operational detail of data gathered and reflective appraisal of the project (Shenton, 2004, pp. 71-72). The research design and narrative of this research study are prepared with the intention to accomplish dependability.

Confirmability

'Objectivity' and 'researcher's bias' are terms related to the use of tools and instruments that do not depend on human skills or perceptions. However, the difficulty of ensuring real objectivity is apparent in all kinds of research. Even in tests and questionnaires it cannot be taken for granted, since they are designed by humans, thus a researcher's bias is inevitable (Patton, 1990).

With the tools used for qualitative data collection in this study, inter-coder confirmability of text meaning (two different readers as raters reaching at similar conclusions) was used to ascertain whether the themes and sub-themes derived from the data occur naturally, and whether both raters come up with similar conclusions. To achieve confirmability and reduce researcher's bias triangulation is again a focus of this research study. The researcher's admission of predispositions about the topic, context and research objectives, the audit trail of the study, and the application of a data-oriented approach to the formulation of conclusions and recommendations are only a few of the strategies used to achieve confirmability (Shenton, 2004).

5.4 Sampling for sequential explanatory design

Sampling in a mixed-methods research study serves the purpose of answering research questions and the issues of generalizability depend on the focus of each strand. Sample size of quantitative component is important to statistical research studies (Cohen, 1988, 1992; Lipsey and Hurley, 2009), as much as representative participants are crucial to bring out the richness for the qualitative inquiry. In order to obtain a representative sample for both components of the study, the main research question required two representative groups from an ITE programme to measure the effect of the CT skills intervention. Therefore, purposeful sampling in the first strand was intended to achieve representativeness and comparability (Creswell and Plano Clark, 2007; Teddlie and Yu, 2007, p. 81). For the qualitative phase as the follow-up phase, the participant requirements were not only to be part of the intervention group but could also be selected as a combination of participants (e.g. extreme cases) that could help to explain the outcomes of the phenomena under study (Creswell and Plano Clark, 2007).

5.4.1 Background of the site of the study

Punjab has total 27 universities for teacher education, chartered by the government of Pakistan (HEC Pak website, 2016; HED Punjab, 2016). These universities are spread across the nine main cities of the Punjab. To be more precise, Lahore was selected as the main site of the study due to its easy reach and the characteristics of the population that the study was interested in.

Lahore is one of the most populated and popular cities of the Punjab. It has more diversity of population and culture, and has an urban status, therefore it is a popular destination for education for students from all over the country. As the third most populous city in Pakistan, it has six public universities and 17 private universities (HEC Pak website, 2016; HED Punjab, 2016). There are a number of colleges and training institutions that offer teacher education programmes (see context chapter in Chapter 3). For teacher education purposes, one public university in Lahore is University of Education. According to HEC (2014-15), University of Education, Lahore (UE), has 16,160 students. This indicates a large number of students in teacher education and training. This number is only for Lahore; it has three campuses across Lahore and six more in other cities of Punjab. The UE, as a charter university, is a single regulatory public university that offers a range of courses and degrees for teacher education. It has ten campuses and a number of affiliated colleges all over the Punjab, estimated at 270. Therefore, to target teacher education programme and for population criteria, UE Lahore suits the purpose of the study.

5.4.2 Target population

Sampling includes two important steps: defining the criteria for population for the study, to which the researcher ideally wants to generalize, and the selection of sample appropriate for the research design and methods. Most importantly, the sample must be representative of the population to which the researcher would like to generalize.

Criteria for the population of the study

The population of interest is the ITE students studying at a public teacher training/education universities in Pakistan. In theory, in terms of population, the study was particularly interested in students enrolled in an ITE Master's programme at public teacher education universities in Punjab, Pakistan.

In effect, to start with, one campus of UE, Lahore, Punjab, was selected as the available population for this study. This campus is attended by students from all over the country, since the university offers accommodation to students from further away. Therefore, the student population can be said as geographically heterogeneous, but largely sharing socio-economic conditions and similar quality of education in public universities (the data collected on demographics of students for this study reflect this). At this university, like most public universities in Pakistan, students belong to lower-middle class and middle-class backgrounds, with some students from poorer backgrounds. At public universities, especially in this teacher education university, poorer students are usually given priority in admission, with a scholarship for high achievers.

The population is assumed to be have similar characteristics in terms of previous qualifications, age, gender and socio-economic background (Gay, 1996). The choice of sample depends on what the research objectives are, and to what population the researcher wants to generalize. More importantly, the sample's reach and availability influence study's the choice strongly (Creswell and Plano Clark, 2007). It would have been desirable to extend the study to similar populations in teacher education programmes, specifically in other campuses of this university, but due to the limitations of the research design this study does not intend to generalize. Therefore, the targeted population may be defined as all students enrolled in MA education programme at the UE Lahore campus in 2015.

5.4.3 Selection of sample

Sampling groups

For the quantitative component of the study, a quasi-experimental study approach was adopted for the first component (Cook and Campbell, 1986; Gliner, Morgan, Harmon and Harmon, 2000). Therefore, the sample needed to have particular characteristics; for example, students must be enrolled in MA education, first semester, and attending the educational psychology module. To select groups based on these criteria, purposeful sampling was intentionally chosen (Creswell and Plano Clark, 2007, p.112; Johnson and Christensen, 2012, p. 231).

The selected sample size of the quantitative component is 40 to 50 students in each group (experimental and control). The minimum number of participants in experimental designs with purposive or homogeneous sampling ranges from 40 to 50 (Teddlie and Yu, 2007; Johnson and Christensen, 2012; Onwuegbuzie and Collins, 2007). The study's sample size thus seems statistically appropriate for the quasi-experimental phase (see Teddlie and Yu, 2007, pp. 80-83; Onwuegbuzie and Collins, 2007, pp. 287-289). A low experimental mortality rate was mandatory, with 80% attendance needed to qualify for the final exam.

The actual sampling groups resulted in 29 students in the non-intervention (control) group and 27 students in the intervention group (experimental). In this study, randomization with existing groups was desirable but not feasible due to several reasons. The two-group quasi-experimental design and criterion-based sample limited the selection of groups, and the researcher did not have the power to assign groups as control (non-intervention) and experimental (intervention) group, since it was the class teacher of these groups who decided which group should be 'a control group' and which 'an experimental'.

Selecting participants

For the qualitative component, participants were selected sequentially, after the intervention was complete and the initial results drawn. In general, in using a purposive sampling approach, a sample of five to ten students is considered to be helpful for qualitatively tracing back the findings and the effect of intervention on students and the purpose of the qualitative follow up; that is, explaining, understanding and providing deep understanding of the phenomena (Creswell and Plano Clark, 2007; Teddlie and Yu, 2007, pp. 80-83; Onwuegbuzie and Collins, 2007, pp. 287-289; Yin 2003, 2014).

Purposeful sampling was used to gather the opinion of the students after the intervention about the intervention experience. Students of the experimental group were offered the opportunity to share their opinion, but in extreme cases (should any happen) in the experimental group, two participants from the experimental group would be selected purposefully to seek a fuller picture. The class teacher would also be interviewed to obtain a comprehensive picture of the effectiveness of the CT skills instructional intervention. The qualitative sample in sequential mixed-methods study was fully developed after knowing the results of the quantitative phase (Creswell and Plano Clark, 2007).

As a result of ineffective intervention results, the class teacher, two extreme cases with reversal effect and four other students from the experimental/intervention group volunteered for the interviews. In total, seven participants were part of the qualitative inquiry: six students and the teacher.

5.4.4 Why it is not embedded or convergent sequential design?

The theoretical drive (deductive-inductive approach to test a theory and explain the effectiveness of an intervention comprehensively) and the research questions led the choice of research approach and research design best to provide answers to the research questions. Hence, the reasons to use two different methods or multiple methods are not popular: the nature of research question and the inquiry naturally unfold in a theoretical drive where both the components are conceived as important to provide a comprehensive picture.

Although it is an intervention with data on the implementation and participants' experience, the study's design not an embedded design, because not every question is different, in the theoretical sense that they feed back into determining the effectiveness of the CT skills intervention. Moreover, the data collected for each subsidiary research question are to be integrated at the end of the results narrative to explain comprehensively why the intervention worked or did not work. The core component needs the supplementary (does the intervention work?), and the supplementary component (understanding and explaining the intervention outcomes) is incomplete without the core. Therefore, the study's research design is essentially sequential explanatory mixed-methods research design, not a multi-method or an embedded mixed-methods design. The following opposite Figure 11 presents the visual model of this study's research design.

5.4.5 Advantages and disadvantages of the sequential explanatory design

No design is devoid of limitations, and researchers have to balance these on the basis of the purpose of the study and the problem under study. The following advantages and disadvantages were identified by Creswell (2003) for the sequential explanatory design.

Advantages

- It offers powerful tools for investigating complex processes and systems such as classroom-level learning and instruction environments
- The two-phase structure is relatively straightforward to implement
- The final report can be written in two phases, making it clear for readers
- Appeals to researchers as it has a strong quantitative orientation.

Disadvantages

- Time, work and effort intensive
- Challenging for a solo researcher to balance various parts of the project
- The decision on which quantitative results need to be further explained can only be weighed precisely after the quantitative phase is complete.

Figure 11: Visual model of the study research design: sequential explanatory design

5.5 Data collection and analysis methods

In this section like previous sections of the study data collection methods and their analysis are discussed under separate headings until the point of integration (narrative of results).

5.5.1 Data collection methods

In this section like previous sections of the study data collection methods and their analysis are discussed under separate headings until the point of integration (narrative of results).

Ennis 1993a explains this variability in CT skills measurement and the nature and need of determining each study's own CT assessment which brings flexibility and credibility to attempting CT skills development through instruction. The data collection instruments are briefly summarized. The composition of instrument are defined, their validity and reliability and administration are defined in detail. All test are discussed under three headings description of the instrument, validity and reliability of the instrument and test administration and analysis, describing how that related to that test is administered and then scored in this study.

Component one: quantitative instruments

Three instruments were used to collect quantitative data. The critical thinking skills test, disposition of CT measuring test and learning environment measuring test. For the measurement of students CT skills, the Collegiate Assessment of Academic Proficiency sample test was used. For measurement of students' self-reported motivation/self-regulation the standard questionnaire of Motivational Strategies for learning Questionnaire was applied. And lastly, for the measurement of classroom learning environment Communities of Inquiry questionnaire was used to collect data on quantitative variables. These instruments are explained with their respective description of the tool, reliability and validity and protocol and administration in the section below.

1: CAAP Critical Thinking Test

The CAAP CT Test has been developed to measure CT skills in the area of argument text analysis. It measures students' CT skills in the areas of clarifying, analysing, evaluating and extending argument. The test has four paragraphs presenting different scenarios and asks multiple choice questions at the end of each paragraph. It has a total of 32 items and requires forty (40) minutes to attempt fully. The test presents text in a series of sub-argument paragraphs that form a more general conclusion towards the end. Each paragraph consists of one or more arguments using various formats such as case studies, debates, dialogues, statistical and experimental arguments and results, and overlapping situations. It covers representative issues commonly encountered in post-secondary school curriculum, for example whether to make regular charity donations to charitable organization, a teacher opposing student evaluations of teaching performance at college level, a discussion on moral obligations of a criminal defence attorney, and a proposed bill in senate about forbidding advertisements directed at children under thirteen. The test provides a key of correct answers at the end and the scores are given for the CT Test; no sub-scores are provided.

Validity and reliability of CAAP CT

The CAAP-CT test was selected to measure the argument analysis, evaluation and extension of argument as CT skills in this study. The test was developed by American Collegiate Testing (ACT) for assessing college and university students' CT skills. The reported internal consistency reliabilities of the CAAP- CT lie between .81 and .82 points (Pascarella, Wang, Trolian and, Blaich, 2013). Kuder-Richardson Formula 20 (K-R 20) estimates are also quite reliable as they measure the correlation of all items on a test with one another, and the reported K-R 20 for CAAP-CT prove that the test holds strong reliability and internal validity - for a sample size of 26,000-43,000 the K-R 20 is .85 or more over test length, test completion rate, item difficulty (mean difficulty (.59-.60), SD=.13-.11) and item discrimination distributions (Mean=.54, SD=.10 to.12) (ACT-CAAP Technical Handbook, 2008).

Due to the limitations of time and financial resources the researcher weighed the pros and cons and decided to use the available test on two strong theoretical and content validity based reasons. Where this can be a potential limitation, it was essential to have a CT measurement not perfect but appropriate for two reasons, first most importantly to carry on research, and secondly, the test has an established validity. This potentially limited the reliability discussion of the instrument. However, the test manual states a strong content validity (KR20=.85) and supports that the test can be used in parallel forms (split half). The test scores can be used to measure change over time in students' academic skills, and these changes can be measured after a general or specific teaching programme (ACT-CAAP Technical Handbook, 2008), and such is the purpose of this study.

Besides CAAP CT has not been used widely therefore, lack comparable data in contexts beyond US, this could be the first opportunity that the CAAP CT was being used beyond USA college environment. The test was however, presented to a small audience to seek content validity for the purpose of the study. The piloting of CT skills test results helped in building the content validity with test language, time required for completion of test, and test scoring. The test was piloted for content validity and the participants found it relevant to the undergraduate and graduate students' intellectual level.

The test content validity was further extended, when many participants opined that test is cognitively challenging, interesting and they required thinking before answering. This supported the rational of the study about the effect of instruction on CT skills development.

This means thinking and practice both are important to learn the CT skills of argument analysis, extension and evaluation hence is the purpose of this study.

Another step was taken to consciously seek the suitability and predictive validity in a non-statistical way was that the content of the test was read and compared for appropriateness to the curriculum materials and CT skills being researched with, both (the class teacher and the researcher) agreed on its use due to the relevance.

Test administration and analysis of CAAP-CT

The CAAP-CT test (split half) is used as a pre-test post-test tool. Both parts measure the same construct but are different in terms of content, and these were administered at both times. The students were given 20-25 minutes to attempt the test. The copy of the test administered is attached at the end as Appendix A. The students were scored out of total correct answers on pre-test and post-test.

2: Motivated strategies for learning questionnaire (MSLQ)

The motivated strategies for learning strategies questionnaire is a multiple-choice Likert scale test that measures aspects related to motivation and learning strategies of student learning. The test is a self-reporting questionnaire that has a response range from ‘not at all true of me’ to ‘very true of me’. The test has total of 71 items and two main parts :1) motivation, it has 31 items, and 2) learning strategies, it has 30 items. Each part further can be categorized into factors of motivation and learning strategies. The list of factors of each part of the questionnaire MSLQ is given below.

Motivation items factors	**Learning strategies items factors**
Intrinsic goal orientation	Rehearsal
Extrinsic goal orientation	Elaboration
Task value	Organization
Control Beliefs about Learning	CT
Self-efficacy for learning and performance	Effort management
Test anxiety	Peer learning
	Metacognition
	Time and study environment
	Help seeking

Figure 12: List of factors in MSLQ

Validity and reliability of MSLQ

The test has shown consistent internal validity over time. The majority of the Cronbach’s ‘alphas’ for the individual scales (9/15) were fairly robust (i.e., they were greater than .70, with the largest one, self-efficacy for learning and performance, being .93). The Cronbach’s 'alphas' for the remainder of the scales fell below .70 (with the lowest one, 'help seeking' coming in at .52). Overall, these results suggest that the MSLQ has relatively good internal reliability (Pintrich, Smith, Gracia and McKeachie, 1991, 1993; Credé and Phillips, 2011; Taylor, 2012). It has been tested with various samples of college students and has proved to be a valid and reliable instrument for measuring motivation and learning strategies for students in any general or discipline specific context (Moos and Honkomp, 2011; Rotgans and Schmidt, 2010). The test contains several sections that can be used either separately or together.

The test was not modified due to its wide applicability in different contexts e.g. Rotgans and Schmidt 2008; 2010 tested it with Singaporean, Chinese, Malaysian and Indian students and confirmed the factor structure of the MSLQ scales valid and reliable. On the other hand, it had recently been tested in Pakistan by Nausheen 2016, but the exploratory factor analysis was performed only on value, expectancy and affect components. The exploratory factor analysis showed that the test was found reliable in this social context however, found differences in students' conception of the control of learning beliefs, self-efficacy for learning components. These were found related with test anxiety. The writer suggested modification in the wording of these sections. Due to the very recent publication, June 2016, no changes could be made in the instruments in this study. However, the findings of this study were accounted when discussing the results of this intervention.

Test administration and analysis of MSLQ

The Motivated Strategies for Learning Questionnaire was administered only once to measure students' perceptions of their abilities in self- regulated learning and motivation closer to end of the study. The copy of the test administered is attached as Appendix C. The scoring of the test is done through taking average (mean) scores on all items related to one construct. Other analysis strategies such as descriptive analyses, using an interquartile range of respondents, mean scores on the test as a whole and on subscales were calculated for detailed analysis.

3: Community of inquiry survey (COI)

The community of inquiry survey was used in this study to determine the learning environment influences. The survey has three subcategories which are measured, namely teacher presence, social presence and cognitive presence. The teaching presence section (13 items) asks about the instructor's role and related questions such as whether the teacher communicates clearly, provides instructions on the task or encourages exploring new concepts in the course. The items in the social presence section (9 items) ask students questions related to classroom discussions, participants' interactions, use of argument mapping software and collaboration tasks, while the cognitive presence section (12 items) asks to what extent the course tasks and activities posed increased interest, motivation for exploration, problem solving, or brain storming opportunities to the student. The total number of test items comprises 34 items using a five point Likert scale range from 'strongly disagree' to 'strongly agree'.

Validity and reliability of COI

The survey has an established reliability and validity and is being used for measuring the abovementioned teaching, social and cognitive factors in classrooms. According to Pollard, Minor and Swanson (2014) the instrument bears Cronbach's alpha of .965. Similarly, Traver, Volchok, Bidjerano and Shea, (2014) report excellent internal consistency of the CoI survey with scores ranging from 0.92 to 0.97. These results are also consistent with the research of Shea and Bidjerano (2010). The test is scored taking an average score (mean) on all items. The test can be used in part and fully. However, all the aforementioned studies have tested CoI in online learning environments, whereas this research study will be using CoI to measure the learning environment (consisting of teacher presence, cognitive presence and social presence) in a mainstream classroom. It is important to confirm whether the survey is appropriate for the intended purpose. To use this survey in a mainstream classroom and a different context, the researcher has modified a few test items (e.g. Items 9 and 4 in Social Presence).

Most recently, Pollard, Minor and Swanson (2014) reported Cronbach's alpha of.909 for social presence, for Teaching Presence a Cronbach's alpha of.965 and for 'Learning Environment' this scale yielded a Cronbach's alpha of.884. In this study the Cronbach's alpha for teaching presence ranges between.912-.898, for social presence ranges between .907-.901 and for cognitive presence ranges between .910-.899.

Test administration and analysis COI

The Community of inquiry survey was administered once only to measure factors of classroom learning environment, teaching presence, social presence and cognitive presence of the students. The test was administered during the third week of the study. The test completion time was 15-20 minutes. The copy of the test administered is attached at the end as Appendix B. The test was analysed using statistical software SPSS, the descriptive analyses was done using interquartile range of respondents and mean scores on the test as a whole, mean scores on three subscales were calculated as well for detailed analysis.

Component two: qualitative instruments

Three types of qualitative data collection methods were used in this study. The phase two qualitative instruments are structured observations, un-structured field notes and semi-structured interviews. These are explained with description of the tool, trustworthiness of the tool and protocol and administration of the tool in the section below.

Structured Observations

The purpose of the observations was to assess the quality of intervention implementation so that the effectiveness of the intervention can be determined at the classroom and teacher level. The observation sheets were adapted from National Center on Response to Intervention NCRTI fidelity implementation tools, and include statements, ratings and possible teacher actions that might be observed to support rating. The observation rating sheet further has space for teacher and student behaviour to rate the implementation fidelity of the intervention.

The research observation sheets helped to observe the fidelity of implementation with regards to the following a 5 observation points. The observations were kept very specific. The rating scale observation has 5 categories yes, sometimes, no, unable to determine and supporting examples. The six classroom observations were conducted to measure the quality of intervention implementation. The NCRTI (2010) Fidelity Implementation Tools classroom observation sheet was used for this purpose. The observation sheet is a rating sheet where each of the components is rated on behavioural actions of the class teacher. The last component is about how responsive and engaged students are during the lesson.

Adherence: is related to the teacher's ability to make learning objectives clear and evident to students, effective use of programme materials during instruction/intervention and achieving the objectives of the lesson.

Exposure: counts as the time spent for the delivery of instruction/intervention lessons and any extra time given by the teacher to optimize the delivery.

The quality of delivery: aspect rates how adequately teacher appeared prepared to deliver instruction, teacher interactions with student reflect encouragement and enthusiasm, teacher provides clear, explicit instruction, teacher provides positive, constructive feedback, pacing and transitions for the delivery of instruction are effective.

Programme specification: this section observes to what extent teacher supports the instructional components as designed, teacher demonstrates knowledge of content and intervention strategy.

Student responsiveness: The student responsiveness section of observation sheets deals with the student engagement as it appears during the implementation of the intervention/instruction on certain times.

Un structured observation: Field Notes

Field notes are also a form of observational record while observing the participants engaged in direct interaction with the phenomenon under study - they can include reflective notes or descriptive notes for analysis or interpretation of situations, for example writing down each day the reflection about a study, questions to ask, the observer's own reactions, and so on. (Sanjek, 1990). Structured observations have a focus and predetermined objectives.

Field notes, field diaries or journals are the description of an event as it occurs. The person engaged in fieldwork keeps records of the field work. In this study, the investigator kept a field notes as a field diary to record the description of lesson plans and activities during the time of the intervention implementation. The field notes is a simple narrative of day-to-day observation of the programme employed as seen by the investigator. The field notes were kept in the form of a narrative for each separate day, starting when the teacher entered the classroom until the teacher announced that the class was over.

Here the field notes provide the flexibility of taking down a complete picture of what the classroom looked like, how the students behaved and how the lesson plan steps and objectives of each lesson were or were not achieved, and with this method the researcher can moreover make use of reflective commentary on the learning environment. This way a wide variety of information, combined with observations and interviews, will allow the researcher to understand the meanings that a specific activity hold for participants of this study (Marshall and Rossman, 2014).

Moreover, field notes were kept to record the overall classroom environment for cross matching the fidelity of implementation and the natural setting. The field notes also helped in noticing factors that might be affecting the integrity of this individual intervention. Integrity/fidelity may be affected by a number of reason for example, lack of clarity in describing the intervention, implementation difficulty in terms of number of people, time, effort or materials needed, lack of incentives or staff and lack of staff skills to implement the procedures successfully.

Semi-Structured Interviews

Semi-structured interviews containing open-ended and close-ended questions were used. The main questions asked were on the participants' experience, for example 'How did you find the instructional design of the intervention?' 'What design feature did you find most helpful in learning CT?' and 'What could have been improved in the instructional design?' The interviews tentatively have five to six questions to be asked, but the definite questions are to be formed once the intervention quantitative results are formed. For duration of the interviews, an estimate of fifteen to twenty minutes was considered sufficient for this type of inquiry.

Once the interview participants had agreed to participate and are selected, a tentative interview schedule was provided to them; and sometime later an interview schedule was maintained with the participants upon availability and mutual understanding. The interview duration was open but can roughly be counted toward fifteen to twenty minutes (15-20 min). It also depended on when and how thoroughly the interviewee has provided their opinion. When the quantitative component was over, the researcher started the interview by thanking the participants for their consent to be interviewed. The researcher welcomed the participant and ensured they were comfortable in the environment. The researcher briefed the participant about the interview procedure and with the agreement of the interviewee started asking structured questions. During the interview probes and iterative questioning techniques were used to bring back the focus of the conversation to the matter at hand when needed. At the end of the interview and whenever the need arose, the respondents were given the opportunity to express themselves freely. The researcher ensured honesty and neutrality of views by using prompts and encouraging honest answers from the interviewee. The interview ended by thanking the participants and asking whether there were any unanswered concerns or comments they wanted to make about their experience of the CT teaching/learning intervention.

5.5.2 Data analysis methods

This section provides information on how the data was analysed in this study on the said variables in the first phase and the second phase of the study. The first part describes how the quantitative analysis would be executed and the second part describes the how the qualitative data would be analysed.

Quantitative data analysis methods

Natural settings are complex and research in teaching/learning presents many known and unknown factors that can intervene with the learning process. Many extraneous variables can be considered to affect the teaching/learning process of CT for the students, and consequently to influence the results of the study, so that alternative explanations may arise from the results. For example, the researcher in this study cannot control the students' ability, previous qualifications, IQs or grades, ages, sex, socio-economic status, cultural backgrounds or motivation, or the teachers' role in the classroom and the overall interaction of subjects under study and learning environment.

For increasing the internal validity of the results of the study, some measures were taken to prevent this. For example, the students' prior ability was tested (pre-test scores), data on demographics was gathered, and awareness of the social setting in which the study was taking place was gained. The measurement of student motivation and learning environment for CT was included as confounding variables, the influence of which may provide us with alternative explanations when analysing the effect of the instructional intervention.

For the quantitative variables in the study, the analysis was conducted to infer findings about persons (students), settings (teacher education programme/module), treatment (instructional intervention) and outcome level (student learning in terms of test-scores) to establish inferences from the current research study (Shadish, Cook and Campbell, 2002). Various types of statistical and descriptive analysis can help in determining the success or failure of a quasi-experimental study. The strength of the relationship between variables is important to note irrespective of the effect size or magnitude of the selected study methods, which can be important to explain certain constructs and their usefulness. It is important to explain a little about the selected variables of the study first. The study aimed to collect quantitative data to measure the effect and relationship between independent, dependant and confounding variables of the study as explained below.

Dependent variable (DV)

CT skills are taken as a dependent variable in this study - it is hoped that some variance in this ability among two groups while manipulated through an instructional programme designed on research recommendations to instil CT in adults can be observed.

Independent variable (IV)

The teaching program (instructional intervention) comprises a set of teaching strategies and a systematic classroom learning environment. Basically, this includes a mixed approach, teaching strategies such as community of inquiry, and visual representation of thinking in the form of argument maps. It is assumed that this would manipulate the dependent variable and some change in the dependent variable would be observed by the end of this study.

Extraneous/Confounding variables

The measurable and non-measurable variables present in an environment can influence the way participants respond, and may or may not be controlled for or by the investigator. There are some individual characteristics that may affect the way individuals respond, for example age, sex, Parent education and profession-socio-economic status- cultural background, qualification, IQ or previous grades, extra or off-campus hours of study, moods, tiredness and motivation, English language ability. For these variables, the researcher cannot take control but actions can be taken, ranging from merely being aware of these variables and obtaining information about them to methodologically controlling some of these. The ones that the researcher cannot take control of are referred to as confounding variables.

Descriptive statistics

Descriptive statistics were calculating for the test and questionnaire data. The sample data was checked for normal distribution and demographic information. The pre-post test data were checked for outliers before running the t-test. The survey data median and interquartile range (IQR) were calculated to check the variability of responses in the questionnaire data. It is useful for indicating, based upon on and related to median, the extent to which the central 50% of the values within the data set are distributed (Field 2013). It provided a clear picture of the overall data set by adjusting for the outliers and extreme opinion values, showing the likeliest average response of the 50% sample to each item. An IQR is the difference between first and third quartile (Q1-Q3). Relatively small IQR indicates consensus for or against the said statement whereas larger IQR shows respondents hold strong opinions either for or against the topic/item.

Inferential statistics

T-test

Independent sample t-tests, gain score analysis were conducted for precise estimate of improvement or no improvement in the treatment group. With reference to research question 1, the former method was used to answer the question: 'How do groups, on average, differ in gains?' when analysing data both questions together allow the measurement of the effect of the intervention (teaching programme) more accurately (Nelson-Walker, Fien, Kosty, Smolkowski, Smith and Baker, 2013).

Regression mediation analysis

For research questions 1 a and 1b, regression mediation models were applied to see the find out the predictive value of mediating effects of selected confounding variables. The Regression coefficients are compared on said variables by transforming ordinal data into scale data and using SPSS Statistics 24 method provided by A.F. Hayes 2013 method in Field 2013. CT pre-test post-test scores and motivation and learning environment data were entered in the regression model to see to what extent these, both separately and together, account for the mediation of the CT learning process.

Regression analysis

Theory generated hypothesis for value added analysis

For triangulating and exploration purposes, data from questionnaires was further analysed through a value-added approach. For this regression analyses of subscales of questionnaires were run on this sample. Nonetheless, there are limitations in the use of any statistical method and results should be interpreted with caution keeping in mind the design of the study (Field 2013; Mitchell and Jolley 2012).

When the t-tests and mediation analysis did not show any effect or linear relationships, I decided for a second round of data analysis based on personal experience as an observer of the study and from the literature review, such as Hattie et al. (1996), Marzano (1998), Abrami et al. (2008), Higgins et al. (2005), Bonney and Sternberg (2011), Lipman (2000), Marin and Halpern (2011), Paul (1992), and Willingham (2007). There were to options at this stage of data analysis 1) I stop at this stage and conclude that there is no effect of CT skills teaching and motivation and learning environment do not play any role in the learning of CT skills and challenge the vast body of research (I did not want to this before I was certain and I had explored the data fully). 2) Though time and effort consuming, as a researcher I must look deep into data and then give up. I opted for the second option.

To statistically and theoretically strengthen the choice of the second in depth round of analysis, I reflected upon the student questionnaires and their answers, I analysed the descriptive analysis of the questionnaires and thought of potentially useful variables to look into the influence of certain aspects of motivation/self-regulation and learning environment on students' learning of CT skills. It should be noted that the results should be taken with a pinch of salt, due the limitations of the research analysis methods used in this study.

Why a second round of analysis was done?

The first phase of quantitative results showed non-significant contribution or influence on CT skills learning in this data. Due to the fact that the control/ no-intervention group's performance stayed the same, only increased slightly towards the end, and the intervention groups' performance declined towards the end, there remains much unexplained. Since, the performance of the experimental/ intervention group declined at the time of post-test examination (they performed one point lower than their pre-test mean scores and lower than the non- intervention group. It could be that confounding variables involved were having a negative effect on student's performance. On the other hand, it is also likely that CT skills intervention design, itself, intervention implementation, intervention teaching were the possible reasons for ineffectiveness. But to come to reasonable conclusions and explanation, first we would look into data on confounding variables, then would analyse follow up interview data and supplementary observational data to reach at a fuller picture explaining about the ineffectiveness of CT skills intervention in this research study.

How the new variables were computed?

A further exploration of the questionnaire data was done where new variables were computed for both questionnaires. Computed new variables using theory again e.g. in Marzano (1998) they say metacognitive self-regulation, motivation, and social, cognitive environment of classrooms may be affecting the CT or deep approach learning of Skills of students. New variables were computed using questionnaires' original factor distribution scales. The mean scores were used to compute new variables using Field 2013 statistical data transformation methods for regression analysis.

Qualitative data analysis methods

The study intended to examine how a carefully designed intervention is received in a traditional setting, therefore a study of the social setting where the intervention was taking place seemed appropriate. There were certain aspects of the social setting of the environment that needed observing for the researcher to determine the effectiveness of the intervention comprehensively. This research study intends to test theory-driven hypotheses for the development of a cause-and-effect relationship between the CT skills intervention and change in CT skills in students. The data was analysed while keeping mind the main research questions of the study. The purpose of which is to examine the effectiveness of theory-rooted design principles for teaching CT. I was interested in discovering the effect of a particular approach (teaching programme to teach CT). However, the success and failure of a particular method may not be fully explained only by comparing gains on selected variables or students' post-test performance. There are numerous other influential factors that might play important role in determining the success and failure of the intervention on a different level.

A qualitative follow up was pre-planned to seek a comprehensive and deep understanding of the outcomes of first phase and the setting, sample, context. The qualitative phase was mainly interested in participants' opinion on the experience of the intervention and observing implementation fidelity for a comprehensive explanation of the quantitative outcomes from the first stage of the study.

The qualitative research question asked were

2: What are the participants' experiences about how a specific instructional model helped or did not help in the learning of CT skills?

(2a) To what extent implementation fidelity influenced the effectiveness of a carefully designed CT skills instructional intervention to increase students' CT skills?

(2b) What are the experiences of students and the class teacher of the carefully designed CT skills instructional intervention?

The qualitative variables for observations of implementation fidelity (2a) of intervention are listed as *adherence, exposure, quality of delivery, and programme specification and student responsiveness* for structured observation sheets. The field notes focused on the general flow in the same reign of implementation and teacher's role of lesson plan delivery and record of what the researcher observed as interactions of teacher, students and learning materials only during the lesson delivery which literature recommends (chapter 2). The overall flow of the lesson and activities was observed, and how much of the plan was actually implemented was recorded. Data collected from observation of fidelity of implementation and interview questions (listed above) were used to answer the qualitative research questions above.

The overall experience of the participants in the whole process and their views provided understanding of when the carefully designed intervention failed and become ineffective, what happened in the quasi- experimental research with units/persons, treatments, observations/outcomes, and settings (interviews with participants), and the implementation fidelity data helped to extend on what worked and possibly explaining why and how, and what did not work and possibly how and why.

Content analysis

Although qualitative research is diverse, complex and nuanced (Holloway and Todres 2003) yet, content analysis is the longest established and widely used approach in qualitative data analysis of social investigation (Kohlbacher 2006). According to Bryman 2004…

'An approach to documents that emphasizes the role of the investigator in the construction of the meaning of and in texts. There is an emphasis on allowing categories to emerge out of data and on recognizing the significance for understanding the meaning of the context in which an item being analysed (and the categories derived from it) appeared' (Bryman, 2004, p.542)

The qualitative data was analysed using conventional/classical content analysis (Kohlbacher 2006) ending in main themes/categories emerging from the objective and systematic description of the content. The purpose of qualitative component was to explain the quantitative results and provide a deeper explanation of the effectiveness of a carefully designed CT skills instructional intervention. Information from semi-structured interviews, structured and unstructured observations was transcribed. Key quotes were initially line by line coded, highlighted, put into meaning full units, then revised and coded and sorted into themes. Data from observation sheets and field notes was used to collect information from participants so that quantitative results can be explained and extended on. The observations of the implementation phase for both groups were conducted by the researcher to compare for example, teaching style difference in control and experimental group or classroom intervention delivery. The analysis focused on finding themes and triangulating quantitative results.

Data from qualitative interviews provided both the teacher's and the students' opinions. Student response was solicited on the intervention, students' participation in classroom activities, and the teaching programme (intervention), while the teachers' response was sought on the intervention, and difficulties or weaknesses of the programme. The reported data was merged with other qualitative analyses of the research questions and observations. Qualitative data was analysed with a content analysis approach for both qualitative questions.

There are several types of content analysis techniques that can be used according to the purpose of the study. Content analysis in its simplest and traditional form involves several steps of analysing textual data. The researcher attempts to develop meanings from the content of communication and context. Textual data can be obtained from various sources of written, verbal or visual communication (Cole, 1988 seen in Elo and Kyngäs, 2008; Kohlbacher, 2006), including survey questionnaires, interviews, focus groups, observations, books, articles or manuals (Hsieh and Shannon, 2005). Content analysis goes beyond simply reading the words to provide knowledge and understanding about the phenomena under study (Hsieh and Shannon, 2005).

As qualitative research can be many things to many people, when the term content analysis is employed in this study I mean an approach to systematically and meaningfully analyse textual data that emphasise the quality of entities in terms of intensity, relevance, frequency and significance (Denzin and Lincoln, 2011, p 1-8). An inductive content analysis approach for categories production was used. This approach allowed analytically matching patterns and building explanations from the qualitative data after intervention phase in this study. The method is appropriate for both the case study that is part of a larger mixed methods research and for methodological triangulation within methods and between methods of data analysis. Content analysis is a popular technique to be used with case studies where first part is experimental and the analytic approach is inductive yet confined within the theoretical boundaries of finding what potential flaws led to the inadequate results of the first phase (Yin, 2014; Kohlbacher, 2006).

In this study, the intention for the qualitative follow-up was to gather deeper meanings, an understanding of variables that were earlier observed through a quantitative lens, and the participants' experiences and understanding throughout the implementation phase of the study. The conventional content analysis approach was adopted for analysing qualitative data because this enabled the researcher to examine and describe the phenomenon studies - namely the effectiveness of a CT skills intervention. Conventional data analysis follows the phases of preparation, organizing and resulting (see Elo and Kynga, 2008, p. 110). This qualitative analysis approach may help to confirm the quantitative analysis of results, and in addition may shed light on aspects which were not considered or could not be measured through the small experiment, hence resulting in useful implications for future research in this area. Moreover, this qualitative analysis may also help in understanding the field of CT intervention better by providing replicable and valid inferences from data to similar context (Krippendorf, 2012; Kohlbacher, 2006). Figure 13 presents the stepwise model of qualitative data analysis in this study.

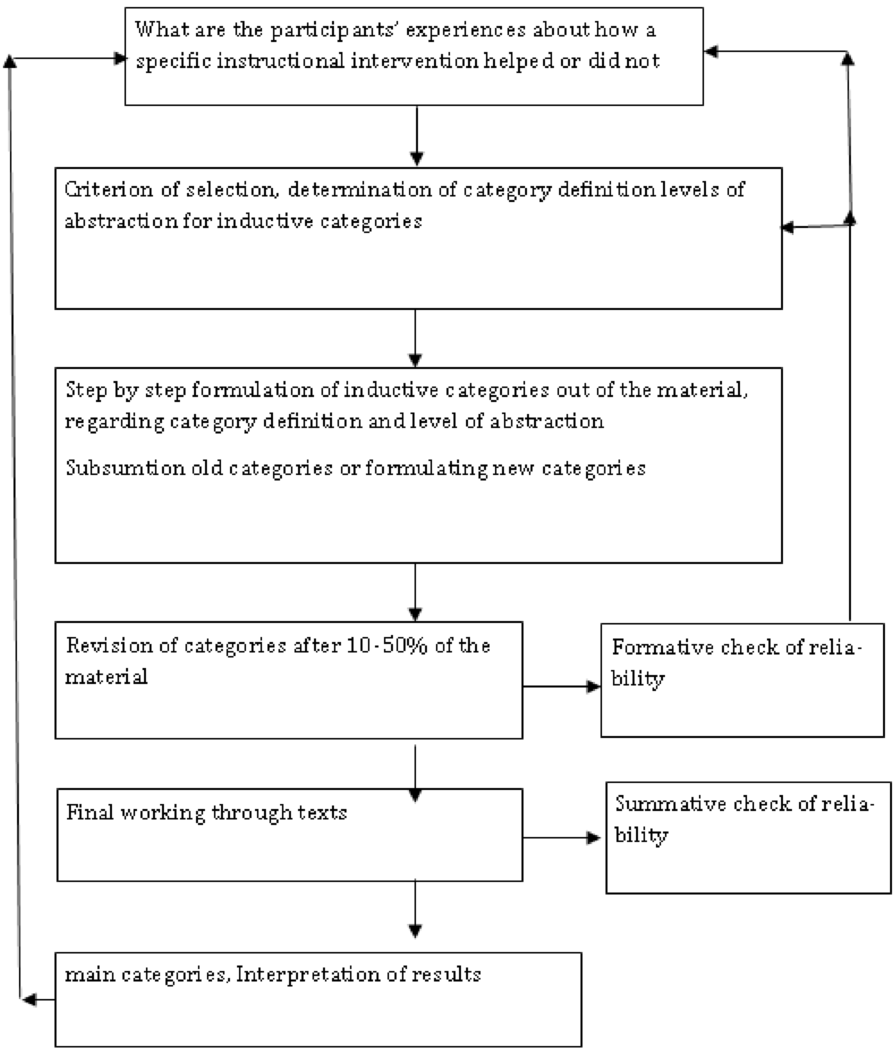


Figure 13: Stepwise model of category development followed in this study (adopted from Kohlbacher, 2006, p.13)

The content analysis approach can be said of inductive-deductive in this study. In an iterative process the data was analyse and explored to find out the explanation of quantitative phase, where the intervention was not quite successful in enhancing students' CT skills. The data led to find out main categories of explanation of quant results. The definition of categories was broadly based on interview questions however, the explanatory data categories appeared inductively on a level of abstraction more in terms of significance, relevance and frequency from raw data (Denzin and Lincoln 2011; Bryman 2004).

The qualitative content analysis was done in three steps. Preparation of the qualitative data, the interview data was transcribed from audio interviews and observations, and a line by line coding was used at first. The sequence of the questions asked, prompts, sounds and pauses given by the respondents were noted down. The interviews of the students and the class teacher were arranged according to the questions asked. Each student's responses were arranged under the relevant question, any illegible sections were revised and grammar mistakes were corrected for a clear understanding of the responses. The data was then organized in a word file.

In the first step/stage and open coding was applied to the responses using direct words from the responses of the students and the class teacher. The open coding helped to develop sub-categories for each interview and observations as a whole, all responses from interviews were categorized according the most appearing and similar words and sentences that the students and the class teacher used to respond. These subcategories were then converted into generic categories or in other words broad themes. The broad themes then abstracted into main categories of responses from interviews and observations. These main categories were used to report qualitative data. The three stages are described as follows.

Stage 1: Open coding/sub categories

At the first stage the researcher used open coding by commenting or adding labels accruing from the text of the data, no boundaries were applied at this point and the researcher allowed the data to lead the flow of codes. At the stage, all coding was worded as appeared in the original responses. The codes were assigned in the form of one word, three words or one sentence at this stage.

Stage 2: Generic categories/themes

In the second stage the data was put into most frequently occurring generic themes from the data. Colour coding was used in a word file to put similar responses in one group. The codes were the themes were not yet put into similar groups however, at this stage the category development has started. And the data was put into generic categories/themes as appearing from participants' responses.

Stage 3: Main categories/themes

At the third stage the categories developed were put into main themes/categories so that the data can be interpreted into meaningful units. These themes are used to report the interview data from participants. The deduced themes were used to analyse the intervention effectiveness, implementation fidelity and assessment of the design and instruction at classroom level. These themes showed what was actually happening inside the classroom in this particular context.

In other words, an iterative inductive and deductive approach was adopted where I not only let the data lead to build possible explanations but also kept the data under logical categories so that it does not deviate from the aim of the study and provide information on the results of the first phase. As the interviews were semi-structured the main categories were reported under relevant questions asked. Whereas the observational data was structured and un-structured both. These are analysed and presented in separate sections. Later the results were used to explain and confirm findings from quantitative analysis and observations of the intervention implementation (Elo and Kynga, 2008; Hsieh and Shannon, 2005; Kohlbacher, 2006).

5.6 Ethical approval of the study

This section discussed the ethical consideration involved in doing research in an educational setting, working with stakeholders of education in a higher education institution (administration, teaching staff, helping staff, and students). The formal, non-formal ethical aspects thought prior, during and after the data collection are discussed (Creswell, 2014).

In the following section I focus on the latent ethical challenges that I had to think as a researcher related to the context, participants and environment of the place of this study.

Prior to beginning the study, the research methods and data collection tools and protocols were scrutinised and approval was acquired by the ERGO: Ethics and Research Governance Online, research ethics committee at University of Southampton. Informed consent forms and participants' information sheets that contained a standard set of elements acknowledge protection of human rights (Sarantakos, 2005, in Creswell, 2014) was provided to all participants. The information on the nature of the study, time required for the tests, and classroom tasks were explained both verbally and on the information sheets. This ensured that participants have access to what's involved and their right to withdraw. The formal forms about participants' information sheet and consent forms are attached as appendix D.

At the beginning of the study, the research problem was identified that would be beneficial to the individuals being studied and to the educational researchers. The students were contacted only at the time of data collection whereas the class teacher's consent was taken earlier and he was contacted prior to the intervention several times. This familiarity had both advantage and disadvantage. On a positive note, at the time of data collection the interventionist was aware of his role and the communication was good in terms of contact and scheduling the intervention execution. On the down side, the researcher had to constantly confirm and remind before each class and share some of teaching load of the interventionist. It posed an ethical issue of mental stress on part of the researcher.

While working in the field, the researcher took care of her own behaviour around the place of the study. She was seen for long hours around the campus and working mainly with the class teacher. However, to maintain and acknowledge the support provided by the selected institution to the researcher to conduct the research; I intentionally made sure to convey a positive deposition by meeting with administration, teaching staff, helping staff and polite encounters with students. I offered to substitute another teacher's classes on two occasions and helping in checking students' work to compensate in small parts. This way I tried to integrate not as an outsider who is there to judge or disturb the institutions routine matters but as an insider who is there to work with them. This attitude helped during turbulences when the room of the class changed, or OHP (overhead projector) was not working, or speakers were required to enhance the audio, the staff was there to assist.

Another ethical challenge was to avoid the power of the researcher over the participating teacher and students. The researcher tried her best to remain quiet and uninvolved during the execution of the intervention. For example, the researcher was aware that the current teacher of the class may not be fully convinced or comfortable with the proposed schedule of teaching regardless of the help he offered. Moreover, the presence and constant shadowing of the teacher may also result in some kind of discomfort/overexcitement on part of the class teacher and students. The researcher took care of this issue by talking about it with the class teacher and reinforcing the boundaries and the role the class teacher and the researcher will be inside the class. Mainly, the teacher was assured that researcher is observing the learning environment and avoided over friendly behaviour with students.

The researcher was aware *during data collection* and analysis that the behaviour observed, some if not most, may be influenced by the researcher's presence. Although the consent form and participation information sheet allowed the student groups and the class teacher to fully understand the demands that implementation of the intervention posed on them still, I think there was a pressure to perform and the working hours that the students and the class teacher needed to put in in order to execute the lessons might have had an ethical consideration through putting participants under pressure. I think that the commitment of the participants for three days a week and the time and effort cannot be rewarded by any means, so at times it was a challenge to demand effort or guide the teacher and students when it was not there. The teacher was provided with a teacher's pack of helping materials and guide of lesson plans so that the extra amount of work required for printing copies, looking for materials teaching CT skills could be eased for the teacher. The students were provided with free copies of worksheets and learning materials that in other circumstances themselves pay for.

Another ethical challenge faced during data collection was autonomy verses protection of participants. While interviewing the students, the researcher had to consider their hesitation in answering questions on the teacher's role and the teaching quality, where a student was uncomfortable to answer or comment. On the other hand, it was a challenge how to avoid negative analysis when looking at the implementation fidelity of the intervention.

After the data collection, the researcher was aware that researching natural educational setting and conducting intervention in a main stream classroom poses an extra layer of human interaction, the feeling of being observed and involvement that needed to be considered beyond the formal ethical approvals. While observing and analysing the data the challenge was to what extent I could paint a realistic picture out of qualitative data due to the small sample of the study. Mostly about the class teacher I had to think to what extent what type of behaviour, reactions should be included in the data analysis or not because ethically it is not appropriate to pose such a grey picture of teacher effectiveness when the participant is only one.

At the end, I conclude that the ethical challenges were many, some of these were research process related, and others were latent. Not all issues were fully resolved, I tried to take care of what was possible thorough the design and process of analysis reporting and be aware of what I was not able to achieve.

Chapter 6: Data analysis

All learning begins when our comfortable ideas turn out to be inadequate.

– John Dewey

This chapter consists of descriptive statistics, inferential statistics and qualitative interpretation of data collected. This first section consists of descriptive analysis of the data. The following section simply describes the pre-test and post-test scores of the control and experimental group, and questionnaire responses about students' opinions on their motivation/self-regulation and classroom learning environment.

The following section presents the data analysis and findings of the study in a sequential manner. Here only the analysis and findings are presented without any justification, comparison or discussion. The findings were discussed with reference to answers to research questions, relevant literature review in Chapter 7. The conclusion, contribution and implications for the CT skills research on learning and instruction of this research study are presented in Chapter 8.

6.1 Data management, data checks and descriptive statistics

To measure the effectiveness of CT skills intervention between the control and experimental groups, the study hypothesized that testing a carefully designed instructional intervention would result in an increase in students' CT skills. To test this assumption, an intervention was designed and implemented in a quasi-experimental (two-group pre-test/post-test) design. After collecting data on students' performance prior and after the intervention, the effect was measured through mean score differences from pre- to post- in the two groups to see if students' CT skills improved or declined.

As the initial analysis after analysing the (pre-and post-test scores of experimental and control group) revealed, the students' performance declined. Soon after, a follow-up study was conducted to seek explanations about the quantitative phase. Research Question 2 dealt with seeking explanations for the outcomes of Phase 1. The analysis of the cases was bounded by Phase 1 in time, place and activity. The data findings and the supplementary observational datum findings are presented first. These were used to enhance the description and confirm the results of the first phase as explained by second phase. The participants were interviewed to share their experiences after the intervention outcomes were analysed initially. The semi-structured interviews asked about various aspects of the intervention features, implementation and outcomes evaluation of the effectiveness of the careful design of the intervention, whether it had been useful or not.

The study aimed to collect both quantitative and qualitative data for testing the effectiveness (i.e. to measure the effect of the carefully designed intervention and provide possible explanations for the relationship between independent, dependent variables of the study. The study of confounding variables and implementation procedures of the intervention were for value-added purposes, so that the understanding of the phenomena can be enhanced for a fuller picture of the study outcomes.

The collected data were organized for analysis purposes. The data were kept in separate boxes for the intervention and non-intervention groups. The transcribed data were further kept in subfolders on a university computer secured with password and labelled separately for each research question, for example, pre-test and post-test, confounding variables, and qualitative interviews, observation and field notes. The data were then organized and saved by digitizing with the help of relevant software. For instance, the statistical software SPSS was used for quantitative data, and interviews were transferred into the computer using Express Scribe software, then listened to and carefully transcribed into MS Word files, and the field notes and observation sheets were transcribed into Word files.

The purpose of data analysis was to interpret information collected and observation recorded in order to explain the effect of methods and procedures applied, and the relationships between variables and factors involved, and finally to be able to draw findings, discussion and conclusions from the analysis of data collected (Creswell, Fetters, Plano Clark and Morales, 2009; Creswell, 2014). For analysis of the effect of the intervention, data from both groups were compared to see the increase, if any, in CT skills. In order to find out relationships between independent and dependent variables, t-test, regression test were applied using SPSS. For the qualitative interviews and observations, data were transcribed using Express Scribe and then analysed manually through using MS Word.

The quantitative data were checked before analysis for normality and sample size, and Likert scale data transformation was undertaken. The data of both groups (experimental and control) were not ideally normally distributed. As per the W (Shapiro–Wilk) statistics: for intervention group W statistics p value on pre-test and post-test= .009 and .012) and for non-intervention groups W statistics p value on pre-test and post-test= .187 and .058) groups. However, for the purpose of t-tests and regressions this was not a problem. According to the central limit theorem, the sample means are basically normally distributed as long as the sample size is at least 20 or 50 for a size of 100 as population (Field, 2013). For regression analysis, the sample size, normality and number of predictors explored in each regression were appropriate to find out relationships (Field, 2013: 313). In addition, the parametric of t-tests and regression analysis are robust enough to be used with violations of the assumption of normality, sample size and Likert scale data. Where necessary, the bootstrapped 95% confidence intervals were used or more realistic estimates of population distribution of the sample (Field, 2013; Norman, 2010).

6.2 Demographic of the sample

This section consists of descriptive analysis of the data on the experimental (intervention) and control (non-intervention) groups. The descriptive characteristics of quantitative phase participants are presented below.

The control group consisted of 27 valid cases in total. All the students provided data on their gender, but the data on one student's age, marital status, previous qualification, ethnicity, religion and parents' education were missing. Three students in the intervention group did not provide data on their latest qualification percentage score grades.

Demographically speaking, the sample was highly female-oriented in the both experimental and control groups. This is not surprising and shows the cultural notions attached to the profession of teaching being respectable and, therefore, most suitable for women. Despite the fact that women's activity in education has increased since 2001 in Pakistan, it is mainly due to the increased inflation rate that has forced the participation of women in all labour sectors. In the education sector, it is also related to high demands for teachers in the country and the Education Sector reform by Government of Pakistan in 2001, gendering of teaching and traditional cultural beliefs around the occupational options for women due to inherent gender bias and social constraints (Khan, 2014; Economic Survey of Pakistan, 2012). In 1999, 38% of teacher were women, and this increased to 50% in 2001 and since then it has been increasing each year (Federal Bureau of Statistics, 2010). This indicates the contextualised characteristics of teacher education programmes in Pakistan as explained in Chapter 3, that it is mostly females who enter the profession of teaching and men do not regard it as a popular profession in Pakistan. The descriptive statistics for female and male participants, their age and marital status are shown in the bar chart (figure 15-16) opposite.

Both sample groups were same regarding their previous qualification and ethnicity. On religion, the experimental group students all were Muslims and there was one Christian student in the control group. This is not surprising due to the country being a majority population following the religion Islam. The descriptive statistics are shown in the bar chart opposite:

Parental education

Although the groups were similar in terms of most demographic information asked from them, subtle differences were observed on variables parent education and students' previous grades on their last qualification before entering the Master's degree in teacher education. The parental education level of at least Bachelors was higher in the sample experimental group than in the control group, but the variation in parental education was clearly more in the experimental group, with 9% of parents with a Master's degree compared to none in the experimental group. The valid percentage of minimally educated parents was less, again, in the control group: uneducated parents (14% vs 11%) and matriculation (15% vs 13%). Interestingly, the percentage of parents with a higher degree than college (e.g. Masters) was a distinguishing feature of the control group class students. The chart shows the ratios in comparison.

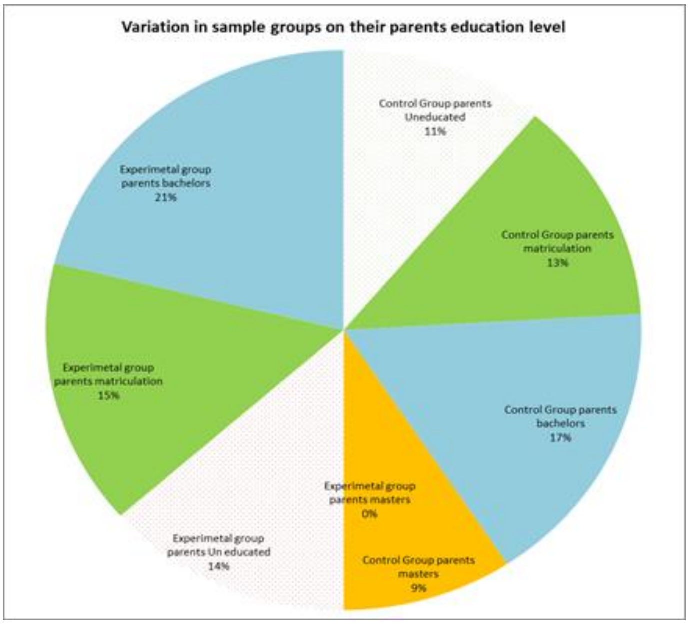


Figure 14: Variations in sample student groups' parental education levels

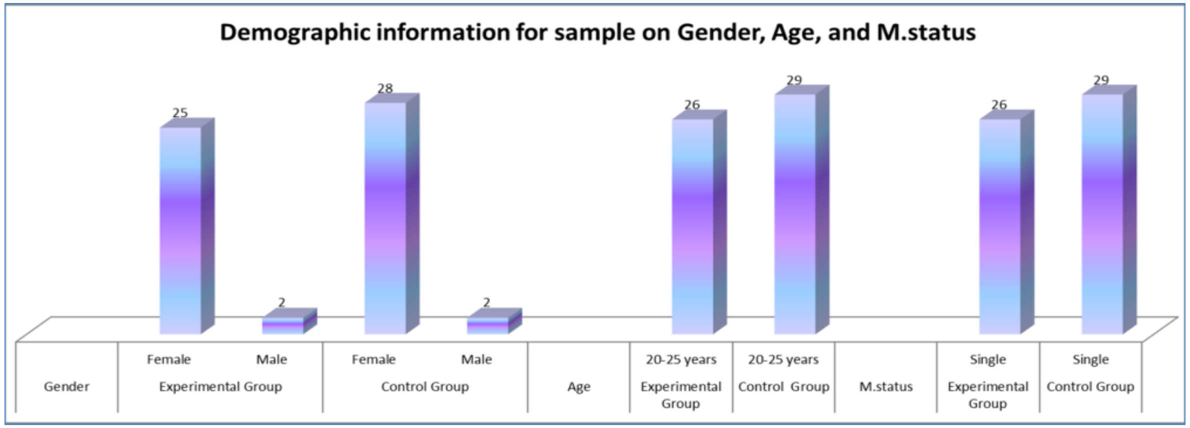


Figure 15: Demographic information on students' gender, age and marital status

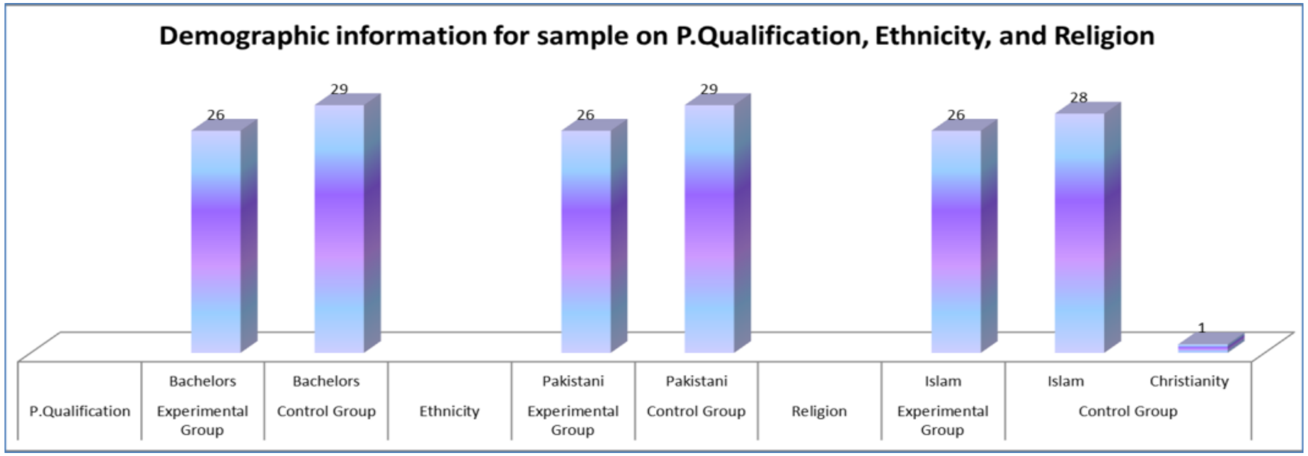


Figure 16: Demographic information on students' previous qualifications, ethnicity and religion

Previous qualification

The analysis of students' previous grades in percentage of marks on their Bachelor's degree was asked as part of demographic information. The reason why the percentages were asked was to ensure consistency across students' achievement on previous degrees, as institutions differ in their grade systems, and 70 % can be a Grade B or C in some colleges, based on merit regulations. By asking the percentages, one differentiates without being confused by grade levels from various institutions. In the experimental group, 22 out of 27 students provided information on their previous grade percentages. In the control group 26 out of 32 students provided this information. The bar chart (Figure 17) shows the group-wise variation in previous grade percentages in both groups.

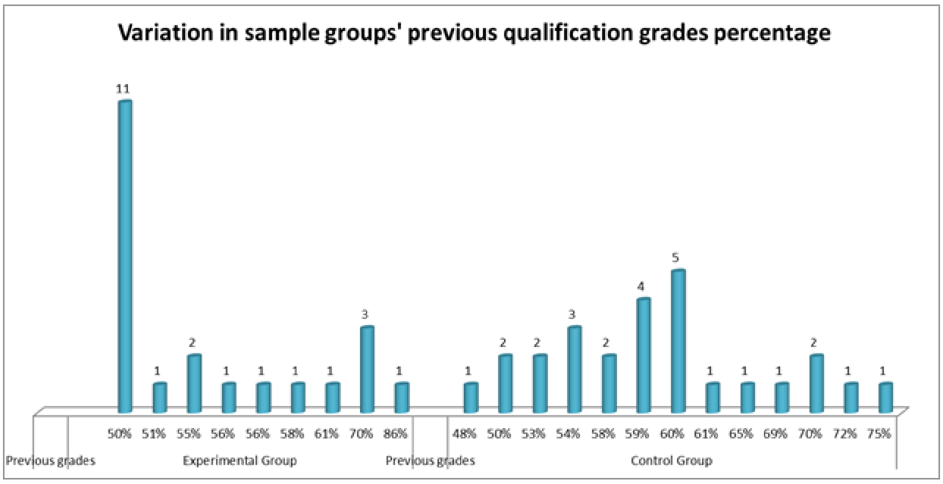


Figure 17: Variation in sample groups' previous qualification grade percentage

As can be seen from the chart on the previous page, experimental and control group have clear differences in terms of variation on students' achievement scores on previous qualification. To make data more readable, the percentages were categorised in three respective ranges (50-60%, 61-70%, and 70-80%) and a percentage pie chart was produced, showing the control and experimental student variation in previous grade percentages. The experimental group had a higher percentage of students with scores of only 50-55% in their last degree than the control group. The control group had more variation not only the rage of scores from lowest percentage at 48% to highest at 75%. The percentages ratio of students with 61-70% was higher in the control group than the experimental group. More than 4% of the control group students were high achievers, at 71-75%, compared to none in this range, yet a single obvious outlier at 86%, in the experimental group.

English language

Another possibly important extraneous variable was the previous English language ability of participants, which certainly could not be controlled for, but was accounted for to gather information in this study. Three questions with options on a Likert scale were asked of the participants. The figures below show a comparison of both groups' self-reported ability in the educational use of English. This provided background information when analysing the intervention's effect and additional insights into the effectiveness of a CT skills intervention in this sample groups at classroom level.

In the experimental group, 26 out of 27 students and in the control group 29 out of 32 students answered this question. The experimental group expressed a higher degree of fluency than to control group (7% vs 2%), a lower percentage of average English language ability compared to the control group (41% vs 48%) and very few students expressed that their ability was poor, compared to the control group students who stated it as nil (2% vs 0%). Figure 18 shows what percentage of the sample of the control group and experimental group students thought of their English language speaking, reading and writing as fluent, average or poor.

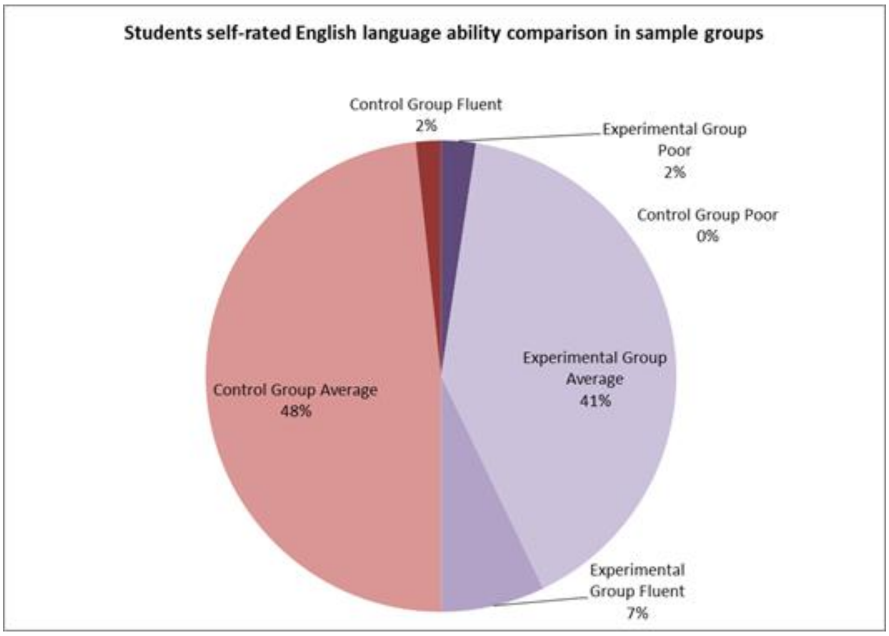


Figure 18: Perceptions of English language ability in sample groups

In the experimental group, 26 out of 27 students and in the control group 29 out of 32 students answered this question. In terms of being able to read coursework, take notes and have non-formal daily conversations, experimental group expressed a lower percentage of being fairly able compared to the control group (2% vs 7%). A higher percentage of the experimental group students expressed that to some extent they are able to read coursework, take notes and have non-formal daily conversations, compared to the control group (26% vs 7%) and very few students expressed their ability as fairly able to read course work, take notes and have non-formal daily conversations both in experimental and control group students, but a larger percentage of the control group (2% vs 7%). Figure 19 shows what percentage of the sample of control group and experimental group students thought of their ability in English language to read coursework materials, notes and non-formal daily conversations as 'I am fairly able', 'I am to some extent able' and 'yes, I am able to'.

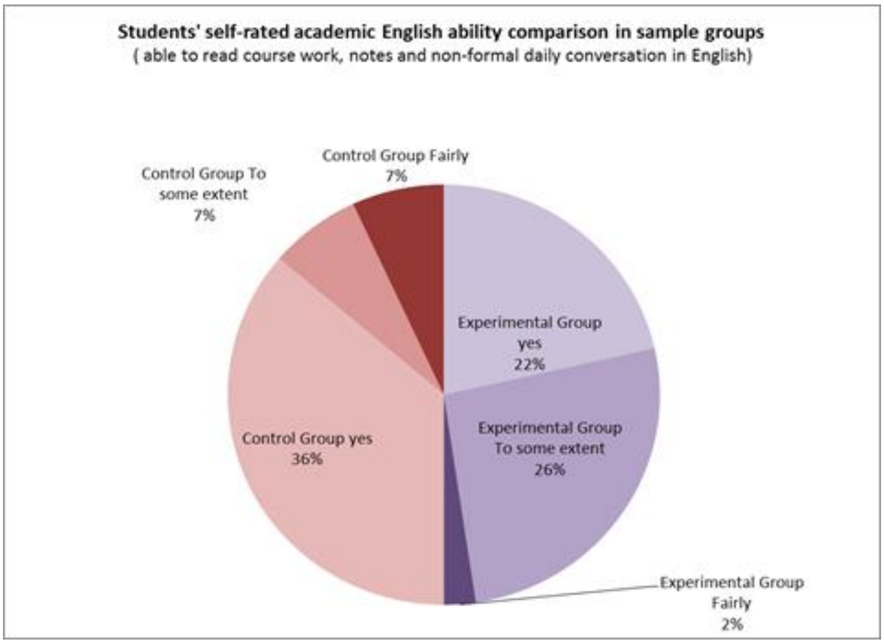


Figure 19: Students' self-rated proficiency of day to day English language ability in sample groups

In the experimental group 26 out of 27 students and in the control group 29 out of 32 students answered this question. In terms of being able to understand, summarize, and paraphrase information and their thoughts both groups showed a lower percentage of such students but none in experimental group (5% vs 0%), a higher percentage of experimental group students expressed that to some extent they are able to understand, summarize, and paraphrase information and their thoughts compared to control group (31% vs 14%) and one third students expressed their ability confidently as yes, I am able to understand, summarize, and paraphrase information and their thoughts control group compared to experimental group students but a larger percentage in the control group (31% vs 19%).

Figure 20 shows what percentage of the sample of control group and experimental group students thought of their ability in English language to understand, summarize, and paraphrase information and their thoughts about given topics in class as I am fairly able to, I am to some extent able to, and yes, I am able to.

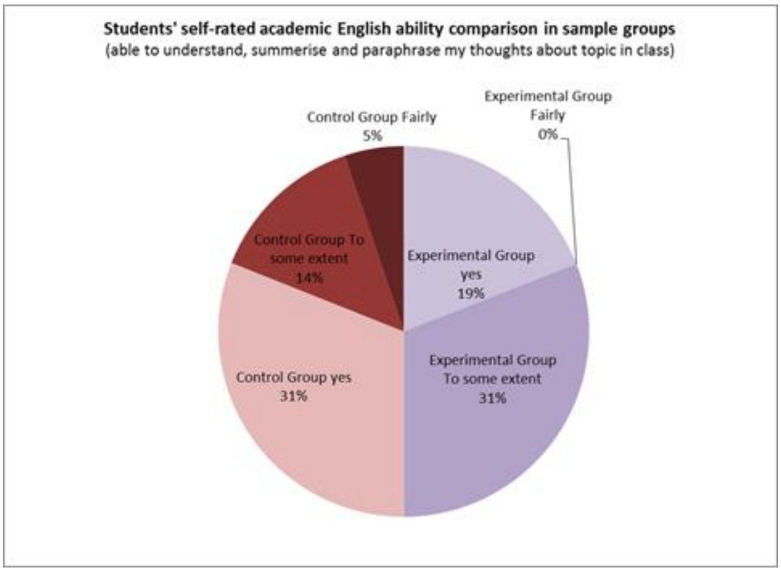


Figure 20: Students' self-rated perception of academic English language ability in sample groups

Over all these three questions tell us the experimental group students' self-considered English language ability in asked dimensions was low compared to control group students. And the based on previous qualification data comparison, it seems the students in the experimental group were comparatively low achievers, with relatively low levels of functional English language at their course level.

Descriptive information about qualitative participants

The following section reported on the qualitative sample characteristics, background of participants. The students' response rate and completion rate on tests and questionnaires are presented. Moreover, the descriptive item scale analysis is provided.

Qualitative phase sample from experimental/Intervention group
Participants= 07
Extreme cases in declining performance= 02 Voluntary students= 04 Class teacher (taught both classes)

Figure 21: Qualitative sample

For qualitative component, the data were checked for accuracy of transcription. For keeping the anonymity of the data all names were removed and unidentifiable general names (e.g. student 1 (SI 1), student 2 (SI2)) were given before performing any analysis on both data types, except where the specific student interviews and test results were needed to be revisited to find out explanations for the quantitative results. In such cases, the students were informed their consent was taken before they participated in the study and follow-up interviews. The descriptive information for qualitative phase participants is presented below.

Table 10: Background information on qualitative sample (interview participants)

Interviewee ID	Back ground information				
	Gender and age(years)	Previous grades	Pre-test to post-test scores	Participated in questionnaires	Participated in intervention
SI1 (Extreme case)	Female 21-25	50%	8 to 2	yes	yes
SI2	Male 21-25	70%	3 to 5	yes	yes
SI3	Female 21-25	50%	5 to 4	yes	yes
SI4 (Extreme case)	Female 21-25	50%	10 to 4	yes	yes
SI5	Female 21-25	missing	5 to 5	yes	partially, was absent due to sister's wedding
SI6	Female 21-25	missing	4 to 5	yes	yes
Class Teacher	Male 55 years	Post doctorate in Education with 15 years of teaching experience. Taught both classes.			

Response rate and completion rate of test and questionnaires

According to Kviz (1977), the response rate should reflect the degree to which a researcher successfully obtains the co-operation of all potential respondents included in the sample. This is expressed as:

Response rate= C/E, where C= the number of completed interviews/questionnaires, and E= the eligible sample members (Kviz 1977, p.265).

Closely related to response rate is the term completion rate. According to Kviz 1977, the completion rate indicates the proportion of completed interviews/questionnaires obtained from a sample. The formula can be described as:

Completion rate= C/n, where C= the number of completed interviews/questionnaires and n= the sample size (Kviz 1977, p. 266)

The overall response rate and completion rate would be identical when every member of the sample is eligible for participation.

The class register of control class showed 35 total numbers of students, and the experimental class register showed 31 total students. Therefore, the potential respondents eligible for participation in these two groups were respectively 31 and 35, whereas the respondents who participated in the study were respectively 27 and 32. The figure 22 below explains the response and completion rate on tests and questionnaires for each group in the study. The response rate and completion rate were calculated with the above formula.

Experimental (Intervention) Group
Response rate
Pre-test response rate= 87%
Post-test response rate =87%
MSLQ questionnaire=87%
CoI questionnaire=87%
Control (No-intervention) Group
Response rate
Pre-test response rate= 91%
Post-test response rate =91%

Experimental (Intervention) Group
Completion rate
Pre-test response rate= 87%
Post-test response rate =87%
MSLQ questionnaire=87%
CoI questionnaire=87%
Control (No-intervention) Group
Completion rate
Pre-test response rate= 91%
Post-test response rate =91%

Figure 22: Response rate and completion rate on instruments

The completion rate and response rate for both groups were experimental group were identical as the eligible sample did not go beyond the sample groups. The potential reasons for non-respondents known are a) the sample was out of reach due to absence from the class and I failed to reach or contact them due to the time constraints of the study.

6.3 Scale item descriptive analysis of Motivation/self-regulation questionnaire

The questionnaire is composed of items with a 7 point, 5 point Likert scale, ranging from '1= not at all true of me ', '2= least true of me' '3= less true of me', '4= moderately true of me', '5= more true of me', '6= mostly true of me' to '7=very true of me '. The total number of completed responses, missing cases and descriptives on each item of the questionnaire are provided in the appendix. The analysis of median and IQR is provided in this section to present a realistic picture of the questionnaire data. The median of the item provided information where the average respondent opinion on lies exactly as middle value. The IQR indicated the dispersion of this thinking is scattered or clustered across the range of possible responses. The descriptive statistics are being provided for N=17 i.e. 63% of total N=27 of treatment group.

Intrinsic goal orientation

The analysis of student responses show that students perceived a low intrinsic goal orientation towards CT skills instructional activities in this class. This indicated a lack of motivation from students' side. The overall intrinsic goal orientation IQR= 2-3 in this sample.

Table 11: Students' perceptions of intrinsic goal orientation towards CT skills intervention

Scale item	Item analysis of intrinsic goal orientation scale	Median & interquartile range
Item 1	Most respondents indicated moderate disagreement with the idea that In a class like this, I prefer course material that really challenges me so I can learn new things	(Mdn=6) (IQR =3)
Item 16	Most respondents indicated disagreement with the idea that 'In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn	(Mdn=5) (IQR =2.50)
Item 22	Most respondents indicated disagreement with the idea that 'The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible	(Mdn=6) (IQR =2)
Item 24	Most respondents indicated disagreement with the idea that 'When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade	(Mdn=5) (IQR = 2.50)

Extrinsic goal orientation

The detailed analysis of the intervention group showed that most students attributed a low value towards the explicit goals of the CT skills intervention in this group. The overall extrinsic goal orientation IQR= 1.50-3 in this sample.

Table 12: Students' perceptions of extrinsic goal orientation towards CT skills intervention

Scale item	Item analysis of extrinsic goal orientation scale	Median & interquartile range
Item 7	Most respondents indicated disagreement with the idea that Getting a good grade in this class is the most satisfying thing for me right now	(Mdn=6) (IQR =2.50)
Item 11	Most respondents indicated disagreement with the idea that The most important thing for me right now is improving my overall grade point average so my main concern in this class is getting a good grade	(Mdn=7) (IQR =1.50)
Item 13	Most respondents indicated disagreement with the idea that If I can I want to get better grades in this class than most of the other students	(Mdn=6) (IQR =2)
Item 30	Most respondents indicated disagreement with the idea that I want to do well in this class because it is important to show my ability to my family friends employee or others	(Mdn=7) (IQR =1.50)

Task value

Students’ responses showed that the experimental group attributed a low task value towards the class activities during this time. The task value scale IQR= 1.50-3 in this sample.

Table 13: Students’ task value towards CT skills intervention

Scale item	Item analysis of task value scale	Median & interquartile range
Item 4	Most respondents indicated disagreement with the idea that I think I will be able to use what I learn in this course in other courses	(Mdn=6) (IQR =2.50)
Item 10	Most respondents indicated disagreement with the idea that It is important for me to learn the course material in this class	(Mdn=7) (IQR =1.50)
Item 17	Most respondents indicated disagreement with the idea that If I can I want to get better grades in this class than most of the other students	(Mdn=6) (IQR =2)
Item 23	Most respondents indicated disagreement with the idea that I want to do well in this class because it is important to show my ability to my family friends employee or others	(Mdn=7) (IQR =1.50)
Item 26	Most respondents indicated disagreement with the idea that I like the subject matter of this course	(Mdn=6) (IQR =2.50)
Item 27	Most respondents indicated moderate disagreement with the idea that Understanding the subject matter of this course is very important to me	(Mdn=6) (IQR =3)

Control of learning beliefs

Control of learning beliefs scale measured respondents own confidence controlling their learning. It appeared from the data that most respondents had low control of learning beliefs based on IQR= 2-3 in this sample.

Table 14: Students' control of learning beliefs about CT skills intervention

Scale item	Item analysis of control of learning beliefs scale	Median & interquartile range
Item 2	Most respondents indicated disagreement with the idea that If I study in appropriate ways, then I will be able to learn the material in this course	(Mdn=7) (IQR =2)
Item 9	Most respondents indicated disagreement with the idea that It is my own fault if I don't learn the material in this course	(Mdn=6) (IQR =2.50)
Item 18	Most respondents indicated moderate disagreement with the idea that If I try hard enough, then I will understand the course material	(Mdn=6) (IQR =3)
Item 25	Most respondents indicated disagreement with the idea that If I don't understand the course material, it is because I didn't try hard enough	(Mdn= 6) (IQR =2)

Self-efficacy for learning and performance

The self-efficacy for learning and performance scale measured respondents' beliefs in own ability to succeed or accomplish a task. The analysis of the scale showed that most respondents had low self-efficacy beliefs for learning and performance based on IQR= 1.50-3 in this sample.

Table 15: Students' perceptions of self-efficacy for learning about CT skills intervention

Scale item	Item analysis of self-efficacy for learning and performance scale	Median & interquartile range
Item 5	Most respondents indicated disagreement with the idea that If I study in appropriate ways, then I will be able to learn the material in this course	(Mdn=5) (IQR =3)
Item 6	Most respondents indicated disagreement with the idea that It is my own fault if I don't learn the material in this course	(Mdn=4) (IQR =2).
Item 12	Most respondents indicated moderate disagreement with the idea that If I try hard enough, then I will understand the course material	(Mdn=6) (IQR =3)
Item 15	Most respondents indicated disagreement with the idea that If I don't understand the course material, it is because I didn't try hard enough	(Mdn=5) (IQR =2)
Item 20	Most respondents indicated mild disagreement with the idea that I'm confident I can do an excellent job on the assignments and tests in this course	(Mdn=4) (IQR =3)
Item 21	Most respondents indicated disagreement with the idea that I expect to do well in this class	(Mdn=6) (IQR =1.50)
Item 29	Most respondents indicated disagreement with the idea that I'm certain I can master the skills being taught in this class	(Mdn=5) (IQR =2.50)
Item 31	Most respondents indicated disagreement with the idea that Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class	(Mdn=6) (IQR =2)

Test anxiety

The test anxiety scale items were revers coded, therefore the higher agreement showed a higher level of text anxiety among students. The respondents showed moderate level of test anxiety, IQR= 2.50-4 in this sample.

Table 16: Students' perceptions of text anxiety about CT skills intervention

Scale item	Item analysis of test anxiety scale	Median & interquartile range
Item 3	Most respondents indicated agreement with the idea that When I take a test I think about how poorly I am doing compared with other students	(Mdn=5) (IQR =4)
Item 8	Most respondents indicated agreement with the idea that When I take a test I think about items on other parts of the test I can't answer	(Mdn=4) (IQR =4)
Item 14	Most respondents indicated agreement with the idea that When I take tests I think of the consequences of failing	(Mdn=4) (IQR =4)
Item 19	Most respondents indicated agreement with the idea that I have an uneasy, upset feeling when I take an exam	(Mdn=5) (IQR =4)
Item 28	Most respondents indicated moderate disagreement with the idea that I feel my heart beating fast when I take an exam	(Mdn=7) (IQR =2.50)

Rehearsal

The students’ responses showed that the experimental group moderately rehearsed the class activities during this time. The task value scale IQR = 2.50-4 overall, in this sample.

Table 17: Students' perceptions of rehearsal about CT skills intervention

Scale item	Item analysis of Rehearsal scale	Median & interquartile range
Item 39	Most respondents indicated agreement with the idea that When I study for this class, I practice saying the material to myself over and over	(Mdn=4) (IQR = 4)
Item 46	Most respondents indicated moderate disagreement with the idea that When studying for this course, I read my class notes and the course readings over and over again	(Mdn=5) (IQR =3)
Item 59	Most respondents indicated disagreement with the idea that I memorize key words to remind me of important concepts in this class	(Mdn=6) (IQR =2.50)
Item 72	Most respondents indicated more agreement with the idea that I make lists of important items for this course and memorize the lists	(Mdn=4) (IQR =4.50)

Elaboration

The students' responses showed that the experimental group moderately elaborated on learning materials during this time. The elaboration scale IQR = 2-4 overall, in this sample.

Table 18: Students' perceptions of elaboration about CT skills intervention

Scale item	Item analysis of elaboration scale	Median & interquartile range
Item 53	Most respondents indicated more agreement with the idea that When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions	(Mdn=6) (IQR =4)
Item 62	Item 62: Most respondents indicated more agreement with the idea that I try to relate ideas in this subject to those in other courses whenever possible	(Mdn=4) (IQR =4)
Item 64	Most respondents indicated moderate disagreement with the idea that When reading for this class, I try to relate the material to what I already know	(Mdn=4) (IQR =3)
Item 67	Most respondents indicated more agreement with the idea that When I study for this course, I write brief summaries of the main ideas from the readings and my class notes	(Mdn=5) (IQR =4)
Item 69	Most respondents indicated disagreement with the idea that I try to understand the material in this class by making connections between the readings and the concepts from the lectures	(Mdn=6) (IQR =2)
Item 81	Most respondents indicated likely agreement with the idea that I try to apply ideas from course readings in other class activities such as lecture and discussion	(Mdn=5) (IQR =4)

Organization

The students' responses showed that the experimental group had low organization of learning and learning materials except a higher agreement showed reliance on notes during this time. The elaboration scale IQR = 3-5 overall, in this sample.

Table 19: Students' perceptions of organization about CT skills intervention

Scale item	Item analysis of organization scale	Median & interquartile range
Item 32	Most respondents indicated moderate disagreement with the idea that When I study the readings for this course, I outline the material to help me organize my thoughts	(Mdn=5) (IQR =3)
Item 42	Most respondents indicated moderate disagreement with the idea that When I study for this course, I go through the readings and my class notes and try to find the most important ideas	(Mdn=6) (IQR =3.50)
Item 49	Most respondents indicated moderate disagreement with the idea that I make simple charts, diagrams, or tables to help me organize course material	(Mdn=2) (IQR =3)
Item 63	Most respondents indicated quite an agreement with the idea that When I study for this course, I go over my class notes and make an outline of important concepts	(Mdn=4) (IQR =5)

Critical thinking

The students' responses showed that the experimental group had disagreement on their critical thinking ability and learning materials during this time. The elaboration scale IQR = 2-3.50 overall, in this sample.

Table 20: Students' perceptions of critical thinking scale about CT skills intervention

Scale item	Item analysis of critical thinking scale	Median & interquartile range
Item 38	Most respondents indicated disagreement with the idea that I often find myself questioning things I hear or read in this course to decide if I find them convincing	(Mdn=4) (IQR =2)
Item 47	Most respondents indicated disagreement with the idea that When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence	(Mdn=4) (IQR =1.50)
Item 51	Most respondents indicated disagreement with the idea that I treat the course material as a starting point and try to develop my own ideas about it	(Mdn=4) (IQR =2.50)
Item 66	Most respondents indicated moderate disagreement with the idea that I try to play around with ideas of my own related to what I am learning in this course	(Mdn=5) (IQR =3.50)
Item 71	Most respondents indicated moderate disagreement with the idea that Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives	(Mdn= 6) (IQR =3)

Metacognitive self-regulation

The students' responses showed that the experimental group had low meta-cognitive self-regulation except a higher agreement on item 57 showed that they read for the class but could not grasp what it was all about during this time. The metacognitive self-regulation scale IQR = 2.50-5.30 overall, in this sample.

Table 21: Students' perceptions of metacognitive self-regulation about CT skills intervention

Scale item	Item analysis of metacognitive self-regulation scale	Median & interquartile range
Item 33	Most respondents indicated agreement with the idea that During class time I often miss important points because I'm thinking of other things	(Mdn=5) (IQR =4.50)
Item 36	Most respondents indicated moderate disagreement with the idea that When reading for this course, I make up questions to help focus my reading	(Mdn=5) (IQR =3)
Item 41	Most respondents indicated agreement with the idea that When I become confused about something I'm reading for this class, I go back and try to figure it out	(Mdn=4) (IQR =4.50)
Item 44	Most respondents indicated disagreement with the idea that If course readings are difficult to understand, I change the way I read the material	(Mdn=6) (IQR =2.50)
Item 54	Most respondents indicated agreement with the idea that before I study new course material thoroughly, I often skim it to see how it is organized	(Mdn=5) (IQR =4)
Item 55	Most respondents indicated agreement with the idea that I ask myself questions to make sure I understand the material I have been studying in this class	(Mdn=6) (IQR =4)
Item 56	Most respondents indicated disagreement with the idea that I ask myself questions to make sure I understand the material I have been studying in this class	(Mdn=4) (IQR =2.50)
Item 57	Most respondents indicated high agreement with the idea that I often find that I have been reading for this class but don't know what it was all about	(Mdn=5) (IQR =5.30)
Item 61	Most respondents indicated moderate disagreement with the idea that I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying - for this course	(Mdn=5) (IQR =3.50)
Item 76	Most respondents indicated moderate disagreement with the idea that When studying for this course I try to determine which concepts I don't understand well	(Mdn=6) (IQR = 3)
Item 78	Most respondents indicated moderate disagreement with the idea that When I study for this class, I set goals for myself in order to direct my activities in each study period	(Mdn=5) (IQR =3)
Item 79	Most respondents indicated moderate disagreement with the idea that If I get confused taking notes in class, I make sure I sort it out afterwards	(Mdn=4) (IQR =3.50)

Time and study environment

The students' responses showed that the experimental group had disagreement on available appropriate time and study environment for themselves. The time and study environment scale IQR = 2-4 overall, in this sample.

Table 22: Students' perceptions of time and study environment about CT skills intervention

Scale item	Item analysis of time and study environment scale	Median & interquartile range
Item 35	Most respondents indicated disagreement with the idea that I usually study in a place where I can concentrate on my course work	(Mdn=7) (IQR =2)
Item 43	Most respondents indicated agreement with the idea that I make good use of my study time for this course	(Mdn=4) (IQR =4)
Item 52	Most respondents indicated moderate disagreement with the idea that I find it hard to stick to a study schedule	(Mdn=5) (IQR =3)
Item 65	Most respondents indicated agreement with the idea that I have a regular place set aside for studying	(Mdn=5) (IQR =4)
Item 70	Most respondents indicated moderate disagreement with the idea that I make sure that I keep up with the weekly readings and assignments for this course	(Mdn=6) (IQR =3.50)
Item 73	Most respondents indicated moderate disagreement with the idea that I attend this class regularly	(Mdn= 7) (IQR =3.50)
Item 77	Most respondents indicated agreement with the idea that I often find that I don't spend very much time on this course because of other activities	(Mdn=4) (IQR =4)
Item 80	Most respondents indicated disagreement with the idea that I rarely find time to review my notes or readings before an exam	(Mdn=6) (IQR =2.50)

Effort regulation

The students' responses showed that the experimental group had disagreement on available appropriate time and study environment for themselves. Interestingly, item 37 indicated high agreement on lack of effort regulation in this group. The overall effort regulation scale IQR = 3-4.50 in this sample.

Table 23: Students' perceptions of effort regulation about CT skills intervention

Scale item	Item analysis of effort regulation scale	Median & interquartile range
Item 37	Most respondents indicated agreement with the idea that I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do	(Mdn=4) (IQR =4.50)
Item 48	Most respondents indicated moderate disagreement with the idea that I work hard to do well in this class even if I don't like what we are doing	(Mdn=6) (IQR =3)
Item 60	Most respondents indicated moderate disagreement with the idea that When course work is difficult, I either give up or only study the easy parts	(Mdn=4) (IQR =3.50)
Item 74	Most respondents indicated moderate disagreement with the idea that Even when course materials are dull and uninteresting, I manage to keep working until I finish	(Mdn=6) (IQR =3)

Peer learning

The students’ responses showed that the experimental group had disagreement on peer learning and collaborative tasks in this class. The overall peer learning scale IQR = 3-4 in this sample.

Table 24: Students' perceptions of peer learning about CT skills intervention

Scale item	Item analysis of peer learning scale	Median & interquartile range
Item 34	Most respondents indicated moderate disagreement with the idea that When studying for this course, I often try to explain the material to a classmate or friend	(Mdn=6) (IQR =3)
Item 45	Most respondents indicated disagreement with the idea that I try to work with other students from this class to complete the course assignments	(Mdn=7) (IQR =2.50)
Item 50	Most respondents indicated high agreement with the idea that When studying for this course, I often set aside time to discuss course material with a group of students from the class	(Mdn=5) (IQR =4)

Help seeking

The students' responses showed that the experimental group had moderate disagreement on help seeking and asking others for understanding in this class, except that students identified with each other (item 75). The overall help seeking scale IQR = 3.50-4.50 in this sample.

Table 25: Students' perceptions of help seeking about CT skills intervention

Scale item	Item analysis of help seeking scale	Median & interquartile range
Item 40	Most respondents indicated moderate disagreement with the idea that Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone	(Mdn=4) (IQR =3.50)
Item 58	Most respondents indicated moderate disagreement with the idea that I ask the instructor to clarify concepts I don't understand well	(Mdn=6) (IQR =3.50)
Item 68	Most respondents indicated agreement with the idea that When I can't understand the material in this course, I ask another student in this class for help	(Mdn=6) (IQR =4.50)
Item 75	Most respondents indicated agreement with the idea that I try to identify with students in this class	(Mdn=6) (IQR =4.50)

6.4 Scale item descriptive analysis of classroom learning environment questionnaire

The questionnaire is composed of items with a 5 point Likert scale, ranging from '1= strongly disagree ', '2= disagree' '3= neutral', '4= agree', and '5= strongly agree'. The total number of completed responses, missing cases and descriptives on each item of the questionnaire are provided in the appendix. The item analysis of CoI questionnaire is comprised of three scales. The analysis of median and IQR is provided in this section to present a realistic picture of the questionnaire data. The median of the item provided information where the average respondent opinion on lies exactly as middle value. The IQR indicated the dispersion of this thinking is scattered or clustered across the range of possible responses. The descriptive statistics are being provided for N=24 i.e. 89% of total N=27 of treatment group.

Teaching presence

The students' responses showed that the experimental group had high agreement that teaching presence was very low in this class. The overall peer learning scale IQR = 0-1 in this sample.

Table 26: Students' perceptions of teaching presence in classroom learning environment

Scale item	Item analysis of teaching presence in classroom scale	Median & interquartile range
Item 1	Most respondents indicated high disagreement with the idea that the instructor clearly communicated important course topics	(Mdn=4 (IQR =0)
Item 2	Most respondents indicated high disagreement with the idea that the instructor clearly communicated important course goals	(Mdn=4) (IQR =0)
Item 3	Most respondents indicated disagreement with the idea that the instructor provided clear instructions on how to participate in course learning activities	(Mdn=4) (IQR =2)
Item 4	Most respondents indicated high disagreement with the idea that The instructor clearly communicated important due dates/time frames for learning activities	(Mdn=4) (IQR =1)
Item 5	Most respondents indicated strong disagreement with the idea that the instructor was helpful in identifying areas of disagreement and disagreement on course topics that helped me to learn	(Mdn=4) (IQR =1)
Item 6	Most respondents indicated high disagreement with the idea that the instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking	(Mdn=4) (IQR =1)
Item 7	Most respondents indicated high disagreement with the idea that the instructor helped to keep course participants engaged and participating in productive dialogue	(Mdn=4) (IQR =0)
Item 8	Most respondents indicated high disagreement with the idea that the instructor helped keep the course participants on task in a way that helped me to learn	(Mdn=4) (IQR =1)
Item 9	Most respondents indicated disagreement with the idea that the instructor encouraged course participants to explore new concepts in this course	(Mdn=4) (IQR =2)
Item 10	Most respondents indicated high disagreement with the idea that Instructor actions reinforced the development of a sense of community among course participants	(Mdn=4) (IQR =1)
Item 11	Most respondents indicated high disagreement with the idea that The instructor helped to focus discussion on relevant issues in a way that helped me to learn	(Mdn=4) IQR =1)
Item 12	Most respondents indicated high disagreement with the idea that The instructor provided feedback that helped me understand my strengths and weaknesses	(Mdn=4) (IQR =1)
Item 13	Most respondents indicated high disagreement with the idea that The instructor provided feedback in a timely fashion	(Mdn=3) (IQR =1)

Social presence

The students' responses showed that the experimental group had high agreement that social presence was very low in this class. The overall peer learning scale IQR = 1-2 in this sample.

Table 27: Students' perceptions of social presence in classroom learning environment

Scale item	Item analysis of social presence in classroom scale	Median & interquartile range
Item 14	Most respondents indicated high disagreement with the idea that Getting to know other course participants gave me a sense of belonging in the course	(Mdn=4) (IQR = 1)
Item 15	Most respondents indicated high disagreement with the idea that I was able to form distinct impressions of some course participants	(Mdn=3) (IQR =1)
Item 16	Most respondents indicated disagreement with the idea that Classroom discussion in form of discussion in groups is an excellent medium for social interaction	(Mdn=4) (IQR =2)
Item 17	Most respondents indicated high disagreement with the idea that I felt comfortable conversing through the mapping software medium	(Mdn=3) (IQR =1)
Item 18	Most respondents indicated high disagreement with the idea that felt comfortable participating in the course discussions	(Mdn=4) (IQR =1)
Item 19	Most respondents indicated high disagreement with the idea that I felt comfortable interacting with other course participants	(Mdn=4) (IQR =1)
Item 20	Most respondents indicated high disagreement with the idea that I felt comfortable disagreeing with other course participants while still maintaining a sense of trust	(Mdn=4) (IQR =1)
Item 21	Most respondents indicated high disagreement with the idea that I felt that my point of view was acknowledged by other course participants	(Mdn=4) (IQR =1)
Item 22	Most respondents indicated disagreement with the idea that Classroom discussions help me to develop a sense of collaboration	(Mdn= 4) (IQR =2)

Cognitive presence

The students' responses showed that the experimental group had high agreement that social presence was very low in this class. The overall peer learning scale IQR = .75-1 in this sample.

Table 28: Students' perceptions of cognitive presence in classroom learning environment

Scale item	Item analysis of cognitive presence in classroom scale	Median & interquartile range
Item 23	Most respondents indicated high disagreement with the idea that Problems posed increased my interest in course issues	(Mdn=4) (IQR =.75)
Item 24	Most respondents indicated high disagreement with the idea that Course activities piqued my curiosity	(Mdn=3) (IQR =1)
Item 25	Most respondents indicated high disagreement with the idea that I felt motivated to explore content related questions	(Mdn=4) (IQR =1)
Item 26	Most respondents indicated high disagreement with the idea that I utilized a variety of information sources to explore problems posed in this course	(Mdn=4) (IQR =1)
Item 27	Most respondents indicated high disagreement with the idea that Brainstorming and finding relevant information helped me resolve content related questions	(Mdn=4) (IQR =1)
Item 28	Most respondents indicated high disagreement with the idea that Classroom discussions were valuable in helping me appreciate different perspectives	(Mdn=4) (IQR =0)
Item 29	Most respondents indicated disagreement high with the idea that Combining new information helped me answer questions raised in course activities	(Mdn=4) (IQR =1)
Item 30	Most respondents indicated high disagreement with the idea that Learning activities helped me construct explanations/solutions	(Mdn=4) (IQR =.75)
Item 31	Most respondents indicated high disagreement with the idea that Reflection on course content and discussions helped me understand fundamental concepts in this class	(Mdn=4) (IQR =.75)
Item 32	Most respondents indicated high disagreement with the idea that I can describe ways to test and apply the knowledge created in this course	(Mdn=3.50) (IQR = 1)
Item 33	: Most respondents indicated high disagreement with the idea that I can apply the knowledge created in this course to my work or other non-class related activities	(Mdn=4) (IQR =1)
Item 34	Most respondents indicated high disagreement with the idea that I can apply the knowledge created in this course to my work or other non-class related activities	(Mdn=4) (IQR =1)

The students' disagreement with several scales related to motivation and self-regulatory questionnaire opined that their metacognitive self-regulation skills were lacking, in the sense that appeared related in later quantitative analysis as well. The item scale analysis also helped to understand and reflect on what might have been the reasons for non-affirmative impact of CT skills instruction.

Item scale analysis also indicated the traditional or regular educational environment are based on rote memorisation and lacked in use of efficient strategies for organization, effort regulation, time and study environment, critical thinking, increased test-anxiety, low self-efficacy for learning and performance and control of learning beliefs, attributing low task value towards this class activities, with an even low extrinsic and intrinsic goal orientation explain the extent of influence of

Similarly, the item scale analysis of classroom learning environment questionnaire clearly indicated that the opinions of the students indicated a low level of teacher presences, social presence and cognitive presence. This evidence supports the observations of the experiments implementation as well as affirms the outcomes of this CT skills intervention testing.

In retrospect, it provides an opportunity to consider how the instruction was provided and other causal explanatory links with the qualitative findings can also be seen as discussed in discussion chapter.

6.5 Quantitative analysis and findings

This section presents the quantitative analysis and findings with reference to Research Questions 1, 1a and 1b.

6.5.1 RQ 1: Effect of the Critical thinking skills intervention

Analysis of Research Question 1: Whether a carefully designed CT skills instructional intervention increases students' CT skills?

Null Hypothesis 1: There is no difference in the CT skills test scores between the control and experimental group after the treatment in the study.

Alternative Hypothesis: There is a difference on CT skills test scores between control and experimental group after the treatment in the study.

Table 29 shows the results from the t-test on pre- and post-test comparison of groups on CT skills performance and, based on the results, the null hypothesis will be accepted or rejected. To measure for group differences, independent sample t-tests were applied to the CT test scores and an independent sample comparison made of learning on CT skills through an intervention.

Result: effect of intervention compared between control and experimental group

The results from independent sample t-test showed that, on average, the reported difference in scores on *CT pre-test* (M= 4.56, SD= 1.8) for *intervention group* compared to CT pre- test scores of *non-intervention group* (M= 4.38, SD=1.6), was 0.18 points (t (54)=.379, p= .93, r= .12) before the implementation of CT skills intervention. On average, the reported difference for *intervention group* in scores on *CT post- test* (M= 3.67, SD=2.1) was lower than *non-intervention group post-test scores* after CT skills intervention implementation (M= 4.41, SD=2.6), t (54) = -1.153, p =.25, r= -0.10. The effect size estimate indicated that the difference in learning CT skills by instructional intervention represents a small negative effect.

Table 29: Independent sample t-test comparing intervention and non-intervention groups' scores on pre- and post-tests of CT skills

Test Group	N	Mean	SD	t	df	p
Pre-test				3.79	54	.93
Intervention	27	4.56	1.8			
No-intervention	29	4.38	1.6			
Post-test				-1.153	54	.25
Intervention	27	3.67	2.1			
No-intervention	29	4.41	2.6			

The overall independent sample t-test comparison showed no improvement in the intervention group. The study retained the null hypothesis, that there was no improvement in CT skills test scores in the experimental group, showing no difference between control and experimental group after the given treatment in the study. Moreover, the t-test output indicated that the mean score in the non-intervention group (i.e. pre-test to post-test for control group) had increased, and the mean score change of the intervention group (i.e. experimental group) had decreased.

Finding: There is no effect from the CT skills intervention implemented for four weeks with two groups of students on an ITE first-semester MA class taking a module in educational psychology in a public teacher education university in Pakistan. The gain scores analysis further revealed a negative gain on experimental group students' performance.

The following section reports on the analysis of motivation/self-regulation and classroom learning environment questionnaires, and analyses Research Questions 1a and 1b to find the indirect influence of motivation/self-regulation and the classroom learning environment for CT skills instructional intervention outcomes.

6.5.2 RQ 1a and 1b: Influence of motivation/self-regulation and classroom learning environment

Research Questions 1a and 1b:

Research Question 1a: Does students' motivation/self-regulation influence the learning of CT skills?

Research Question 1b: Does classroom learning environment influence the learning of CT skills?

The study theoretically hypothesized that dispositions such as motivation/self-regulation might have an influence on the learning of CT skills. Similarly, the learning environment in a classroom might also influence students' learning of CT skills through an instructional intervention. Therefore, the study raised the subsidiary research question on whether students' motivation/self-regulation and classroom learning environment have an indirect effect or influence on the learning/performance of their CT skills. This subsidiary question relates to the main effectiveness research question for a better understanding of the effectiveness of a carefully designed CT skills intervention.

To answer this question, multiple regression mediation analysis and value-added regression analysis were performed on the data. Analysis was conducted in two parts, first with mediation regressions analysis and a second round of analysis with single linear and multiple linear regressions to find if there were any value-added relationships regarding the effect of confounding variables on CT skills intervention in this group. Within the data from questionnaires, separate regression models were developed for confounding variables; some interesting findings were drawn to explain the possible relationship of CT skills learning with plausible learning environment and motivation factors.

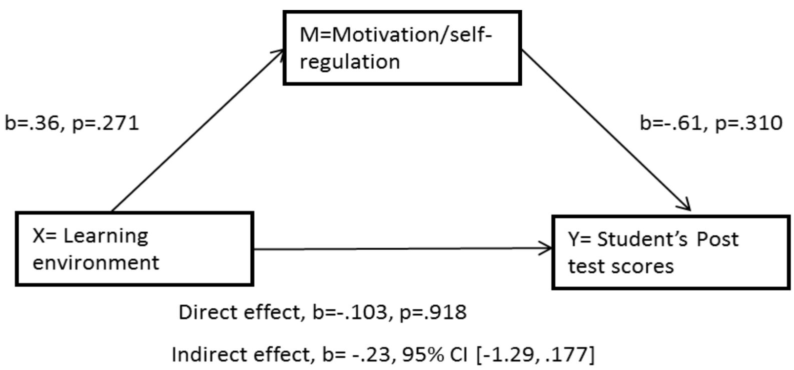
1: Result: Motivation/self-regulation as mediator of learning of CT skills

The first mediation analysis was run to predict student CT skills from learning environment and the indirect effect of students' motivation on learning of CT skills. The outcome is students' CT skills learning in the form of CT post-test scores. The predictor is learning environment mean scores and the mediator is students' motivation/self-regulation mean scores. The first regression showed to what extent motivation/self-regulation can be predicted from students' CT skills post-test scores. It can be seen that motivation/self-regulation is non-significantly predicted from students' CT skills post-test scores, b=.368, t=.1.124, p=.271. The R tells us that learning environment explains 4% of variance in students' CT skills post-test scores. However, the positive b predicts the direction of the relationship: that if the learning environment becomes better or improves, CT post-test scores would also increase (no role of the learning environment).

The second regression shows students' CT skills post-test scores predicted from both the learning environment and motivation. We can see that motivation does not predict CT skills post-test scores significantly: b= -.618, t=-1.036, p= .310; neither did the learning environment predict CT skills post-test scores: b=.103, t=.1034, p=.918. The R^2 value tells us the relationship value of the model that explains 4 per cent of the variance in CT skills learning. This relationship of motivation is not in the predicted (negative beta) direction, but the learning environment (positive beta) is in the predicted direction (no role for motivation/self-regulation and the learning environment).

The third output reported on the results of far the learning environment predicted students' CT skills post-test scores if the mediator (motivation/self-regulation) is not present in the model. The results showed that the learning environment does not predict students' CT skills post-test scores significantly: b= -.124, t=-.127, p=.90. The R^2 value tells us that the model explains nothing of the variance in this model and data.

The final output of mediation analysis returned a non-significant indirect effect of learning environment on students' CT through motivation: b= -.228, BCa CI (-1.29, .176).



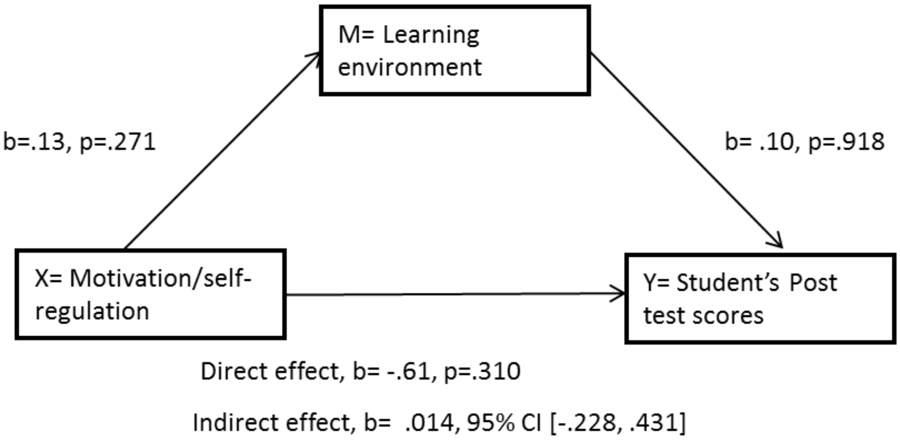
Standardized regression coefficients for the relationship between students' post-test scores and classroom learning environment in learning critical thinking as mediated by student Motivation. The standardized regression coefficient between students' post –test scores and learning environment, controlling for motivation, is in parentheses.
**p* > .05.

Figure 23: Summary of motivation/self-regulation mediation analysis

2: Result: Classroom learning environment as mediator of learning of CT skills

The second mediation analysis was run to predict student CT skills from motivation/self-regulation and the indirect effect of learning environment on learning of CT skills. The outcome is students' CT skills learning in the form of CT post-test scores, the predictor is students' motivation/self-regulation questionnaires mean scores and the mediator is the learning environment questionnaires' mean scores. The first regression showed to what extent the learning environment can be predicted to affect students' CT skills post-test scores. It can be seen that the learning environment non-significantly predicts students' CT skills post-test scores: b=.131, t=.1.124, p=.271. The R^2 tells us that motivation/self-regulation explains 5 per cent of variance in students' CT skills post-test scores, but the positive b predicts the direction of the relationship – that if motivation/self-regulation becomes better or improves – CT post-test scores would also increase (no role of motivation/self-regulation).

The second regression shows that students' CT skills post-test scores can be predicted from both motivation/self-regulation and the learning environment. We can see that the learning environment does not predict CT skills post-test scores significantly: b= .104, t= .1034, p= .918; neither did motivation/self-regulation predict CT skills post-test scores: b= -.618, t= -1.0365, p= .310. The R^2 value tells us that the relationship value of the model explains only 4 per cent of the variance in CT skills learning. This relationship of the learning environment (positive beta) is in the predicted direction, but motivation is not in the predicted (negative beta) direction (no role of learning environment and motivation/self-regulation). The third output informed on the results on how much students' CT skills post-test scores are affected by motivation/self-regulation when the (mediator) learning environment is not present in the model. The results showed that when the learning environment is not in the model, motivation/self-regulation does not predict students' CT skills post-test scores significantly: b= -.605, t=-1.0603, p=.299. The R^2 value tells us that the model explains 4 per cent of the variance in this model and data. The final output of mediation analysis informed that there was a non-significant indirect effect learning environment on students' CT skills post-test scores: b= .013, BCa CI (-.228, .431).



Standardized regression coefficients for the relationship between students' CT skills post-test scores and student motivation/ self-regulation for learning critical thinking skills as mediated by classroom learning environment. The standardized regression coefficient between students' post –test scores and motivation, controlling for learning environment, is in parentheses.
**p* > .05.

Figure 24: Summary of classroom learning environment mediation analysis

Finding: There was a non-significant indirect effect by motivation/self-regulation and the learning environment on students' CT skills post-test scores, and no effect whatsoever on the experimental/intervention group of students in an ITE first-semester MA class at a public teacher education university in Pakistan.

Value-added approach to analyse influence of motivation/self-regulation and classroom learning environment

In the section below the results from second round of analysis are presented. The rationale for this second round of analysis is in the methodology section.

Null Hypothesis 2: There is no linear relationship between students' motivation/ self-regulation strategies and the classroom learning environment; neither predict CT as an outcome.

Alternative Hypothesis 2: There is a linear relationship between students' motivation/self-regulation strategies and the classroom learning environment; both predict CT as an outcome.

1: Regression analysis of motivation/self-regulation (MSLQ)

A simple regression analysis (Table 30) was run to determine the extent to which motivational strategies for learning influence or predict CT skills from students' post-test scores. Using the enter method, it was found that this variable non-significantly predict CT skills, $F (1, 25) = 1.851$, $p=.186$, $R^2 = .069$. The analysis shows that the motivation/self-regulation does not significantly predict the learning of CT skills after four weeks of intervention implementation ($\beta= -.263$, $t (25) = -1.360$, $p=.186$).

Table 30: Relationship of motivation/self-regulation as predictor of CT skills outcome

Model 1	**b**	**SE B**	**β**	**p**
Constant	6.347 (2.205, 10.48)	2.01		p=.004
Motivation/self regulation	-.554 (-1.394, .285)	.408	-.263	p=.186

Note.
$R^2 = .069$
Constant= Intervention group students CT skills post-test scores

2: Regression analysis for classroom Learning Environment (LE)

A simple regression analysis (Table 31) was run to determine the extent to which learning environment influence or predicts CT. Using the enter method, it was found that this variable non-significantly predicts CT skills, $F (1, 25) = .016$, $p=.900$, $R^2 = .001$. The analysis shows that the learning environment does not significantly predict the learning of CT skills after four weeks of intervention implementation ($\beta= -.025$, $t (25) = -1.27$, $p=.900$).

Table 31: Relationship of learning environment as predictor of CT skills outcome

Model 1	**b**	**SE B**	**β**	**p**
Constant	4.14 (-3.65, 11.94)	3.78		p=.284
Learning environment	-.124 (-2.14, 1.89)	.980	-.025	p=.900

Note. $R^2 = .001$
Constant= Intervention group students CT skills post-test scores

3: Regression analysis of subscales of MSLQ

A simple multiple regression analysis was run using the enter method to predict the probability of metacognitive self-regulation and extrinsic and intrinsic goal orientation predicting or influencing students' CT skills post-test scores. The overall model fit of these variables significantly predicts CT skills: F (2, 24) = 3.872, p=.035, ΔR^2 =.181. Both the variables added statistically significantly to the prediction for CT skills post-test scores, p<.05. This means that the metacognitive self-regulation and extrinsic and intrinsic goal orientation component of students' motivational learning strategies has a positive linear relationship with the outcome CT and it predicts students' CT skills post-test scores. The coefficients of the regression are shown as Table 32 below.

Table 32: CT skills post-test scores as predicted by students' metacognitive self-regulation and extrinsic and intrinsic goal orientation scales

Regression model 1: Metacognitive self-regulation+ Extrinsic and intrinsic goal orientation(constant)				
ΔR^2	ANOVA			
1 = .177	F(2,24) = 3.872, p=.035			
Note. Constant = Intervention group students' CT skills post-test scores				
Variables	**B**	**SE B**	**β**	**p**
Extrinsic and intrinsic goal orientation	.445 (-.424, 1.314)	.27	-.474	.30
Metacognitive self-regulation	-.716 (-1.272, -.160)	.42	.188	.01

4: Results for regression analysis of subscales of MSLQ

A stepwise multiple regression analysis (Table 33) was run to determine the extent to which metacognitive self-regulation and critical thinking (subscales of MSLQ) predict CT skills from students' post-test scores. The overall model fit of these variables significantly predicts CT skills: F (1, 25) = 6.598, p=.02, ΔR^2= .177 and F (2, 24) =6.715, p=.00, ΔR^2=.305. Both of the variables added statistically significantly to the prediction of CT skills: p<.05. This means that there is a probability in this sample that students' post-test scores have a linear relationship with students' metacognitive self-regulation and CT components. In this model, metacognitive self-regulation showed an inverse relationship with students' post-test scores. The coefficient table for the regression is presented in Table 33 below.

Table 33: CT skills post-test scores as predicted by students' metacognitive self-regulation and critical thinking scales

Regression model 1: Metacognitive self-regulation(constant)
Regression model 2: Metacognitive self-regulation+ Critical thinking(constant)

ΔR^2	ANOVA
1 = .177	F(1,25) = 6.598, p=.02
2 = .305	F(2,24) = 6.715, p=.01

Note. Constant = Intervention group students' CT skills post-test scores

Variables	**B**	**SE B**	**β**	**p**
Metacognitive self-regulation	-.691 (-1.245, -.137)	.27	-.457	.02
Critical thinking	.733 (.095, 1.372)	.31	.414	.03

5: Value added regression analysis of subscales of MSLQ and LE questionnaires

Metacognitive self-regulation and the learning environment significantly predict the learning of CT skills when experimental groups' gain scores were entered as outcome. A regression analysis was run to predict student gain on CT skills from their metacognitive self-regulation and learning environment.

A multiple regression analysis (Table 34) was run to determine the extent to which metacognitive self-regulation and learning environment predicts CT skills. Using the enter method in SPSS, these variables significantly predicted CT skills: F (2, 24) = 6.463, p=.06, R^2=.350. Both of the variables added statistically significantly to the prediction of CT skills, p<.05. This means that the metacognitive self-regulation and learning environment has a positive linear relationship with the outcome of CT, calculated as gain scores.

Table 34: Relationship of students' CT skills gain scores as predicted by students'

metacognitive self-regulation scale and learning environment questionnaire

Regression model 1: Metacognitive self-regulation+ Learning Environment (constant)	
ΔR^2	ANOVA
1 = .296	F(2,24) = 6.463, p=.006
Note. Constant = Intervention group students' CT skills gain scores	

Variables	**B**	**SE B**	**β**	**p**
Metacognitive self-regulation	-.470 (-.802, -.138)	.27	-.482	.007
Learning Environment	-1.164 (-2.239, -.088)	.42	-.368	.035

Findings: The value-added analysis showed that there was a significant positive linear relationship between the cognitive self-regulation and extrinsic and intrinsic goal orientation component of students' motivation/self-regulation with students' CT skills post-test scores. The metacognitive self-regulation and classroom learning environment have a positive linear relationship with students' gain scores. However, the nature of the relationship is negative, meaning the higher the student metacognitive self-regulation the lower students' CT skills gain scores. The study also found that students' post-test scores have a linear relationship with students' metacognitive self-regulation and most CT components. In this sample, metacognitive self-regulation and learning environment showed an inverse relationship with students' post-test scores and gain scores after the CT skills instruction. The linear relationship of students' goal orientation, metacognitive self-regulation needs further attention and research in initial teacher education programmes for the development of CT skills.

6.4.3 Summary

The above section reported on the significant and non-significant relationships that were found in the main and value-added data analysis for the theoretically generated hypotheses to answer the quantitative phase of the study research questions. The second round of analysis theoretically built selected regression models to find and explore the relationship of CT skills intervention outcomes with subscales of motivation/self-regulation and classroom learning environment-related variables.

The findings were further strengthened when qualitative data were analysed, and the study reflected on the classroom situation and the behaviour of both the students and the teacher during the implementation of the intervention, and their interview answers. The analysis of data on follow-up interviews supplemented by observations of the intervention implementation for explanatory purposes is analysed and reported in the following section.

6.6 Qualitative analysis and findings

This section consists of four main qualitative analysis and findings parts: the students' experience of CT skills intervention; extreme case analysis; the teacher's experience of CT skills intervention; and observing the implementation fidelity and the classroom environment.

The analysis findings are grouped under main themes, which are broader grouping of findings of qualitative data. This is to reduce the breadth of qualitative findings and to enable a compressed line of argument across the qualitative data sets. These main and sub-themes were used in the findings and discussion in Chapter 7 to describe and explain the quantitative analysis results and the effectiveness of a carefully designed CT skills intervention.

The research questions for the qualitative component of the study are:

> Research Question 2: What are the participants' experiences of how a specific instructional model helped or did not help in the learning of CT skills?
>
> Research Question 2a: To what extent did implementation fidelity influence the effectiveness of a carefully designed CT skills instructional intervention to increase students' CT skills?
>
> Research Question 2b: What are the experiences of students and the class teacher of the carefully designed CT skills instructional intervention?

The interviewees were asked five interview questions covering the intervention experience, intervention design, problems and challenges, personal learning and feedback on intervention implementation. All were interviewed using semi-structured questions in the same order and, on occasion, probing or descriptive questions were also asked to encourage free expression of their experiences or when further clarification was needed. The purpose of 'What was participants' experience of the intervention' had a single objective; that is, to find out why and how the intervention was unsuccessful and therefore ineffective. The observations and field notes provided a confirmatory balance (when what was said and what was observed matched) or contradictory (what was said and what was observed contradicted the quantitative results and the researcher's observations) between predictions about the study results, rather than only relying on participants' personal accounts of how they felt or what they said.

6.6.1 RQ 2/2a: Participants' experience of intervention

1: The students' experience of CT skills intervention

The study interviewed several students about the experience, the challenges, the instructional approach, the personal learning and their feedback on the design and implementation of the intervention. The information allowed the researcher to answer the research questions about participants' experience of the CT skills intervention in an inductive manner and informed on the key features of the intervention failure and later discussion on how these elements interacted with the context where it was applied.

CT skills learning experience

The interview question for qualitative follow-up was first to ask the students about the experience of the instruction. The first question was 'How did you find the learning of CT skills through instruction during four weeks?' The main theme was named 'CT skills learning experience' for this question. The analysis of the data is presented with quotes showing the generic categories derived from original data.

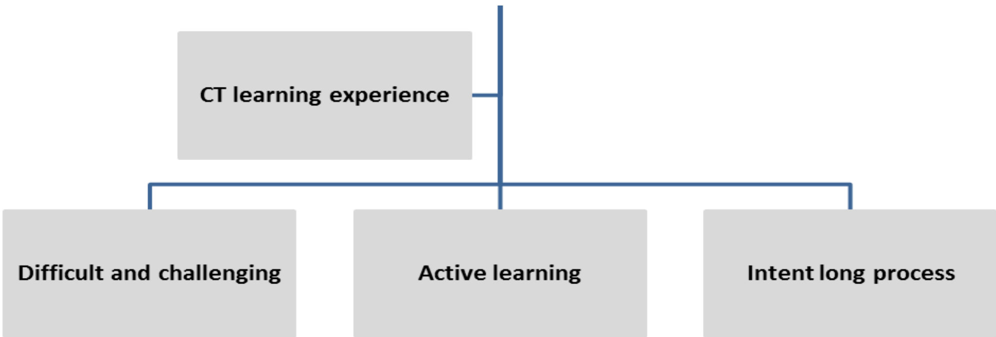


Figure 25 CT learning experience Main theme 1

The data showed that the process of learning CT skills was experienced variously by different students: some experienced it as a long, challenging and gradual process; some as an active process of learning, not passive; and others found it uninteresting and boring. Their personal accounts can be categorized under the following sub-themes.

Difficult-challenging

Students expressed that learning CT was not an easy task or experience for them. They experienced that effort more than regular was needed to think critically.

Intervention Student 3 could not understand what she was supposed to do in the classroom and it was hard to meet the goals, and expressed that, once she understood what was required from her, she thought the experience was good.

> I cannot understand anything and it was very difficult to meet the goals. Slowly... slowly I understand about the CT and work on CT then I realized that it is not difficult and my experience was good (SI 3).

Intervention Student 1 seemed overwhelmed by the different instructional techniques, and the way of learning was new and very difficult for her during the intervention, but after some time it became easier and interesting to follow the instructional programme.

> Many experiences like survey questions, video audio clips, and different activities. In the start it unknown for me and very difficult, but after one week I found it interesting and easy (SI 1).

The students described their experience of learning as difficult and overwhelming, because there were many things to pay attention to and tasks to be completed. They considered learning CT a gradual, slow process and, overall, their experience was good. This shows the complexity involved in learning CT as a process; the student is only able to recall the basic components of teaching CT when asked how they would summarize their learning of CT. It seems that students needed some time to adjust to the teaching-learning model that was being applied in these four weeks. The first impression was 'I cannot understand anything and it was very difficult to meet the goals'.

Active learning: enjoyed when actively participating

The students expressed that they enjoyed participating in the research, as it was active learning, and various learning experiences were designed to be participative and intellectually challenging. There were also accounts in student interviews that they liked this (active, student-centred) way of learning that (it was structured and simple). They defined the teaching/learning environment as good, active, attentive and participatory.

Intervention Student 1 said that it was simple (active) and not a boring way of learning. Simple ways of learning turned out to be due to systematic activities and the structure of learning CT skills step by step.

> It is a good way of learning and a simple way, simple way of learning anything and not boring (SI 1).

Intervention Student 5 said that the lesson structure made her more active, but the need to be both focused and attentive was difficult to deal with during these lessons.

> It made us very active and attentive, meaning we needed to be focused, concentrated and very carefully, made it very difficult (SI 5).

Intervention Student 6 did not express much, apart from that the experience was a good and that she felt good while participating.

> That was a good thing, when participating I felt happy (SI 6).

Intervention Student 2 expressed that his newness to the concept of CT skills and how to see things differently in daily life was a new and active learning experience.

> we have never thought about the things in that pattern… which we learned in these four weeks and… we learned how to, how to think critically about the different aspects of the of the things or work we are which we are to do in our routine matters and daily life. (SI 2)

Intent long process

The students understood that the CT skills learning process required much determination, time and effort. The multidimensional activities, pressure to take double classes, and the mismanagement of resources and class time made it a stressful and lengthy process.

Intervention Student 3 said that the process of learning CT was long and tedious, therefore it needed more time and a peaceful environment. She expressed that if there was less time pressure they would have been better involved in the learning process. This pressure could also be a reason for the lack of interest by students in participating in CT activities, as it was seen by students as some kind of enforced activity on them, an extra burden on top of all the coursework and exam pressure.

> I think, it’s not interesting, maybe it's a long process that first student…. meaning there was much pressure of time, even if we have any lecture free we were required for some task, so maybe if the schedule was different or some other way to lessen the workload was there, it would have been better and better involved (SI 3).

Intervention Student 5 reported problems with the technology and resources in the classroom, but said that she was happy to be part of a research project for the first time.

> Hesitating… actually it became boring to me, because of the projector, and listening. But I participated and I felt happy and first time part of a research (SI 5).

This student indicated the issue that the speaker’s quality was not loud enough for the classroom, and also the projector: this related to the teacher standing in front of the projector and blocking the screen.

Instructional approach

The CT skills intervention was based on various broad components (multidimensional approach to teaching CT skills) that were recommended by the literature. Main learning strategies were group work, collaboration, CoI (discussions), and working with concept maps and AM software. This interview question helped to estimate which design features were liked and found effective by students for learning CT skills, regardless of the overall effect of the intervention.

Students expressed various opinions about the tasks and activities presented to them. The interview question asked was 'What design features of instruction; for instance, learning in CoI, working independently and in collaboration, learning with AM software, discussions in broader and deeper meaning of curricular topics and the teacher's role they found useful during the whole process?' Most students liked the AM features of the CT instructional programme.

When asked about the experience of the instructional design applied to teach CT skills five categories emerged. These are described below.

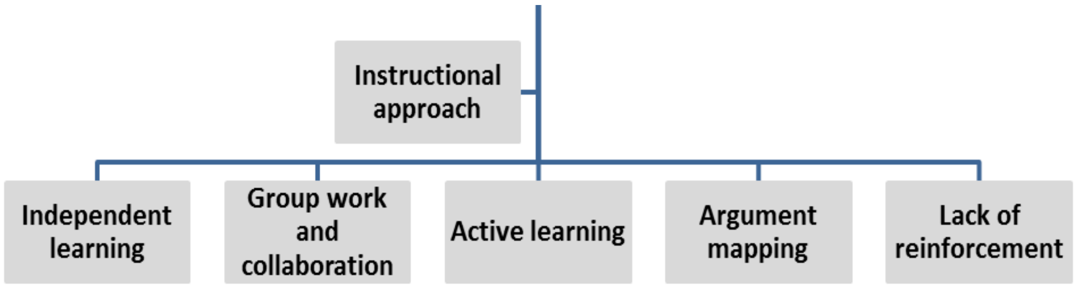


Figure 26 Instructional approach: Main theme 2

Independent learning

The students seemed to enjoy the independence and confidence in learning, which shows that the instructional approach was to some extent a positive experience.

Intervention Student 2 said while learning independently he experienced an improvement in thinking, and that AM helped to put in practice what was learned about the topic in the class. In groups, he learned to collaborate and share responsibility. He added that discussions also helped to improve his argument, thinking pattern and decision-making ability. This student evidently felt that this way of looking at curriculum and topics is better than the previous style of learning (traditional).

> when I tried to learn individually (independently) I was observing that my thinking is improving,… from those mapping software I learned… make maps of the good/topics… I will be more critical to think about it and evaluate. When we learn in group we learned how to distribute our work and how to work…. We learned the negative and positive… relation or non-relation with the main topic with the main heading. All these things we learned from these discussion which we done in group

> and individually my thinking pattern was also improved because when we thought individually about the good… about the selection of goods we did it in better now we are doing in better way than our previous thinking style. (SI 2)

Group work, collaboration and active learning

For these students' group work, a collaborative active learning experience of the instructional approach, was a positive experience. Learning in groups was liked by most students in this sample.

Intervention Student 5 said that we learn socially with our fellows. Learning AM was easy due to it being hands-on and activity based. The reading exercise was not liked by this student, because she does not like to read. However, the discussion was of interest and the student thought that one learns much from discussion.

> In a group of students was also good. Working with groups was normal, okay and we learned to think critically in groups. With my fellows, I could not make it with our friends because it was tough, it was tough... I can't make it without my friends. I found learning AM was easy because we did it practically, by our hands in front of us and by our mind. It was good. I am not a book reader so reading was not of interest to me; I read non-academic books. Reading the articles was not interesting for me. Discussion is too good for learning, by discussion I learned a lot. For me, I understand by discussion more better so that was good also. (SI 5)

Intervention Student 1 appreciated the active learning plan that included group work, working in a lab with AM software to prepare for the exams.

> before this period of critical learning we did not learn in classroom with activity and practical and group discussions and after and during CT course, to do group work, go lab and work in group and then after CT we also work… understand our exams (test and evaluations) in groups or... (pause). (SI 1)

Intervention Student 6 liked working in groups, and collaborating on tasks helped her to understand better. Sharing ideas while listening to others' ideas helped to broaden her thinking. While discussing in groups, the teacher being present to cooperate with students was liked by the student.

> we worked in groups, that was a good thing, you know like this firstly collaborated work we could learn better and understand more, secondly we share our ideas and we come to know what others are thinking and in this way our thinking becomes like vast thinking. Experiencing all types of group, individual and lab work was very interesting… (SI 6)

Group work was much liked by this class, and students liked working in collaboration, as they not only help each other but also take responsibility for their role in learning. This student expressed that in group work and discussion our thinking becomes vast (deep learning) and helps this student to discover and search an issue in depth.

AM

AM was seen as a helpful instructional tool for clear thinking and building logical arguments.

Intervention Student 4 expressed that learning with technology (AM) is an interesting and different experience. To this student, AM was helpful to structure the line of argument, claims or evidence, and how this can be applied to other subjects (transferability of CT skills). AM also helped to improve the writing of this student.

> *Learning with AM*: [Prompt] It was different and interesting. Earlier we never had done anything like this… the structure of the AM software helped to learn. We never thought of information that it is relevant or credible, no we don't. After this teaching we have learned all this and now we can apply it in other subjects as well. It improved my writing and it motivated me for learning. (SI 4)

Intervention Student 2 said that working with AM helped to develop a critical aspect in thinking. The student felt motivated through AM (use of technology), and even when they were not interested in learning, computer-enhanced argument maps helped her to see the structure of thought and kept students' interest. Learning in a technology-enhanced environment was also liked because the teacher was there to guide, there was proper planning and materials were readily available.

> I personally feel that I groomed myself… I can criticize and handle a topic, situation. Motivated through computer lab work that experience, even if we did not want to do but it was motivational as well because we could see the structure of thought and we also saw teacher as a guide and instructor there at that time and then we understood how it should be. That there was proper planning, software was available and we were given all the materials in USB that phase was motivating but there were some limitations to it as well. (SI 2)

Intervention Student 1 found the practice of thinking with AM helpful. It can be seen that the AM helped the student to see both sides of an argument, and being fair-minded can be a starting point in developing a CT skills disposition. The students also see the practice with AM as applied knowledge that they learned in class earlier.

> The entire lecture or with arguments and step by step and see the things very closely and think with own mind not read the books as it is. CT is very important that I have learned that whenever I come across any topic in any subject, I cannot take it as it is, we need to look at the positive sides, negative sides closely then we need to analyse, evaluate and then we will make some decision. Also we worked with AM on this type of thinking and building arguments which was a real application of what we learned. (SI 1)

Lack of reinforcement and reward for good work

One student explicitly expressed that there was a discouraging classroom environment, not encouraging. This was expressed by one student aloud, and it is important to give voice and presentation to all types of experiences about the intervention instructional approach. This helps in predicting ineffectiveness and its relation to various factors that could not be accounted for quantitatively.

Intervention Student 4 expressed that there was lack of reinforcement and reward for good work in this class.

> There should have been reinforcement for work and reward for good work, and that was missing. (SI 4)

Teacher's role

The role of the teacher in an instructional intervention is important. It provides deeper insights on implementation of the teaching programme, the student-teacher relationship, the reception of the intervention, and how the dynamics of teaching and teacher can affect learning and instruction of CT skills.

During the interview, the students were asked 'How would you explain the role that teacher played during these weeks of instruction?' Almost all students were hesitant to answer. I observed that it was important for them to keep the teacher's estimation and most avoided any answer that might make him unhappy. Almost every student paused longer, and looked for ways and words to state it nicely when commenting on the teacher's role during this time in general. Moreover, as the teacher's behaviour was polite and helpful to the students, I observed that they trusted each other on the basis that, as students, they did not complain about how he taught and so that he would give the marks and leverage that they needed to pass this course in their short attendance, as it is a semester system at this university. The main theme emerged as teachers' role from data.

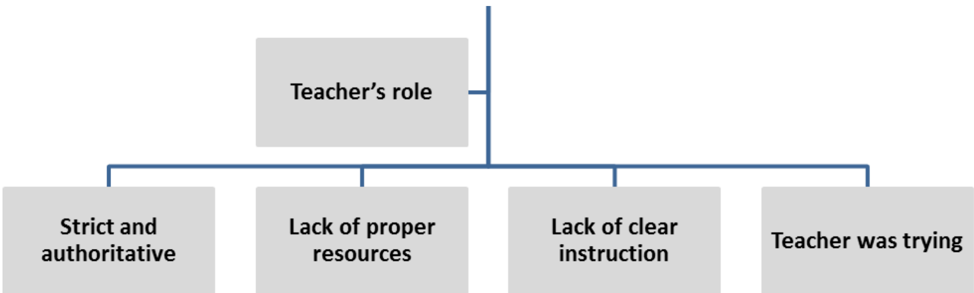


Figure 27 Teacher's role: Main theme 3

Strict and authoritative

Intervention Student 1 described the teacher's teaching style as strict and authoritative. The students considered that during this CT skills intervention teacher's teaching became more student centred and earlier there was monotony in the class, and now they see the teacher making efforts educationally to teach, approach and guide them. This student sees the influence of the instructional intervention as not only improving the teacher-student personal relationship but also the teacher's teaching habits.

> Earlier we were new to the university (students are in their first semester) and we did not had understanding with the teacher, now we are more familiar with the teacher, he is using group work. He used to come to the class and teach strictly and would go out but now he is teaching us like making us understand things, he personally conducts the group work, personally get us work, now we have come to an understanding with him, Now if we find a problem or are stuck in studies we can go to him and ask him easily. Earlier we were frightened to go to him and talk to thin. So, now it does not feel that much. When we all go to the lab, work together so we improve the relationship and improved our learning. Ma'am after taking the class with CT we see all the things critically with arguments. (SI 1)

Intervention Student 3 was hesitant to criticize the class teacher in front of the researcher, either due to the teacher-student power relationship or just to please the researcher. Mostly students showed fear or reluctance to judge the teacher's teaching. A student, when asked about how effective teacher's role was during the intervention replied hesitantly, even stopping or leaving the answer unfinished.

> (pause, hesitant) teacher role was effective he was there when I needed some guidance. Whenever I felt difficulty in thinking about different aspects of the or the setting of the… (reluctant, animated and shows fear) (drops the sentence in the middle) (SI 3)

Intervention Student 2 was quite vocal about how the teacher could have improved the learning experience. They reluctantly pointed out that the class teacher seemed to have limited knowledge of the field and could not explain things with clarity. Students hesitated to raise questions, as this might have had annoyed the teacher, so they just quietly took part in the class activities. This student also wanted to say more, but then stopped in the middle and changed his way by suggesting that, by the end, the students realized that the key to learning CT is practice and that they had no questions about teacher's effectiveness: they had learned a great deal.

> that (pause)… teacher also were very helpful but there is a point which I thought… the teacher told the things but in a limited way, like the knowledge of the thing that teacher gave us was limited. If that was explained we could have learned in a better way and we did not raise questions because sir… sir (Teacher's name) was explaining the things (dropped the subject). We concluded that the answers of the questions we had in mind will be solved with practice which we were making with the work, exercises and working on software. At the end we realized the answer is in practice at the end we had no question at all we learned a lot. (SI 2)

Lack of proper resources and clear instruction

Students reported a lack of proper resources and audio-visual aids, and a poor teacher's role (lack of preparation, lack of teaching skills, no clear instructions and lack of clear communication).

Intervention Student 3 was aware that it would have been better if the teacher knew how to convey the set of activities to the class. This also means that dealing with activities during the class or conducting group work was not the usual style of the teacher, and perhaps that was why he was uncomfortable.

> I think teacher, teacher as well as the resources, proper sound was not there, and easily we could not listen to the video/audio. Teacher was not perhaps prepared and did not pre-planned, meaning if he had a plan to teach, he did not seem to be clear how to do it, he had the knowledge but he was unable to convey, how to convey. And we had this talk in the class that we understand that why he is not able to convey, may some other type of activity would have been better. (SI 3)

Intervention Student 2 seemed aware of teacher's ineffectiveness and expressed that if there was a better or different teacher the student/class would have had better results. This student thinks that they were not using their full potential and they could have achieved different results.

> Okay, teacher has to be or needed to tell us clearly, a proper instructor I feel there were to be a better teacher and we would have given much better results than this. (SI 2)

Teacher was trying

Some students viewed that the teacher was making an effort to teach through this instructional approach, and had played a motivating and cooperative role. One student who was not regularly attending classes expressed that she could see that the teacher was making an effort to teach CT-embedded classes.

Intervention Student 5 expressed that without teacher no learning can happen and it was evident that this class teacher is trying hard to cope with the demand of the CT skills instructional course and the approach.

> Class teacher have their own points. He did effort and we could see the effort that he was making to teach us. Obviously without teachers nothing can be complete. I have not done regular classes. (SI 5)

Intervention Student 4 felt that the teacher was a motivating and cooperative figure for some students. He was explaining the audio-video, so the students liked it.

> Teacher was very motivating, and video we could not understand so he explained well which was good. (SI 4).

The role of teacher appeared as a major influencing variable, not only from students' interviews but also from the analysis findings of observations and field notes.

Students' personal learning

The question, related to personal learning, was to check students' improvement in personal learning related to CT skills or any disposition towards CT that could not be measured quantitatively to help in estimating the impact of introducing CT skills in teacher education courses. The question was asked 'In what aspects of personal learning (improved focus, improved motivation, improved logical thinking and so on) they improved or experienced during the intervention?' The analysis findings are presented below.

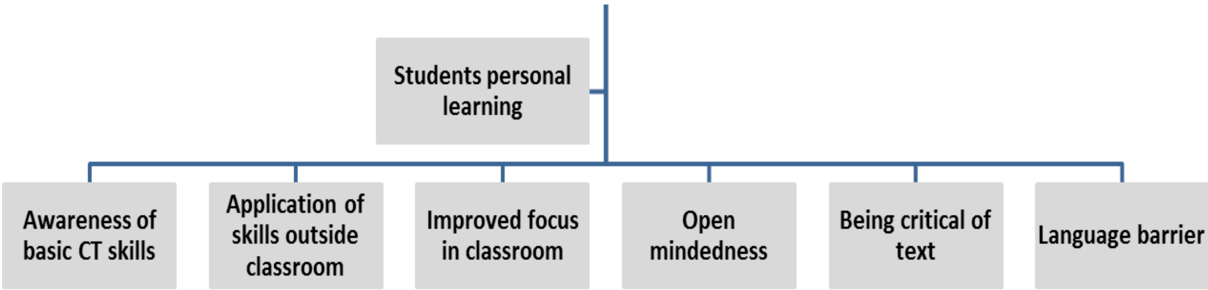


Figure 28 Students' personal learning Main theme 4

Awareness of basic CT skills

The students' accounts showed that they learned the basic idea and meaning behind the CT skills.

Intervention Student 2 expressed that his personal learning of basic CT skills improved and he tries to link his learning to the class task. He learned to identify the rules of reading and criticizing a writing, evaluating written materials for their credibility, unlike his previous learning methods in which he only read and memorized the learning materials.

> the CT that we learned last week developed us or in me... to decide whether the given the paragraphs (arguments) are related to the main paper or not… Like when we did assignment 2, …before this when we did study about any topic, we did not used to care about these things. And before these classes I have never noticed these things... I just read the paragraph and keep on memorizing. (SI 2)

Intervention Student 3 expressed that although she cannot claim to have learned CT, she has an idea of thinking critically and what it involves. The student shared her experience that earlier the classroom teaching-learning was only for achieving a pass mark, whereas now they actually thought about the curriculum and discussed it. This student liked the open environment for communication and the process of productive learning in terms of practising CT. On the other hand, an issue that concerned her was time issue and the lengthy procedure.

> I personally felt that I… that I have learned the sense and idea of CT, earlier we were like careless not thinking and doing work for the sake of getting passing marks. But during this time, we actually thought about the topics and if there is a topic we discussed it, we made argument maps… an open environment for communication and negotiation among instructor as well as among students. (SI 3)

Intervention Student 4 referred to learning CT as personal grooming and found the whole instructional plan - learning materials and activities and building argument maps - helpful in building their confidence in their ability to think and criticize, and even the class teacher motivated them sometimes and the student is confident to build arguments in future, if required.

> Okay I personally groomed myself; I criticize each topic or the activities, and that last time… the theories and all the materials and mapping that helped a lot to have an idea in what aspects we have to criticize means on what bases and how many ways we can criticize. Over all I have improved myself before this I think I did not had this ability meaning also it has built my confidence and the instructor tried to motivate us sometimes. Yeah and I can build arguments more, in future in any field when required. (SI 4)

From this account, it seems that the student started to recognize the patterns and steps involved in thinking within the four weeks of experiencing CT. The student was able to keep an open mind towards information presented to them and were using their cognitive skills of analysis and evaluation at an introductory level. The student also seemed to recognize the dispositional component of CT; for instance, effortful cognitive work to draw plausible conclusions about written material.

Application of skills outside classroom

Some students considered the application of CT skills outside the classroom; this can be said to relate to the application of CT skills and the transfer of learning outside the classroom.

Intervention Student 2 pointed out his changed perception of things and how he looks at both positive and negative sides of issues, deducing meaning, relevance and ambiguities. Earlier, for notes and classwork, he used to rely on memorizing the content, but now focuses on understanding and adding personal meaning.

> I feel that (pause) I am having a big change in shape of CT and I am thinking in a better way about the course and about the different aspects of the things or topics or products and my selection about the things has been very well, after these classes. (SI 2)

Improved focus in classroom learning

An improved focus on learning, being attentive and careful has been described in various ways by students; for instance, in Main theme 1, when asking about personal learning, the improved focus appeared as a positive impact, but when describing the experience of learning students felt that it was challenging, difficult to focus and be attentive.

Intervention Student 5 expressed the impact of systematic learning programme as becoming more focused and conscious of thinking. She also said that it motivated her, but only for this project, and that this experience would help her on working at the tasks.

> I am very careless, unfocused, when we worked on this project I became a thinker, I started thinking. It motivated I improved me but only for the project, it will help me in working on tasks. (SI 5)

Open mindedness

A few accounts were about an awareness of being inquisitive, critical and open-minded. Although it is hard to measure precisely students' development of CT skill, with the current non-significant results of the study, some accounts showed an awareness of the concepts, at the very least.

Intervention Student 6 said that undergoing this experience was a start to thinking independently, learning to deal with difference of opinion or opinions of others, and how to put forward one's position. For this student, learning CT during this time had opened up her mind and she now reflects on all things.

> I started looking and thinking at things by ourselves and started thinking how to deal others and how we have to put our claims, the advantages and disadvantages. It has opened my mind I see all things critically now. (SI 6)

Intervention Student 4 expressed that learning CT separate to the curriculum was not helpful rather he/she learned the same skill embedded with the curriculum topics, it was useful.

> As I told you before, I did not know that how we have to look at things and phenomena and after this experience we learned about critical thinking. When you learned separately it was not helpful, when you learned the same topic of curriculum topic then I found it useful. (SI 4)

Being critical of the text

The students had no idea how to read, evaluate and criticize a text, and the practice of such tasks in the classroom was somewhat alien to them.

Intervention Student 2 explained how he learned to analyse writing, for instance educational articles, and now she evaluates it and thinks about how she can add her point of view to it by judgement based on criteria.

> the relation of concepts, which writer is giving all examples which write is concluding, I am able to evaluate or judge in better way that these things are related or not or what more can be added into this or what things could be added in this paragraph and what things are extra added in this writing. I am able to judge all these things. (SI 2)

Language barrier

English as a second language was reported as a potential barrier to performance, interest and understanding.

Intervention Student 2 said that, despite the teacher's explanation, their understanding of the CT process could have been better if the learning materials were in Urdu.

> I think it were have been better if we read Urdu because in English some student have problem to understand, if I understand or some students can understand but there many student who are not able to understand in a better way, in English so there way of communication so(pause) if this were in Urdu at somehow or the like

> teacher's teachers tried to translate everything and the paragraphs we had received that were also in English, the assignment but I think so if those were in Urdu that was better or that would be better to wide our thinking approach. (SI 2)

Intervention Student 5 expressed that she experienced difficulties in understanding due to a lack of listening skills in English. She thought she was better in speaking, and that was why audio-video lessons were the part of the CT skills that she could not understand.

> I had a lot of problems for English language. I can speak little bit better in English, but in way of listening I am not good. So there were difficulties (SI 5).

Intervention Student 6 expressed the same problem with listening to videos as a barrier to understanding the CT skills lectures, and said that if the materials were provided in hard copy or if the videos were translated into Urdu, it would have been better. The attention and focus was not so much due to poor audio quality as a lack of familiarity to listening to English.

> the language problem, because if we get it written may be we would have get it better. Maybe if the audio-video clips were written or a hard copy it would have been better. Because while listening to clips my attention can divert but if I have had a hard copy I could go back and see where I was (SI 6).

Feedback on intervention implementation

Another important aspect was obtaining the interviewees' feedback on the experience of the intervention in terms of its quality and fidelity of implementation. This question was aimed to identify potential problems, difficulties that could not be covered during this time and will help to improve the intervention teaching plan, especially in the context in which it was applied and for the teaching CT research field. The interview question asked was 'What could have been improved or implemented in a better way?', and the categories emerging from data analysis are presented below.

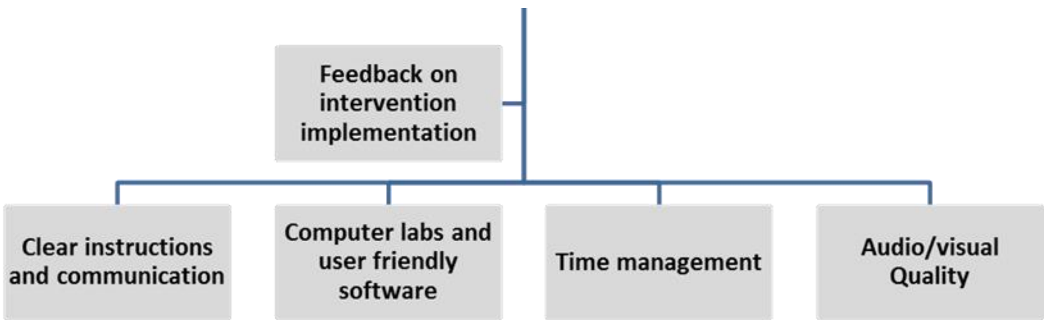


Figure 29 Feedback on intervention design and implementation Main theme 5

Clear instructions and preparation

The students provided feedback on the implementation of the intervention. This revealed certain contextual factors affecting its effectiveness. Students reported on the teacher's lack of communication and preparation in various ways, for example saying that there was no clear communication, no reinforcement and no preparation on the teacher's side. The class teacher's performance seemed to be a major influence on students' learning and performance.

Lack of clear instructions

Intervention Student 2 thought that the teacher needed to be clear when teaching and providing instruction, and that he felt that they would have given much better results if there was a better teacher.

> Okay, teacher has to be or needed to tell us clearly, a proper instructor I feel there were to be a better teacher and we would have given much better results than this. (SI 2)

Lack of reinforcement from class teacher

Intervention Student 1 identified why there was less interest from some students. She observed that due to much work but no evaluation marks, the students did not take the class task seriously. Students were not coming to the class because of all the work that they had to do, but if they came to know that the assignments and classwork were to be marked, they would become focused. This student suggested that giving marks for class activities could have made students keen and attentive.

> I have observed that many students would sit outside in the ground when there was this CT class, and they did not do the assignment but one assignment had marks and when they come to know it had marks, everybody was in the class. So, I think if the class teacher had communicated well beforehand about the tasks and that they have 4 or 5 marks, everybody would have been more keen and attentive. (SI 1)

Teacher's lack of preparation

Intervention Student 5 expressed that the teacher's unplanned lesson and lack of clear instructions seemed to be a barrier even to implementing the CT skills programme properly. The class teacher did not only lack preparation. The students remained under pressure during the entire time of the intervention, as the exam dates were being changed constantly, there was uncertainty, and time and exam pressure were hanging over them.

> It could have been implemented better. Over all the results of our class have improved and secondly the teacher could not convey to us easily and he was very strict. And student did not like the strictness and then personally the studies pressure was there, exams pressure. (SI 5)

Intervention Student 4 said that lack of planning and the teacher not being prepared for lessons were issues. The student did not elaborate on this point, even when prompted.

> lack of few things, yes teacher must be preparing for lecture or proper time management, lack of meaning, proper pre-planned, it needed to be pre-planned and prepared, meaning it was not at all pre-planned by the teacher (SI 4).

Computer labs and user-friendly software

The computer labs were described as in a poor condition. Because of this, the software could not be fully installed. Moreover, the communication of the teacher was again mentioned as a barrier to learning CT skills.

Intervention Student 2 informed that the computer lab where they worked was not up to date and they had difficulties in using the software with all its functions active:

> yes, I have said before like when we went to the computer room, there were not proper software and the computer on which we were working was not working properly so that should be better, and after that… communication, communication way of the teacher. (SI 2)

Intervention Student 3 said that the computer lab, its management and time issues were issues that could have been improved.

> The computer lab was not up to date and managed, and time issue and long process (SI 3).

Intervention Student 6 expressed the need for better software.

> Okay user friendly software should be there to ease the process of CT. (SI 6).

Time management

Students also expressed that ineffective time management and teacher's authoritarian behaviour needed to be improved.

Intervention Student 3 saw the time not appropriately managed by the class teacher and felt it was too strenuous, due to implementing the intervention.

> Also the time should be short enough but equally managed. Not like teacher is calling you for extra classes to teach the course so it was so meaning like we were mentally tortured. (SI 3)

Intervention Student 5 expressed similar and said that actually the teacher did his job quite well, and that there was nothing lacking in the whole teaching plan. However, this student showed the same kind reluctance before in commenting on teacher's performance.

> actually (reluctance) Yeah time was short, there was little more time I could be better and we the whole class had less time with the teacher and that was an issue. But in little time in that little time teachers did very good job and they performed very good and they taught us very well even in this short time (reluctance)… there was everything I don't think there was lack of something just the lack of time was the issue. (SI 5)

Audio/visual quality and translated materials

The speaker quality needed to be improved and the material from audio-video clips needed to be in print form as well.

Intervention Student 6 suggested language as a barrier and pointed out that it would have been better if the materials were translated.

> Speakers, and if we had a print copy of the clips as well, also the language may be if translated into Urdu, it could have been better. The best was if we had it in written form (SI 6).

Types of challenges

The purpose of this question was to inquire what challenges they faced, cognitively or contextually, when learning CT. The question was 'What type of challenges did you experience during this period of time?' The answers explained many reasons why the intervention was unsuccessful and contextual factors related to its ineffectiveness and teaching/learning of CT skills.

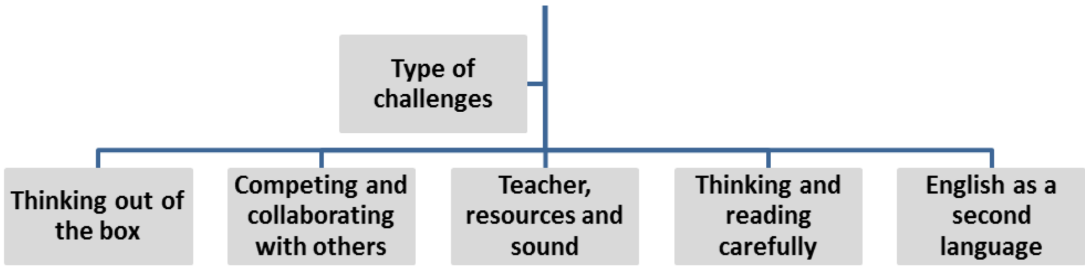


Figure 30 Types of challenges Main themes 6

Thinking out of the box

For most students, thinking in a rational, logical way was the most challenging task, as they had to change their previous learning habits.

Intervention Student 2 replied that the challenge was to think 'out of the box' about issues, and that they were trying something very unusual and unlike the traditional way of teaching/learning. The student also admitted that after some time and with practice they were able to do so, and understood its use and purpose.

> the challenges we faced, actually we had never thought in a pattern like this, we now think about the products, or other things or their condition. We thought in our old style of thinking, now we faced difficulty in adopting new style of thinking. when we thought about the things about in negative and positive patterns, benefits and disadvantages of the things, that was… critical and… disturbing to think in a new way but after short practice we are able to think about the things in that way and now we have an idea to, we have learned to make better decisions about the things (SI 2).

Competing and collaborating with others

For one student, the challenge was to compete with other students when working on class tasks.

Intervention Student 3 explained that in working with diverse interest-based groups where all group members were not working with same interest, it was hard to accomplish tasks. It seems students were experiencing a lack of interest in class activities.

> My challenge was to compete with all other students who were also part of learning CT (in this class)… was the most complicated task for me… many students were not interested. Means, it was like even if we were working together in groups, we did not have bonding and lack of group communication and the minds were not settled and most of the work was like time passing and no body tried to work properly. (SI 3)

Teacher, resources and sound

A student noted that the teacher was also a challenge during this intervention, as well as the lack of resources and proper sound.

Intervention Student 3 mentioned that both the teacher and the audio-video were a challenge for her during the intervention.

> I think teacher, teacher as well as the resources, proper sound was not there, easily we could not listen to the video/audio, the voice was not clear and every student did not find it easy to listen. (SI 3)

Thinking and reading carefully

Thinking carefully and thinking better were difficult and challenging for a student during this time.

Intervention Student 5 said that in reading with concentration and to answer the questions or complete class activities, the tasks demanded them to be focused and attentive, and made them difficult to accomplish.

> I think making myself thinking, and thinking better, reading carefully and make my thinking was difficult and was too challenging because when we were given the passages to read and give answers. It made us very active and attentive meaning we needed to be focused, concentrated and very carefully made it very difficult. (SI 5)

Intervention Student 6 said that thinking in a critical manner by putting an element of thought into the process of reading and looking at issues was challenging.

> Challenges umm, meaning there were many, looking at everything with a critical perspective and means to evaluate it and judge etc., it was new for me (SI 6).

English as a second language

Intervention Student 5 expressed that the classroom environment and the pace of the class lesson were uncomfortable. Learning materials in second language (English) were a challenge. Also, the poor quality of audio-video lectures did not help much. Students felt excited to see the projector and the use of technology in the classroom, but felt bored and lost interest shortly after experiencing the teacher’s lack of planning, inadequate resources, the general learning environment of the class and difficulty in understanding the high-level curriculum tasks. The student expressed an inclination to develop personal skills, but felt that context, resources, teachers and environment posed a challenge to their progress.

> It was good, I learned, the assignment were good and valid and I suggest that the language and environment must be considered. Things in a second language should be given in different ways; I mean the audio-video only could not help me much. I was excited first but when I was watching the projector, so the attention span diverted it was me or the video was making me so... I don't know. So I want that according to the environment, mental level. Teachers must push us for the betterment, but we do not have resources for this, I want to develop my skills, many problems our backgrounds, teachers, environment affect us. I don't think in Pakistan we don't have environment like this these little problems of resources make us backward. Our listening power of English is not so good. I see English movies but I read the translation (translation ribbon running under the screen). (SI 5)

The next section presented the analysis of teacher's experience of the intervention.

2: The Class teacher's experience of CT skills intervention

The study interviewed the class teacher for the purpose of explaining the intervention results. It was observed during the intervention that the class teacher appeared to have great influence on the intervention implementation. Similar questions were asked, for instance on the experience, the challenges, the instructional approach, the personal learning and the feedback on design and implementation of the intervention. The purpose of obtaining the class teacher's perspective was to seek explanations that the teacher, as a participant, might have recognized in the importance of his role. This role incorporated both implementing the intervention and acquiring knowledge about his experience of teaching CT skills as an interventionist. The information allowed the researcher to answer the research question about participants' experience of the CT skills intervention, and informed the key features of the intervention and how they interacted with the context in which it was applied.

Teaching experience

The class teacher was asked to describe his experience of the intervention and to what extent he thought it was useful. He hinted that in the Pakistani culture of teaching/learning it was quite new. He elaborated on his beliefs about students, indicating that they are not seen as ready or responsible enough for independent learning in such ways as CT skills. The teacher was asked 'How did you find the teaching of CT skills through instructional intervention during four weeks?' The three main categories from his reply are presented in the figure below, and the details of the findings are explained further.

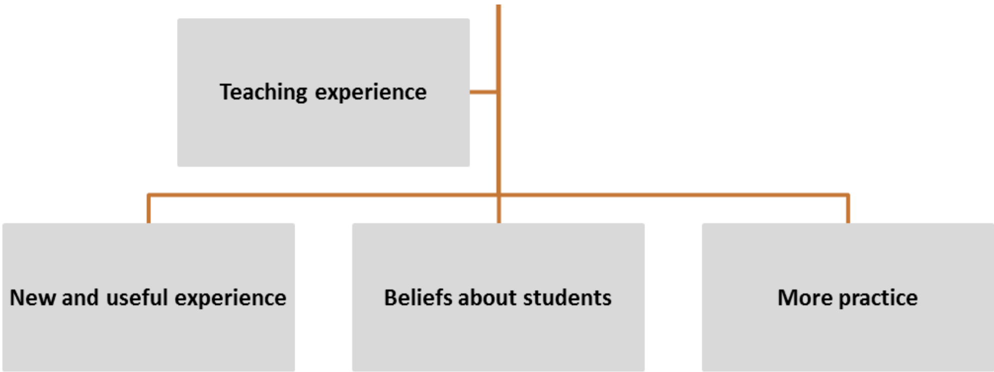


Figure 31: Teaching experience Main themes T1

New and useful experience

Intervention Class Teacher found the teaching of CT skills to be a new and amazing experience. He found the programme of teaching and teaching materials well defined and elaborated.

> It was marvellous experience, it was really a new thing even for me and the programme was very well defined and elaborated, the video audio clips were also very helpful for teaching to students about CT and the practical assignments, the drill exercises which were implemented during each lesson of CT and gradually the… it was really fine experience for me. (Class teacher)

Beliefs about students

Intervention Class Teacher said that the experience of teaching this way was new to the cultural practices of teaching-learning. The students generally do not take responsibility of learning and depend on the teacher.

> I think students were as far as students umm students' learning, it was new thing for students and the method was also new in our cultural practices of teaching/learning because our students are most of them are not habitual of they are dependent and they mostly depend on teacher and they are unable to accept the responsibility of learning by themselves. So it was new experience for them, anyhow they took interest and they learned, I think they learned a lot.

More practice

Intervention Class Teacher said that although the programme of teaching was different and new, students took interest and learned but that there is still a need to have more practice in teaching/learning. He emphasized that the programme of teaching was good for the general teaching-learning process.

> Only the need is to make more practice for teaching them and this is what I think, this teaching/learning experience was really fine and useful even for more common and general teaching/learning process.

Teaching challenges

The purpose of this interview question was to go beyond the failure and try to establish what ground challenges the teaching of CT skills poses for a class teacher when it is made part of a natural setting. The challenges faced by the teacher would show what compromises were made about the intended implementation of the CT skills intervention and if these affected its effectiveness with this group. Broadly speaking, beyond policy, this was what practical concerns, limitations or challenges this teacher faced in teaching CT skills in an ITE programme in Pakistan. The interview question asked was: 'What type of challenges did you experience during this period of time?' The three main categories from reply of the teacher emerged, presented as the figure below, the details of the findings are explained further.

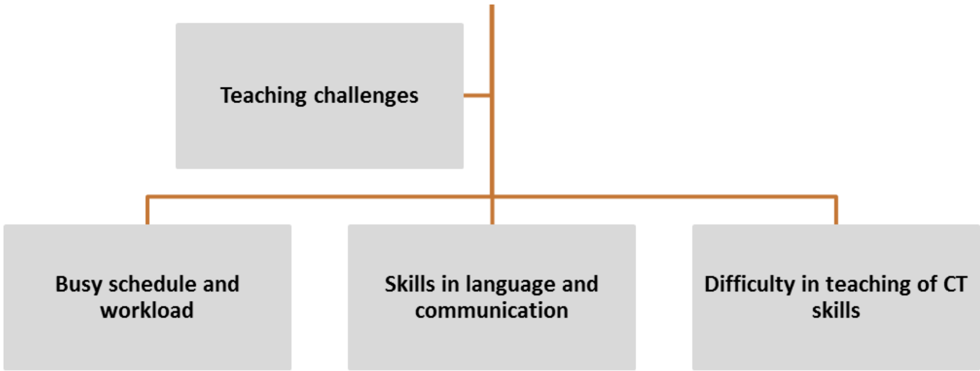


Figure 32: Teaching challenges Main themes T2

Busy schedule and workload

The busy schedule was a challenge for the teacher. Due to various teaching and non-teaching commitments, the teacher felt unable to cope with the demands of the course, mainly the amount of reading and preparation that was required in teaching CT skills. The teacher mentioned that management tried its best to facilitate the researcher.

> We have to work on some other assignments along with the teaching assignments, we have to work our own official assignment sometimes so that's why I felt problem to cope with this. Anyhow the management tried to facilitate the researcher and me as a teacher facilitated a lot.

Skills in language and communication

Intervention Class Teacher said the main challenge he faced was regarding language, as his ability to communicate in English was limited and he had to use mixed Urdu and English to deliver the concepts and materials to students. However, he avoided accepting his own limitations of skills in teaching and limitations of English language.

> I faced the challenges regarding the language problem, so this was the main barrier, because our students are not habitual of total English medium of instruction. We have to use a mix language; we have to use the concepts in our national language along with the English. The main challenge was language barrier and the other challenges are our busy schedules.

Difficulty in teaching of CT skills

Intervention Class Teacher also found the whole experience of teaching to be challenging. The audio-video based learning materials were ineffective and the teacher suggested that if there were hard copies as well, it would have made the CT skills audio-video lessons more understandable.

> the other challenge was, this experience, this other challenge was in this sense that these lessons were based on listening, I think, there should be a written material particularly of the videos, so that it could be more beneficial for students… I faced problems of extensive reading of the material that I found for this project, so this was the second challenge. I think these were two main challenges that I faced during this process.

Instructional approach

The class teacher was asked about the instructional approach or the teaching programme that he had to apply. The purpose of this question was to trace inductively the reasons of failure of the intervention by looking into teacher's beliefs and perceptions of the intervention, the lack of implementation fidelity and the intervention curriculum. I (the researcher) asked the same question that was asked from students what design features of instruction; for instance, learning in CoI, working independently and in collaboration, learning with AM software, discussions in broader and deeper meaning of curricular topics and the teacher's role that they found useful during the whole process? During the interview, it led to two more sub-questions about the curriculum and teacher's own role. The main themes emerged from interview question 3.1a are presented within the teaching and teacher beliefs theme and from the interview question 3.1b that was related to the teacher's role in the intervention is presented as a sub-main theme under the heading of role of the teacher and as a figure in sub-main theme, 3.1b.

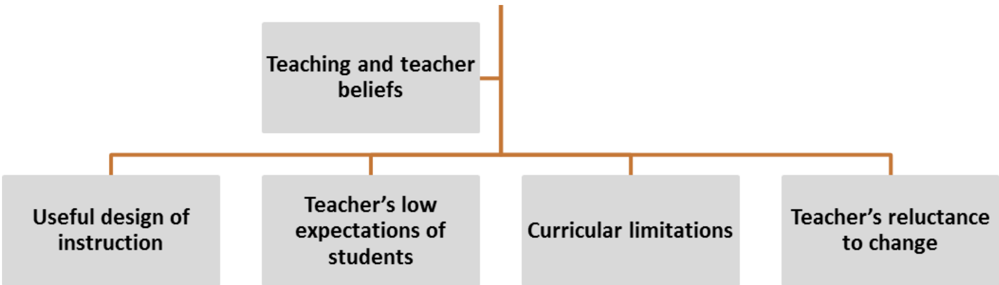


Figure 33: Teaching and teacher beliefs Main themes T3

Useful design of instruction

Intervention Class Teacher found the design of the instruction very useful however, there were some problems. The teacher stresses the importance of methodology (instructional plan) and design features especially CoI, collaboration and argumentative software and expresses his interest in future use of this method (CT embedded instruction).

> I found this design of instruction very useful and very fine. Anyhow I can't refuse the importance of this methodology. It's really useful and workable teaching/learning strategy to enable the students work in CoI, collaboration, to work on argumentative software so I can't deny its importance. So whenever get a chance I will apply this method in my own teaching.

Teacher's low expectations of students

Intervention Class Teacher said that the students in his opinion are unable to take the responsibility of learning for themselves, they are not used to it although on the contrary the teaching is going to change in Pakistan but it will take time. These kinds of learning experiences are not common yet students worked eagerly. They will need more practice and drill on it, with practice students will perform better on AM.

> Anyhow I found some problem, for example, the one problem that our students as pointed out earlier, that they are not, they are unable to take responsibility of learning by them. So they are mainly dependent on teacher so they are (dropped the subject), no doubt, in our country the teaching is going to change and our classroom is also change in practices like working in communities, groups and collaborating. But (emphasized) these kind of experiences have not become so much mature right now but this would need more practice and drill on this work. So I think with more practice they can perform well on this.

Research Question 3.1a How did you find teaching curricular topics in a broader and deeper meaning with the help of CT?

Curricular and time limitations

Intervention Class Teacher explained that teachers cannot go outside of the course; they have to follow the course outline and need to finish it in a short time. Teachers do have some flexibility in choosing topic due to time constraints.

> In our format, our courses and the format of our programs and our teaching in different courses, we have to strictly follow the course outlines so we have to teach according to the limitations of course outlines. Anyhow we individually want some topics, we try to teach with the deeper study of topics or knowledge or and we according to the teaching.

Reluctance to change

Intervention Class Teacher explained that the usual way of teaching in his class was that course outlines are normally distributed among students by topic, and that they search, prepare and present material in the form of assignments. In class teacher's opinion, this is quite deep learning that is provided to students in the form of distributed course outline topics that they collect material and present on their own.

> Along with the teaching through course outline we assign the students course outline, in this we assign them to study, to search more material and study and recent in course outline shape and that allow them, the students, they work more... deeply on the topics of assignments so this is of course in sessional practices the

> student studies the course outline deeply and present it in the shape of assignments in the classroom.

Research Question 3.1b How would you comment on teacher's role in general during this intervention implementation?

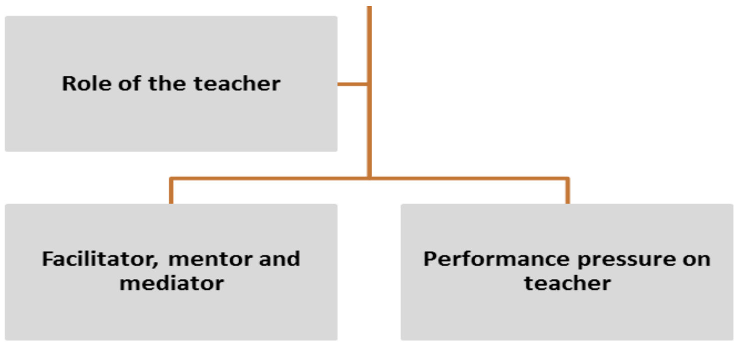


Figure 34: Role of the teacher Sub-theme, T3.1b

Facilitator, mentor, mediator and knowledgeable

Intervention Class Teacher commented on teacher's role, in that it has to be that of a facilitator mentor and mediator in this type of teaching. The teacher has to guide students on each task, for example on collaboration while working in CoI and when working on AM, therefore he needs to be knowledgeable. The teacher has to be encouraging to the students as well.

> I think that the teacher role was really important in this sense that the teacher has to work as a facilitator and mentor and mediator on this project, so I think without teacher we cannot implement this project.

Performance pressure

Intervention Class Teacher was aware of his vital role as the teacher for the implementation of intervention in this study. This responsibility to lead or complete the project seemed to be pressuring the teacher, as he had to be out of his comfort zone, and the teacher's words 'teacher he has to perform in this project' convey the idea that he was perhaps under pressure.

> I think it's the role of teacher very crucial, very important for the implementation of this… the teacher role is not is only facilitator, encourager, this sort of role teacher has to perform in this project….

Personal Learning

The class teacher was asked how he personally experienced this intervention and in what aspects he thought he had improved or learned. This interview question helped to gain explanations about the teacher's competency or lack thereof in teaching and implementing the instructional intervention as intended, since the teacher had been given some prior on-the-spot training and support for teaching. The teacher was asked 'In what aspects of personal learning or improvement in teaching have you have experienced during the intervention?' The teacher's answer provided the following themes.

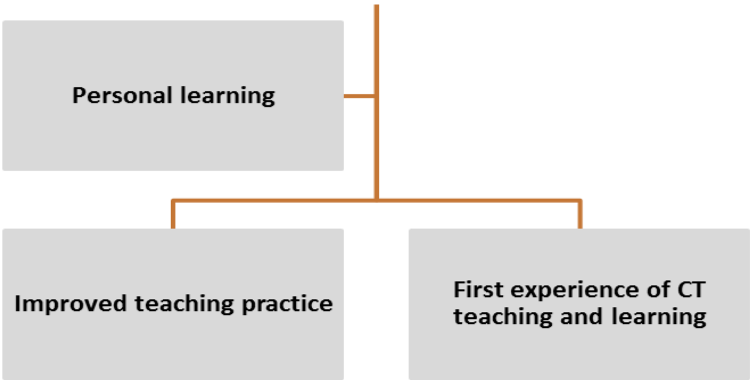


Figure 35: Personal learning Main theme T4

Improved teaching practice

Intervention Class Teacher felt that he has personally improved and learned much during this intervention, and especially the experience of building learning arguments using CT skills was new to him. Teaching in a systematic way surely helped the teacher to improve his professional skills as a teacher and he found it useful. The teacher has found that the experience itself helped him to improve/learn CT skills, for example analysis, evaluation and inferences.

> I have even learned myself from this method, it was new thing for me, particularly argumentative software, as I never had used this software and, moreover, the CT skills (principles and components)… all these things that were designed in a systematic way. It surely helped me in improving my teaching, even in future for my teaching I find this method very helpful to improving my own even CT skills, practices etc.

First experience of CT teaching and learning

Intervention Class Teacher's response to personal learning about CT skills shows his unfamiliarity with the concept and components of CT. The teacher realized his own knowledge limitations before participating in this study. He learned how to work with AM software and feels that he can improve his own teaching in any course by using this instructional model and teaching tools.

> So the whole process of CT which honestly speaking I did not know… I was illiterate about the levels so for example, CT analysis, evaluation and inference and criteria for judgement so all this I during this intervention. I knew the meaning of CT little bit but I learned in detail, all the steps of this concept through this intervention. I learned Moreover I learned to use the software, I think this is very useful software for the improvement of my teaching/learning process, even I can make better my lessons in any course by using this model and argumentative software.

Feedback on intervention design and implementation

The class teacher was asked to provide feedback on the design and then the implementation of the intervention. This led to insights into the teacher's own ability to see if there was anything that needed improvement in his own teaching or that he felt that he could not implement as required. But the teacher articulated a general answer that did not reflect what the students had expressed and what I, as a researcher, had observed in the classes. The teacher was asked that what could have been improved or implemented in a better way. His answer provided two main themes, as presented below.

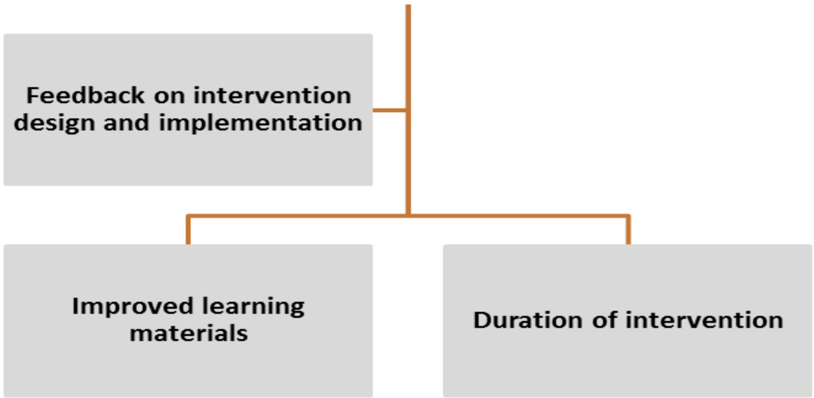


Figure 36: Feedback on intervention design and implementation Main theme T5

Improved learning materials

Intervention Class Teacher was asked about what could have been improved. His response was almost the same as the students'. He expressed that the impact of audio-video lesson could have been improved by providing additional printed copies of the slides by the researcher. This would have helped students to work more flexibly on the tasks at their own pace. Regarding the duration of the project, the teacher thinks more time was needed. Also, for assignments and class activities, there was a tight turnaround. If there were 15 days more for to this intervention, they could make a better job of this project.

> I think we can improve this method by providing video clips along with the help of written material which were presented by the resource person (he means me, the researcher). If there is material available students will work better and, moreover, because the time span was less I think for this, project there is a need to give more time to our students for the implementation. Especially for assignments as some time we felt, the students felt, that there was a bombardment of assignments. So they become bored or sometimes frustrated, so anyhow if I gave this project 15 or two weeks more, it could have been implemented more. I mean to say that if we were provided six weeks, so we can do better in this project, I think so that's my personal experience and so this is.

Duration of the intervention

Intervention Class Teacher emphasized increasing the duration of the intervention when asked about the feedback on implementation procedure. He pointed out that there is a need for printed material to supplement the video. The teacher suggested that the videos would also be more useful in print form because students found it easier to learn from printed material in a visual and enduring form to refer to later than by watching and listening. This would help to improve the design of the intervention.

> As a suggestion I can say, that only the increase in duration of this intervention, this is my suggestion only and, moreover, the written material. If all is in written form, material about the videos if that were in print that would have been more useful, right for their learning, audio in shape of video that could be more useful because students learn more through vision as compared to other sense, like hearing or seeing touching etc. So videos will be more useful to your design.

6.6.1.1 Extreme Case Analysis

Previous sections have presented an analysis of the cases with an information-oriented and explanation building lens directed on the potentially flawed implementation, design, instructional approach, and participants' personal learning and challenges. These extreme cases were interviewed to obtain information on the experience of the CT skills intervention and possible explanations for any non-empirical causal links for their negative learning. The other way in which extereme cases can be helpful is by providing triangulation and depth to the single case study narrative. Extreme Case 1 is a female student with 50% marks on her previous degree who scored highly in the pre-test and very low on post-test. Extreme Case 2 is another female student with 50% marks on her previous degree who scored highly on the pre-test and dropped very low on the post-test. The following question examines their interviews with relevance to the questions asked. A summary of both cases' findings is presented at the end.

CT skills learning experience (Interview question 1)

Student Intervention 1, when asked about the experience of the intervention from *SI1 Ext.C,* provided an answer in a collective manner rather than speaking about her own experience. Her experience was that during the intervention period everybody used their critical thinking skills. She was able to name the skills taught during the lessons. However, her answers do not reflect what she thinks about this learning experience in the class, but rather sees CT skills as general for 'everybody' and for the purpose of 'any work'. Even after prompts, she did not say much. The short answer and almost memorized manner of replying seem to indicate that she did not learn beyond the perceptual meaning of CT skills.

> I found that during instruction these four weeks that everybody used their critical thinking whenever we do any work, we see firstly analysing, evaluation, and then inferences. (SI 1 Ex.C)

Student Intervention 4 seemed to explain her experience of leanring as useful for critically evaluating others' work, by which she meant the activities based on research articles and group discussions, and also expressed the activities as 'unknown for me' and their difficulty as 'very difficult', after she had done the various actitivites and survey questions.

> There were many experiences like survey questions, video audio clips, and different activities. In these four weeks the instruction of CT was very useful, now I can easily think critically about others' works. In the start it was unknown for me and very difficult but after one week I found it interesting and easy. (SI 2 Ex.C)

Instructional Approach (Interview Question 2)

In terms of interview questions related to the instructional approach, both students were more confortable and interested in strategies that were learner centred and directly related to the course topic.

Student Intervention 1 expressed that, of the different instructional strategies, argument mapping was most helpful to her. She also found meeting the class goals quite difficult, and expressed that she could not understand anything.

> argument mapping was interesting for me, I liked argument mapping. There were many learning strategies…. I cannot understand anything and it was very difficult to meet the goals. SI1 Ext.C

Student Intervention 4 saw the intervention as helpful and focused on the difference of instructional approach that she experienced. Her account provided some insight into the 'traditional' teaching in the classroom. Although she saw this short teaching/learning experience 'very helpful' and was able to apply basic skills to all subjects, she also expressed that the CT skills teaching embedded strand was more useful, in her opinion, than the independent strand.

> it was very helpful ehh because before we were not taught like this…. After this teaching… we can apply it in other subjects as well… learned separately it was not helpful, when learned the same topic [CT skills explicit strand] with curriculum topic then I found it useful. (SI4 Ext.C)

Teacher's role (Interview Question 3)

In interview questions related to teacher's role, both extreme cases were positive about the efforts that the teacher made to teach the module. **Student Intervention 1** thought that the teacher taught in a simple way, yet revealed that there were some underlying issues going on in this class, that the students and teacher perhaps did not share a great relationship, and that the dynamics of the relationship somehow changed during this experience in a positive way.

> He taught in simple way and help whenever… we did not had understanding with the teacher,... He used to come to the class and teach strictly and would go out but now he is teaching us, like, making us understand things,… now we have come to an understanding with him, now if we find a problem… we can go to him and ask him easily. Earlier we were frightened to go to him and talk to him. So, when we all go to the lab and work together, so we improve the relationship and improvd our learning. (SI1 Ext.C)

Student Intervention 4 expressed her opinion succinctly on this question and settled on saying that the teacher was 'motivating' and helped in explaining the otherwise incomprehensible videos.

> Teacher was very motivating, and video we could not understand so he explained well which was good. (SI4 Ext.C)

Students' personal learning (Interview Question 4)

Both extreme cases expressed that in terms of their personal learning they had found it novel – 'did not use to' and interesting 'not boring' – which means that the activity-based systematic design of the study was found to some extent useful to students' personal learning.

Student Intervention 1 was positive again about learning the use of argument mapping, and Student Intervention 4 expressed that the intervention experience helped in improving writing and motivated her to learn.

> It is a good way of learning and as a simple way, and learning of anything and not boring, not boring. Before this period of critical thinking learning we did not use to learn in classroom with activity and practicals. Group discussions… the entire working with arguments and step by step and… think with own mind, not read the books as it is. (SI Ext.C)

Student Intervention 4, although she did worse in the post-test, felt the positive influence of the intervention, and found improvement in her personal learning in terms of increased motivation for learning and improved writing.

> it improved my writing and it motivated me for learning. (SI4. Ext. C)

Feedback on Intervention Implementation (Interview Question 5)

Answers to the question on feedback on intervention implementation from the extreme cases provided two different opinions. One student saw the importance of the skills in terms of reflecting on each situation that one comes across and its importance of decision making in her life, observing that most students would skip classes and stay outside the class because they did not see it as important, due to no marks being given to them for the class activities and tasks. The other student saw the lack of reward and reinforcement in terms of positive behaviour by the class teacher. This feedback reflects the teacher's central role in keeping the classroom environment and student interest together, but also reflects how students in this group or context do not see learning and effort as important, in the absence of external rewards such as marks.

Student Intervention 1 said that she found the intervention implemenatation important for learning about CT skills and their application in life but that the implementationwould have been better if there was some reward or reinforcement in the form of marks for class assignments.

> critical thinking… important… we need to look at the positive sides, negative sides… make some decision... I have observed that many students would sit outside …when they come to know it had marks, everybody was in the class. So I think if the class teacher had communicated well before hand about the tasks and that they have 4 or 5 marks everybody would have been more keen and attentive. (SI 1 Ext.C)

Student Intervention 4 said that there was lack reinforcment and reward during the intervention implementation.

> There should have been reinforcement for work and reward for good work that was missing (SI 4 Ext.C).

Types of Challenges (Interview question 6)

In terms of challenges, again one student was more expressive in pinpointing what was a major challenge and the other was again impersonal about the challenges that she experienced. The students' accounts provide the information that the effort and audio-video lessons were challenging due to the volume of work and the language hurdles.

Student Intervention 1 expressed that to meet the goals of the study, by which she meant the pace of activities and number of classwork assignments and reading, was diffiicult. Later on, when she must have become used to the way of learning in the classroom. it became easier.

> There were many experiments, firstly, firstly, I cannot understand anything and it was very difficult to meet the goals . Slowly slowly I understand about the critical thinking and work on critical thinking then I realized that it is not difficult and my experience was good. (SI 1, Ext.C)

Student Intervention 4 expressed that the audio-video lessons were diffcult to understand and listen to, for her. When asked if she tried to re-listen to them later, it had not occurred to most of them to try to play back or listen to the lessons again. This was the case with all interviewee and indicates perhaps a lack of interest and perception of value in the intervention.

> …audio video clips because that was not the voice was not clear and every student did not find it easy to listen. (SI 4, Ext.C).

Conclusion

The main reasons for the potential decline in critical thinking skills learning, hence the effect of this carefully designed CT skills intervention, were various variables that come out in the qualitative analysis.

The pre-test socres show that students had a tendency towards CT skills and their abillity in the skills of analysis, evaluation and inference. In both cases, the high scorers in the pre-test were low achievers in their previous qualification grades. The classroom learning environment as an outcome of the teacher's effective role in intervention execution did not help in encouraging or reinforcing the skills and learning in these students. The unsupportive behaviour of the teacher may also relate to the potential declining scores, in that it had almost a negative effect among the experimental class. Therefore, these students lost their motivation not only due to mismanaged time but mismanaged teaching, which increased the time and performance pressure on students. Add in the unhelpful teacher role and the systematic multidimensional nature of the instructional design, and students' performance could not be improved, hence they declined.

Another reason for the extereme cases' decline in performance and loss of interest can be attributed to lack of reward, reinforcement, teacher's clear communication and students' spending little time listening to the course videos or on homework. Disinterest could be due to lack of proficiency in the English language in each of the extreme cases, and can be extended to other cases in this group.

It could also be related to the time and exam pressures that these students had to face, moreover the changingg schedule, asking students out of hours to come to attend classes, and the added pressure of intervention tasks led to negative emtions and performance during the intervention. The students were not interested and had not learned the skills for which they had had a natural inclination before the intervention was applied. In this sample, if the learners of CT skills are low acheivers, the unsystematic teaching tends to have a negative effect on them. Nonetheless, they do seem to have developed a better understanding of the concept and how thinking skills are applied, although in terms of test performance they did worse.

6.6.2 RQ 2b: Observing the intervention implementation fidelity

Observations (structured and unstructured), mainly conducted by the researcher herself, were made to record the implementation of the intervention, and determine the *fidelity of the implementation*. Observation is more objective due to use of a checklist and fidelity more subjective. A discussion of findings is provided in the next chapter.

6.6.2.1 Structured observation for intervention implementation

A total of six observations were made of the intervention implementation. The researcher recorded the overall quality of each lesson by rating it on the observation sheets on five aspects: adherence; exposure; quality of delivery; programme specification; and student responsiveness. The data were analysed by a single count of occurring or non-occurring elements of intervention implementation. For example, if adherence to the intervention implementation was present, it was marked with an asterisk (*), and any examples written on the sheets. Similarly, if it was not present or not clear enough to be determined, the same mark as fidelity aspect was used on the observation sheet. At the end, a total count of evident and not evident instances was conducted and conclusions drawn about the fidelity of implementation, keeping a balanced, rational approach to the circumstances.

The analysis of structured observational data revealed that most of the time the element of implementation fidelity was not present in this classroom. The implementation phase was explored with regard to the fidelity and it was observed that the framework, which had been prepared as an educational psychology CT instructional intervention, was being implemented by a class teacher. This noted which features were effectively implemented and which were not, the constraints, the teacher's influence and basically the interaction between the teaching programme, teacher-students and learning environment. The study hypothesized that at the implementation level of the CT skills intervention, the teacher's role is by far the most important agent for change, or bringing any change.

The following section reports on the qualitative data analysis and findings from the structured observation for intervention implementation. A sample of the analysis rating of each implementation fidelity aspect is shown beneath each relevant section.

Adherence

The teacher's ability to make learning objectives clear and evident to students, effective use of programme materials during instruction/intervention and achieving the objectives of the lesson was poor. Of six observations, in three lessons it was evident to some extent, and in the other three it was not evident at all, as in the following table:

Table 35: Observation record of adherence to instructional intervention programme

Adherence	Evident *** Not evident***

Exposure

The teacher lacked the ability to manage the time spent on the delivery of instruction and intervention lessons and any extra to optimize their delivery. There was only modest exposure of the intervention programme to the students; often, it could not be determined because the teacher did not used the provided materials effectively in instruction. Overall, in six observations, four times the exposure could not be determined at all, as there was unsystematic, haphazard lesson execution in this classroom. The following table shows an example of the 'unable to determine' exposure aspect of the instructional intervention.

Table 36: Observation record of exposure of instructional intervention programme

Observation Target	Rating over all for six observations
Learning objective is evident to students	Unable to determine****
Teacher uses programme materials effectively during instruction/intervention	Unable to determine**** **Supporting examples:** 1. Students were giving feedback and answering teacher's introductory question.

Quality of delivery

This implementation fidelity aspect was to determine how adequately the teacher appeared to have prepared to deliver the instruction, how far the teacher's interaction with student reflected encouragement and enthusiasm, how far the teacher provided clear, explicit instruction, or positive, constructive feedback, and to what extent the pacing and transitions of his delivery were effective. With regards to quality of delivery the intervention, of six observations, in three instances the teacher to some extent provided an acceptable quality of delivery.

Table 37: Observation record of the quality of delivery of instructional intervention programme

Quality of delivery	Evident *** Not evident***

Programme specification

The programme specification aspect of the fidelity observations relates to the extent to which the teacher supported the instructional components as designed, demonstrating knowledge of content and intervention strategy. This was frequently violated and the teacher struggled to keep up with lesson planning and programme specific delivery for the intervention. Of six observations, four times the programme specification of lessons was not present at all and once it could not be determined, because only half of the lesson was on the specified programme plan. There was only one instance when it could be said that the teacher was demonstrating knowledge of both the content and the intervention lesson plan delivery strategy.

Table 38: Observation record of programme specification of instructional intervention programme

Programme specification	
- **Teacher demonstrates knowledge of content and intervention strategy.**	- Yes* - No**** - Unable to determine* Supporting examples: 1:lack of preparation and interest 2: reinforces, gives feedback 3: confused everyday on what to do and how to do it. Spontaneously changes the strategy or teaching plan.

Student responsiveness

The final structured observation of for implementation fidelity was the student responsiveness during the intervention implementation. This section observed student engagement as it appeared during the implementation of the intervention/instruction at certain times. Of six observations, the students appeared moderately engaged four times and not at all engaged twice. When they were noted as moderately engaged, there were instances when students attended well, listening attentively and discussing the class and work tasks and so on. In the table below, the student responsiveness observation count is given with supporting examples.

Table 39: Observation record student responsiveness during instructional intervention programme

Student responsiveness - Highly engaged	- Possible student action that might be observed to support student rating: - - good attendance rate - Listening to videos attentively
- Moderately engaged****	- Participating in class activities - Passively listening - Working on class and lab tasks actively. - Discussing class work and working on worksheets - Talking about other things. - On average student were engaged and actively involved in class however others were highly enthusiastic about the lesson.

Conclusion about implementation fidelity

In terms of exposure, the quality of delivery and the integrity of programme specification was best compromised and often poor. Although the teacher was trying to state the objectives of the lesson and students seem to be moderately engaged during this time, this was not coordinated due to major flaws in the time management of the delivery of the instruction/intervention, the preparation to deliver instruction, the interactions with students to reflect encouragement and enthusiasm, the provision of clear, explicit instruction, and positive, constructive feedback, with pacing and transitions. Moreover, the teacher's support of the instructional components as designed was low, and he could not demonstrate knowledge of either the content or the intervention strategy.

6.6.3 Researcher observing the classroom environment

Field notes were written to observe classroom events related to the teaching/learning environment. The field notes helped to assess and record the interaction of classroom learning environment with the variables of the study and the overall environment of the selected context at the classroom level.

The researcher's presence helped to record of the activities, interactions, and the emotional and educational atmosphere in the classroom. Field notes helped to record and be aware of the researcher's own bias towards the implementation phase and feelings related to the ownership of the project in terms of implementation fidelity aspects.

This section reported on main themes emerged from my observations of the classroom and the learning environment relating to teacher-curriculum interaction, teacher-student interaction and, in general, the flow of the intervention. The following section reports on the qualitative data analysis and findings from the unstructured observation for intervention implementation.

6.5.4.1 The synopsis of the intervention/experimental classroom

The classroom field notes were written as an anecdote of how the researcher saw or observed the instructional intervention being implemented. The synopsis is written from the daily field notes to capture *what happens or how it is taught* and a weekly observational summary is presented below.

Week 1

The main problems during the first week of intervention implementation were the teacher's lack of proficiency in content command, lack of efficiency in dealing with technology and, to some extent, the electricity outage, which may also have related to the lack of preparation.

The class teacher could not prepare for the class due to his workload. He was explaining the videos while translating into Urdu. He provided examples from local context and students were interested. The class teacher also was moving around the class and provided additional assistance to the students while they were discussing the lesson.

The researcher observed that teacher as the communicator of the curriculum needed to be well prepared for these lessons, otherwise his unsystematic application might not achieve the results easily. Students were confused about some of the content and, when asked, the teacher seemed to lack knowledge, but instead saying he did not know, attempted to explain.

Week 2

The morale of both teacher and students seemed to improve, however departmental schedule changes disrupted the class timing. Issues with multimedia were handled by changing the classroom, but still it was not fully soundproof. Issues with timing made the class start and end times irregular. It was sports week at the university and the mid-term exams schedules were being drawn up and, due to all these changes and the teacher's autonomy, the class schedules were really flexible in this department. It was quite surprising to see how teachers switched their classes at their convenience.

Another observation was made about the teacher's behaviour during the second week, and this was how the teacher dealt with stress, and his mood swings. It seems to me that teacher has issues with emotional health, and his personal mood affected his teaching and dealing with students considerably. It was also observed that the teacher's awareness of a pressure to perform might be due to the researcher's presence in the class. However, it was evident that he was making serious efforts to teach according to the plan.

Week 3

Similar environmental elements to before. Week 3 started with a delay of 15 minutes from the actual time of the class, adjusting the loudspeaker volume, the teacher's and students' personal and educational backgrounds, readiness for learning, teacher's lack of pedagogical competency were at play. The teacher had the experience and potential skills, but seemed to lack motivation for teaching due for personal reasons said to me time and again non-formally. At times during lessons the researcher observed that the provided good explanations, and encouraged and reinforced learning, which resulted in greater student engagement and interest. At other times the teacher looked as if he was challenged by the systematic application of the instructional plan and was struggling to follow, and in almost every lesson this was mainly due to lack of preparation.

In the second lesson of the third week it seemed that the teacher and students were engaged and responsible for their part in the learning process. The teacher provided feedback on given tasks, and students made simple argument maps on general topics. Students liked to work collaboratively more in this class. The session on training in how to use AM went well. Students learned with enthusiasm and interest about the functions of the argumentative software. The class teacher and students were both involved in learning.

Week 4

By the fourth week, it seemed that both students and the class teacher were used to the study environment and learning patterns, so they were more familiar with tasks and the procedures to carry them out. On the other hand, the teacher's behaviour regarding pedagogical skills remained the same. The teacher would come to the class unprepared and uncomfortable with student-centred approaches. Despite trying, he would naturally slip into teacher-centred approaches and start lecturing rather than implementing activities. The researcher concluded that teacher's uncertainty, lack of commitment and discomfort with student-centred approaches could be due to lack of continuing professional development opportunities, old age, inflexible habits and the experience of being a traditional teacher in the field for a long time.

Regardless of the poor delivery of the lesson plans, students did seem to enjoy and participate in the constructivist approach to learning. They were engaged in discussions and followed the CoI stages to discuss the content. Even quiet student were taking part in the class activity. The students then worked with argument maps on the same topic that they had discussed in the class, were fully interested in the process of building arguments and some even stayed longer than the required time for the past two weeks. This was a positive sign for the usefulness of visual tools to enhance cognitive skills like CT.

Main themes of observational data

The main themes that came out of structured observations (implementation fidelity) and unstructured observations (field notes) for assessing intervention effectiveness in a non-statistical way in this particular environment are shown below. What happens or how it is taught implementation fidelity (IF); and observing the classroom environment (OCE) is used to display the main themes.

At the end, the themes will be used to triangulate both what the participants expressed and what was observed about the intervention's effectiveness to explain the quantitative results. In summary, the findings from qualitative component can be listed as:

- Overall, six principles of intervention design elements were moderately present during the four weeks of lessons: subject specificity; a mixed approach; motivation (intrinsic and extrinsic)/self-regulated learning; constructivist student strategies (collaboration and group work); formative feedback (reinforcement and encouragement); and explicit teaching of CT.

- Other elements of instructional design were not consistently present throughout the intervention implementation time. Systematic steps of instruction were not followed, at times. The very first problem noticed by myself was lack of proper equipment or rather poorly maintained audio-visual aids and the teacher's reluctance or lack of interest.

- The teacher did not seem to be professionally trained in methodology or competent enough to meet the demands of the modern-day teaching/learning environment. He seemed unprepared and came to class without preparation on most days. This teacher lacked basic presentation skills and computer literacy, and would stand in front of the screen blocking students' view of the screen and struggle to run basic software, for example videos and PowerPoint presentations. On some occasions the class teacher ignored students' questions and complaints. There was lack of feedback from the teacher. The class teacher tried to follow the student-centred instruction. It seemed as if it was difficult for him to break his habits.

- The teacher's performance, technology resources, time management and pedagogical skills were poor, as were the motivation of both teacher and students and the contextual factors, for example the novelty of the instructional intervention in this, a teacher education university. The following figure 37 summarizes the themes that emerged from observational data analysis:

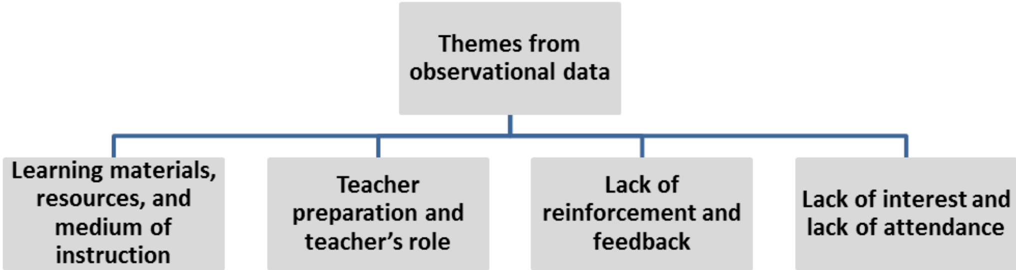


Figure 37: Main themes emerged from observation of IF and OCE

6.7 Summary of study findings

Quantitative component findings

The intervention, designed on six principles, had no statistically significant effect on students' learning of CT skills.

The motivation and self-regulation of the students did not affect the learning of CT skills; rather, it had a negative relationship with student learning of CT skills overall.

The classroom learning environment had no significant relationship with students' learning of CT skills in this intervention group overall.

There was some indication in the value-added analysis that students' meta-cognitive self-regulation and learning environment were statistically significantly related to students' CT skills outcomes.

Qualitative component findings

Major themes that emerged from qualitative data that explained the causal links about the unsuccessful carefully designed intervention are:

- Students' learning experience and challenges
- Intervention design and materials
- Motivation and classroom learning environment
- Intervention implementation fidelity
- Teacher's role in delivering instructional programme (teacher characteristics and teaching style).

In the next chapter, I present the merged discussion of significant findings from the quantitative and qualitative data that pertain to the study's research questions. These are discussed with the relevant literature.

Chapter 7: Discussion and integration of results

> *Give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking; learning naturally results.*
>
> *–John Dewey*

This chapter elaborates on the findings of the study and the relevant literature in the field of CT skills learning and instruction research. The discussion explains through the qualitative data findings the contextual explanation for the intervention's lack of effect in the classroom. It suggests the factors that might be related to the absence of students' motivation/self-regulation and classroom learning environment, hence affecting their CT skills performance after a certain type of instruction. However, no effect by the CT skills instructional intervention, student motivation/self-regulation and classroom learning environment could be established, due to the absence of statistical evidence on these variables on this occasion.

The follow-up analysis of participants' accounts and site observations explained why there was no effect from the intervention, and how and what could have led to students' low CT skills in their post-test performance, their lack of motivation/self-regulation and the ineffective classroom learning environment. A discussion of explanatory findings is presented with relevant literature for 'how and why' of the intervention's unintended outcomes.

In the first section of the discussion, personal insights are not used, but in the second relevant personal experience is used to examine the case of testing the effectiveness of a CT skills intervention in a classroom nested in a public teacher education university in Pakistan. The case is presented in the form of key factors that may be attributed to the ineffectiveness of a carefully designed CT skills instructional intervention in a teacher education programme classroom. Insights from the context chapter on Pakistan, short but relevant, my own background and experience as a university teacher, were used to make sense of the results with the setting, topic and context. At the end, I summarize what was learned from the study and its importance to learning and instruction of CT skills in the field of ITE.

7.1 Analytical model for integration and explanation building

The findings from both the quantitative and qualitative components are integrated and a discussion of relevant and significant findings related to research questions is presented. Each research question's findings are discussed with a quantitative finding and then the sequential qualitative explanation, as summarized in the analytical model (Figure 38).

The CT skills intervention design and implementation integrity are speculated, with tentative insights into educational research, in terms of what is taught, how is taught and where is it taught, how is it measured and why it works or does not work. The discussion of a *careful design* is also reviewed in connection to the theoretical and conceptual foundations that were derived from previous research in the field of CT skills.

The research problem was to test the effectiveness of a carefully designed CT skills intervention. It should be noted that this problem was investigated in part through the quantitative and part through qualitative research questions. The study was to answer two main questions: (1) whether a carefully designed (mixed approach Ennis, 1990, and six research theory-based principles) intervention to teach CT skills can enhance CT skills among students; and (2) the participants' experiences about how a specific instructional model helped or did not help in the learning of CT skills.

In the next section, results are elaborated and interpreted in sequence and, relative to each research question, the qualitative data are blended where appropriate, and extended understandings are discussed with relevant literature.

The analytical model show an integrated discussion of findings from both the quantitative and qualitative components for interpretation, conclusions and implications. The sequential connection between both quantitative and qualitative phases and the merging of both types of data into interpretation of these results can be seen in the form of the visual map. The integration of quantitative and qualitative data findings enabled the study to portray a holistic description and explanation of the problem of testing the effectiveness of a CT skills intervention in an ITE postgraduate programme in Pakistan.

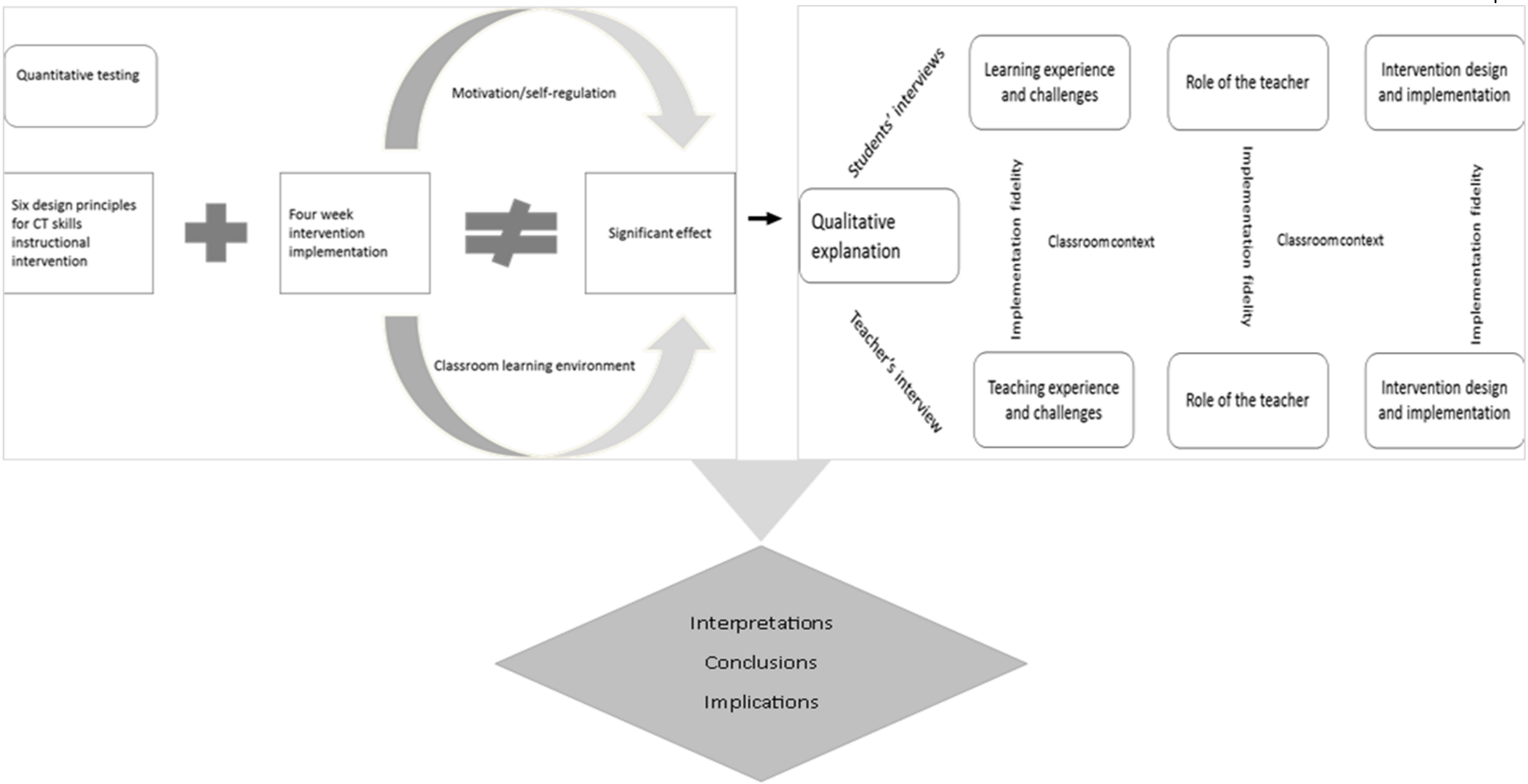


Figure 38: Analytical model for integration and explanation building

7.2 Synopsis of the study

In the previous chapter, analyses and findings from the quantitative and qualitative components were presented. This study was conducted to test the effectiveness of carefully designed CT skills, through an instructional intervention aimed at ITE students at a public teacher education university in Pakistan. The careful design in this intervention is important in two aspects. The first aspect is the theoretical consideration of what counts as CT skills as a dependent variable, and what important associated variables (motivation/self-regulation and classroom learning environment) are important to consider in the research on learning and instruction of CT skills. The second aspect of a carefully designed CT skills intervention is attention to the design principles and implementation; that is, the manipulation of the learning and instructional environment. The study attempted to address both of these aspects so that a holistic picture of the effectiveness of CT skills instructional intervention could be formulated from the outcomes of the study.

The study designed the instructional programme from theory-driven principles in CT skills literature and planned an intervention consisting of six instructional principles for teaching CT skills. A total of 12 lessons were delivered for four weeks to students studying a first-semester educational psychology module in an ITE postgraduate programme of a teacher education university. The intervention was implemented as a two-group quasi-experimental design for three hours a week, on average, with the help of two purposefully selected groups, one control/ non-intervention and one experimental/intervention, and the same class teacher for both. Observational data on how the intervention was being implemented were collected for supplementary purposes to argue the effectiveness or otherwise of the intervention at the qualitative explanatory phase.

Analysis of the initial data found that the intervention was not successful in increasing students' CT skills on this occasion and that no significant mediatory effects of the motivation/self-regulation or the classroom learning environment were found. Consequently, a qualitative follow-up was conducted to investigate the reasons or possible explanations for the non-significant effect of the carefully designed intervention. For this, the students' and the class teacher's interviews and the observational data were used in a sequential explanatory research design to build explanations and discuss the phenomenon of testing the effectiveness of a carefully designed CT skills intervention in this particular setting. The qualitative phase of the study data analysis revealed possible reasons and descriptions of events that explain the non-effect of the intervention on students. The qualitative explanatory phase single case study analysis method, that is, classroom-level analysis of various units of data such as interviews of participants, selected cases including extreme cases that represent the impact of how the intervention was actually delivered and the teacher's role as the interventionist. Collectively, these reinforce the previous analysis that that although the intervention was unsuccessful, the failure could not be solely attributed to the design of the intervention itself, but that implementation process appeared to account for it. Moreover, teacher effectiveness as a factor can be attributed to the poor learning environment, in which a lack of reinforcement and feedback may have caused even brighter students to lose interest. The unsuccessful outcomes for the increase in students' CT skills abilities in this research study: a) confirm that good design and fore planning in isolation are not enough: there is a need for increased teacher and organizational involvement in CT skills promotion; b) the CT skills effectiveness research needs to refocus investigation on the greater role of meta-cognition in intervention design and student characteristics; c) CT skills learning and instruction research needs to be more aligned and merged towards teacher-effectiveness. The school effectiveness and leadership research role will help in extending the existing theories of teaching/learning thinking.

In addition, it provided comprehensive descriptions in which it seems, according to the setting, the role of teacher, students and implementation in a classroom context serve to influence the study outcomes.

Thus far, the findings inform us that the non-significant results might be explained by three broad aspects of the qualitative inquiry of the research problem. These quantitative results can be explained by the qualitative findings that are broadly grouped into the following three most explanatory aspects:

1: learning experience (student perspective), teaching experience (teacher perspective) and challenges (these can broadly be said to be nested in institutional culture)

2: Role of the teacher (students', teacher's and researcher's triangular perspective)

3: Intervention design and implementation (students', teacher's and researcher's triangular perspective).

In the section below an integrated discussion of research questions is presented.

7.3 Explaining the no effect of the CT skills intervention

The effect of a carefully designed CT skills instructional intervention on students' CT skills learning

The first main research question asked if a carefully designed CT skills intervention increases students' CT skills. For Research Question 1, no significant results were found from the pre- and post-test measures when compared with control and experimental group. ITE students exposed to a CT intervention for four weeks did not seem to benefit from the instruction on this occasion, and it can be concluded that a carefully designed CT skills intervention could not facilitate the improvement of CT skills in this study.

For Research Questions 1a and 1b, there was no statistically significant linear relationship of students' motivational/self-regulation strategies for learning and the classroom learning environment on CT skills overall. Moreover, no mediation effect was found for motivational learning strategies and learning environment as confounding variables on students' CT skills in this study.

The value-added and subscale analysis revealed some useful information on the possible relationship of students' improvement of CT skills in terms of their metacognitive self-regulation, CT, extrinsic and intrinsic goal orientation, and that metacognitive self-regulation and the learning environment predict CT skills gains. So, narrowing down the dispositions specifically to look into metacognition-related variables, for example cognitive presence in classroom, students' metacognitive self-regulation, extrinsic and intrinsic goal orientation, may help to create a powerful learning environment and understand the field of teaching-learning CT skills (De Corte, 2003).

The following section scrutinizes the findings relating to the effect of the intervention and discusses with the help of qualitative findings why the effect was non-significant and what factors provide the explanation of the ineffectiveness of a carefully designed CT skills instructional intervention on students' CT skills learning.

Unsystematic implementation of the instructional intervention and ineffective role of the teacher as an interventionist

There was no statistically significant effect found in the intervention and non- intervention groups' CT skills performance. The study found that the design would not succeed without implementation fidelity. The experiment was conducted on the assumption that the design and constructive learning environment would succeed, but upon investigation, failure of the intervention led to undesired results.

The gain scores analysis further revealed a negative gain on experimental group students' performance. Data on student previous scores came up from this study which may explain the reasons why the students of the control group (non-intervention) had a one point increase without the intervention. The class teacher expressed at the end of the intervention that he thought the intervention group should be the weak students' group i.e. section A and section B as control as they are already good students. This is confirmed by the previous scores data (descriptive statistics). On the other hand, it emphasises the importance of careful systematic implementation even more for low achievers, otherwise the teaching may have a negative effect altogether. This could have implications on the effect of a multi-dimensional intervention that required systematic holistic teacher and student input in a traditional setting. No previous research has reported on differences on gender, students' parents' education and previous grades in CT skills intervention research. There was no statistically significant relationship found of previous scores and parental education on students' gain scores, but these observed differences might have the potential to explain further the variance found in CT skills experiments in this university at programme level. These differences latently could be affecting the students' interest, motivation in terms of extrinsic stimulators and effect of CT skills instruction on low and high achievers. In this study, we cannot make inferences with any strong inclination. Nonetheless, reporting and investigating these background factors might help better to design and implement CT skills interventions in educational settings. No research has empirically tested the influence of parental education and socioeconomic status associated with students' motivation/self-regulatory habits, and it is certainly not the variable included in this study analysis. But parental education (descriptive statistics) may be associated with socioeconomic status in Pakistan in terms of students having the opportunity to set aside time for study, have an organised separate space (time and study environment scale related questions on the MSLQ). It would be interesting to look at the extent to which various levels of parental education, previous grades and being able to set time and study environment influence an individual's motivation/self-regulation in learning the CT skills process. Similarly, does having highly educated parents make a difference to young adults/teacher educators to become critical thinkers, if and how?

The quality of the intervention and its relationship to its implementation is a crucial link for gauging its effect. Course content/curriculum and pedagogy are closely related to the quality of the intervention hence to the effectiveness of CT skills studies (Abrami et al., 2008). The quality of instruction, in addition to available resources, mostly depends on how well the class teacher delivers the intervention. All these factors together count more for the effect of the intervention, and one can conclude that the effect of the intervention is not only what is taught but how it is taught and how it is measured, all together.

The datum on implementation fidelity 'how it is taught' found that *exposure, quality of delivery, programme specification (main theme IF and OCE)* were the most likely causes for the CT skills 'no effect' outcomes. However, the poor delivery of the content and deviations from *programme specification* (along with who is teaching) explain the unsuccessful results of the intervention. Prior to the intervention execution, the lesson plans were prepared with the help of the class teacher to maintain the relevance and reliability of the content prepared and local curriculum at this particular university. Therefore, the curriculum can be said to be valid in terms of relevance and selection. Moreover, the teacher's role and demonstration of CT skills instruction were vital for obtaining the desired effect from the carefully designed instructional intervention.

Overall, the ability of the teacher as an interventionist affected the intervention implementation the most. This is closely related to the *effectiveness of the CT studies,* as Abrami et al. (2008) concluded that all positive results are associated with how instruction is provided. Variables closely associated with the effectiveness of CT studies are course content/curriculum, pedagogy and how it was instructed, and therefore can be said to be related to teacher effectiveness in the classroom.

The data findings, for instance *teacher preparation and teacher's role,* were that the intervention lesson plans were executed haphazardly and that the original plan was not followed by the teacher. The poor delivery of the content can be a plausible cause of these results. It was observed that most of the time the class teacher was unprepared and struggled with the effective delivery of the lessons. In this study, the lack of development in CT skills among students is likely to be explained by Behar-Horenstein and Niu's (2011) inferences that the development of CT skills is dependent on the learning environment, instructor training and instructor-student interaction. All the former were found to be not effectively present during the implementation of the intervention.

One cannot deny the key role of effective use of teaching strategies for quality delivery of content. The teacher's lack of pedagogical competency affected the systematic implementation of the intervention. Consequently, these compromises in the *quality of intervention implementation* hindered *the effect of the intervention* on students' CT skills learning. Sufficient opportunity to practise CT skills (Halpern, 1993) is also required for learning of CT skills, which in this study's case was not evident. The results are consistent with what Iqbal and Shayer (2000) found in Pakistan, that teacher variation (teacher characteristics, teaching style) in grasping the underlying philosophy and methodology of CASE, institutional variation (administration and teacher's response), student characteristics (interest, participation) as favourable or non-favourable conditions for such intervention programmes.

The intervention implementation was not rigorous enough to see the effect or the impact convincingly. The lack of preparation, interest and pedagogical command over content were observed as the *teacher's reluctance to change* and as major hurdles in the way of quality delivery of the intervention. The *adherence* towards objectives of the lessons, *exposure* time of the intervention, *quality of delivery*, *programme specification* and *student responsiveness* fluctuated from poor to moderate during the observed lessons.

The teacher effectiveness-related factors can be one of the major reasons for various types of effects found in instructional interventions. It also affects the response of students (*student responsiveness*) towards the intervention. This means that teacher effectiveness-related factors are important to student progress in any learning environment, and are even more important when it comes to learning skills such as CT. The content of the intervention was compromised on certain occasions due to the class teacher's other commitments. The study data on *teacher's role, teaching and teacher beliefs* show that teacher's experience and professional skills affect the delivery of intervention.

Students also provided information *on teacher's role* with regards to the effective implementation of the teaching programme. Research by McBer (2001) on teacher effectiveness and student progress and on classroom climate by Creemers and Reezigt (1999) argued that *learning environment and teacher* significantly influence student progress and an effective classroom. This study found in the data that although the teacher was cooperative and tried his best to assist students, in general the teacher's role was *strict and authoritarian* (Main theme 5) during the implementation phase.

The programme of instruction was deviated from so many times that it was difficult to gauge the consistent effect of the intervention, which certainly came out in the results as to the ineffectiveness of the CT skills intervention in this context. Essentially, the non-effect of the intervention can be explained due to insufficient opportunities to practise CT skills. Some researchers (Cotter and Tally, 2009) opine that the instructional technique is irrelevant to teaching CT; however, in contradiction, this study found evidence that the instruction and classroom environment widely affect the learning and teaching of CT skills. This is consistent with Willingham (2007) and Bailin (2002), who argue that CT skills learning not only depends on the context, subject and situation but, on top of it, what is taught and how well is taught, which in this study's case was not good, due to the *unsystematic implementation of the intervention and ineffective role of the teacher.*

Complexity of the instructional intervention

The instructional intervention was prepared as a mixed approach to teaching CT skills following a *design principles*-based instructional plan. The study found that the non-effect of the instructional intervention could be explained by the nature of the curriculum, also known as the study features (Tiruneh et al., 2014). In such a systematic approach, each element is intended to be taught in a structured and successive order also known as a multistructural/dimensional curriculum intervention (Marzano, 1998; Hattie et al., 1999; Sipe and Curlette, 1996; De Corte et al., 2004). The study observed the imbalance between the three of these elements, for example the amount and quality of instruction: that is, the exposure and quality of delivery were poor; the motivation, ability, development of the CT skills, that is, motivation/self-regulation were clearly lacking; and the environment, or the interaction of the teacher, students, learning materials in classroom did not add up to an effective instructional intervention for cultivating CT skills among students of ITE at this university in Pakistan. Learning through such types of interventions is most affected by instruction, aptitude and environment (Sipe and Curlette, 1996; Higgins et al., 2005; Moseley et al., 2005).

Looking at the intervention's *design principles*-based curriculum (conceptual and theoretical framework of the study), the intervention made assumptions about how well - *design principles* – the curriculum - *CT skills* - can be taught in a classroom. Therefore, much planning went into the process before the actual intervention was implemented. The instructional intervention had various high cognitively engaging elements, for example audio-video lessons, CoI discussion and AM. All these elements were intended to be presented and learned simultaneously in a structured learning environment.

In addition, element interactivity is always related to the level of expertise of an intended learner. The more elements of interactivity are present in the learning materials, the heavier the working memory load. These interactions between levels of expertise of intended learners and the isolated and interacting elements effect of presented curriculum could lead to poor delivery of the content (Kalyuga, Ayres, Chandler and Sweller, 2003). Also, the analysis of curriculum- based efforts to improve CT shows that they do not necessarily produce incremental gains (Huber and Kuncel, 2015).

The learners were novices to the CT curriculum and the element interactivity seemed to be high for them. Such learners may need to attend to each of the elements and interactions between the elements individually (e.g., audio-video lessons, class activities, discussion on curriculum-embedded topics and preparing argument maps). Kalyuga, Ayres, Chandler and Sweller (2003) described reversal effects, and have discussed the interaction between levels of expertise and the isolated or interaction elements effect in their work.

It was also observed in the statistical results that the students who scored well on the CT pre-test performed lower on the CT post-test. This is known as an expertise reversal effect and can happen due to learners' level of expertise. A similar effect was found by Bokhove (2012). Additional instruction might be redundant for experienced learners. Research by Kalyuga et al. (2001) has indicated that inexperienced learners may initially benefit from more tasks. However, after becoming more experienced and reaching a certain level of familiarity with skills and materials, the effect may disappear.

The students who scored well on pre-test were perhaps more experienced in CT skills taught through heavily guided materials. So, this decline can be due to the expertise reverse effect. By contrast, an increase in the control group's scores was observed, despite not having had the CT teaching intervention. The increase in the control group's scores can be due to maturation.

Looking at the students' experience of the CT skills intervention, it was seen that the basic skills of CT and the need for *thinking out of the box, concentration, and hard work* were seen as a potential challenge, therefore may have hindered the effect of the intervention. Inexperienced learners benefit more from guided instruction, so providing more detail-laden guidance on how to do tasks helps novice learners (Kalyuga et al., 2001). However, the ineffective instructional approach: *lack of reinforcement and reward for good work* and teacher's role*: strict and authoritative and lack of clear instruction* explain the non-significant learning of CT skills in this group compared to the control group. The teaching strategies and environment can have both a direct and an indirect effect on the cultivation of CT (Mathews and Lowe, 2011, Browne and Freeman, 2000).

Interventions that have complex materials and put a high cognitive load on learners' minds may not achieve significant results over a short time, as the learners will need to go through an exploratory phase before they reach understanding. This is a new finding and calls for a rethink of the multidimensional approach to teach CT skills, and the role of the context also needs more research. Comparing previous successful multidimensional approaches to teaching CT skills, such as by Masui and De Corte (1999), and the current study results, it can be speculated that perhaps contextual factors and the complexity of CT skills interventions need to be aligned with more attention to the local setting. What is successful in a Flemish university due to instruction, aptitude and environment may not work in a Pakistani university, and vice versa.

The evidence shows that, in innovative projects, the greater the planning, the greater the chances that it will fail (Fullan, 2007), and multistructural interventions may be successful in inculcating positive attitudes but ineffective in improving skills in near transfer. Moreover, multistructural interventions aiming for far transfer have a negative effect on near transfer (Hattie et al., 1996). The results can be understood further from Fullan's (2007, 2008a) perspective on six secrets of change process, and Newmann, King and Youngs (2000) proposed professional development with whole-school/institutional capacity.

Consequently, materials that impose an intrinsically high cognitive load cannot be processed without risking understanding, because all the *elements of curriculum* that must be learned *must interact* (Kalyuga, Ayres, Chandler and Sweller, 2003). In situations where new skills and new understandings are required in performance, one is always at risk of unsuccessful results in the beginning, which Fullan (1999; 2007) termed 'implementation dip'. This is when an intervention's effectiveness and students' improvement connect with understanding change, its relationship with school/organization, complexities of change and institutional leadership.

To interpret the non-effect of the carefully designed CT skills draws our attention to the highly relevant but infrequently discussed issue that not only intervention design matters, but also intervention adaptation and implementation relevant to context. The implementation and the role of the teacher were obvious hurdles in the way of the intervention's effect on student learning, but goes beyond that. What is learned from this experience is that for a CT skills intervention's success, it could perhaps be more useful to work closely with the context, subject, institution and approach CT skills learning and instruction as an adaptive process. In this gradual process, the teacher acts as an interventionist and the institutional leadership is closely involved throughout the process of enhancing the effective classroom atmosphere, rather than a planted change.

7.3.1 Students' motivation/self-regulation influenced the learning of CT skills

Influence of students' motivation/self-regulation on the learning of CT skills

In terms of dispositions that influence CT skills learning, motivation/self-regulation was studied as a confounding variable in this study. Overall, in the quantitative results, not all aspects/scales of motivation/self-regulation questionnaire were found to be associated with improvement in CT skills. This could be the non-contextualization, language or simply non-association due to the clustered opinions of the participants.

The metacognitive self-regulation, and extrinsic and extrinsic goal orientation scales appeared as a significant predictor of CT skills in the analysis. The metacognitive subscale shows a negative beta, meaning that the association was significant and linear, but that the direction of the relationship was negative. The study found that students' metacognitive self-regulatory skills were probably hindering the learning of CT skills. Stronger associations were seen in these findings when qualitative and quantitative data were merged for interpretation.

On the MSLQ, metacognitive self-regulatory skills are related to the control of cognition and asked students about whether they plan, monitor and regulate their learning for this course (Pintrich, Smith, Gracia and McKeachie, 1991; Kuhn, 1999). The reason why the students did not improve their CT skills could well be related to the negative impact of teaching and learning environment resulting in a negative association of self-regulatory skills with learning of CT skills in this class. With the help of qualitative analysis, it is understandable why it might be the case that the students in the experimental group fell down on activities to plan, monitor and regulate their learning. The qualitative data pinpointed instances, for instance, *feedback on intervention design and implementation* (Main theme 5), *teaching and teacher beliefs* (Main theme T3) about the teacher having *low expectations of the students* and *lack of clear instruction, lack of reinforcement from class teacher* and *teacher's lack of preparation,* and all these lead to ineffective classrooms in which the students' performance may be significantly affected by the lack of extrinsic motivation or teacher modelling 'think aloud' thinking.

If the students do not see value in the personal or academic use of the classroom tasks and learning experiences, provided them with guidance can motivate the learners to work hard, but struggling can be exhausting and demotivating as well. Considering the evidence that the students experienced learning of CT as *difficult and challenging* and, along with that, a lack of teacher support, it is likely that students *lack interest* and motivation/self-regulation in the classroom in both their own learning and the instructional approach or programme.

On the MSLQ, goal orientation refers to a student's perception of the reasons why they are engaging in a learning task and their general goals or orientation to the course as a whole. The analysis found an association between metacognitive self-regulation and intrinsic and extrinsic goal orientation subscales, and in students' learning of CT skills, like the metacognitive self-regulation, the beta was negative.

Goal orientation has two types, extrinsic and intrinsic, on the questionnaire subscale. Intrinsic goal orientation is related to students' cognition control, where they reorganize their knowledge to make more meaningful connections. Similarly, extrinsic goal orientation complements intrinsic goal orientation, and concerns the degree to which the student perceives herself to be participating in a task for reasons such as grades, rewards, performance and evaluation by others, and competition (Pintrich, Smith, Gracia and McKeachie, 1991). This is an important stage at which to put CT skills instruction into motion for students to be motivated for the learning of CT skills in a classroom learning environment. The goal orientation of students towards the CT skills intervention was very low and they often were seen to be losing interest due to lack of intrinsic motivation as well as extrinsic motivation, including the lack of language competency, mismanagement of time and the teacher's lack of professional skills (Coleman, 2010).

The evidence from students' data themes of *personal learning, teacher's role, instructional approach* and *types of challenges* further strengthens this explanation that, although students felt improvement in developing a positive attitude towards the instructional intervention and CT skills learning; that is, *students' personal learning* (Main theme 4), it is very likely that they could not control their own cognition (intrinsic) due to the *types of challenges* (Main theme 6) that they faced in this short time. Students' self-discipline and self-regulation as a predictor of their academic achievement has been argued by Zimmerman and Kitsantas (2014), and needs further exploration in the field of CT skills learning, especially in teacher education programmes in Pakistan and elsewhere.

The evidence from students' explanation of *teacher's role* (Main theme 3), *instructional approach* (Main theme 2), *and types of challenges* (Main theme 6), and the comparison of explanations from teacher's *teaching experience* (Main theme T1), *and teaching challenges* (Main theme T2) further confirmed that in classroom learning environment extrinsic value of tasks, goals and learning materials did not lead to form meaningful connections for students. Despite *student responsiveness* being moderate, the deficiencies in *time, resources and* *language barriers* played an important role to add to the adversity (Coleman, 2010).

In this class, teacher's differentiated treatment towards students and the *lack of feedback and encouragement* could have led to students' negative *CT learning experience* (Main theme 1). The observational datum from the classroom on *what happens or how it is taught* further supports the reason why the student had no interest or motivation to participate and perform in this ineffective classroom climate for learning CT skills. The reciprocal relationship between teacher behaviour and student engagement in learning in schools is argued by Hattie 2008 and as Pygmalion effect and by Friedrich, Flunger, Nagengast, Jonkmann and Trautwein (2015). Moreover, teacher beliefs, teacher characteristics, and contextual variables can result in differences in teacher's instructional practices and differing classroom climates (Rubi-Davies, Flint and McDonald, 2012). However, due to the limitation of the present study strong association cannot be made, sufficient further research is needed to explore and find direct links between teacher effectiveness and teacher expectancy effects on students' learning of CT skills and motivational/self-regulatory skills domain.

A plausible explanation for the negative associations of these scales with CT skills performance of students can be that students' metacognitive self- regulatory skills and goal orientation value beliefs were negatively affecting the outcomes in this study. Students' regulating activities could be enforced intrinsically and extrinsically both. The responsibility of no effect of motivation/self-regulation cannot solely be attributed to teacher. Fundamentally, the role of the teacher, his individual's characteristics, and environmental characteristics of classroom primarily become more important when the situation is not effective already (Creemers and Reezigt, 1999). The motivational and affective factors are also related to regulation strategies of behaviour and context, and learning strategies as explained by Pintrich (2000).

A major indication of negative associations with context and learning strategies was expressed as a feeling of *pressure and torture*, is likely to be the reason of lack of interest. This was surprising to know from students that the class teacher often asked them to take extra classes because he had not taught the course outline, whereas he had told the researcher that he had. This explains much the unsystematic implementation, lack of motivation and interest, and the pressure of time that has been vocalized by the participant students and teacher.

An explanation of these findings came through qualitative research evidence of the study where it was observed that the control of the learning was mostly in teacher's hands, and often students in Pakistani context do not consider themselves to be able to make judgements about their abilities to perform on a task. And think that these judgements should most probably be made by their teachers, quiet possibly leading to low value of tasks for personal meaning and motivation. Research suggests goal orientation beliefs in a classroom context, especially social goals may be related to effort and academic and achievement outcomes through self-regulation (Wentzel, 1991, 1999, 2000; Anderman, 1999; Patrick, 1997). Similar conclusion on students' value beliefs and traditional teaching resulting in low personal goal orientation, were made by Ali (2011) and Nausheen (2016), where lack of readiness to embrace new pedagogies in Pakistani context was a possible interpretation.

The lack of interest leading to lack of motivation and therefore, lack of control of cognition could partially explain the no effect of the intervention. This has been argued by Pintrich (2003) that if students seemed not to be highly motivated lack of interest and extrinsic or intrinsic motivation can be the reason. The student did not improve on their CT skills was also seen as attributing low value towards the task and found them boring *CT skills experience* (main theme 1). A possible explanation could be the level of value and care (self-attributes) of students where they think that the task is important in some way, and this can influence their motivation and consequently participation in the learning environment in a specific context (Eccles, Wigfield and Schiefele, 1998; Marzano, 1998; Eccles and Wigfield, 1992; Wigfield and Eccles, 2002).

Students' interest and involvement was from low to moderate during the intervention. These reasons again indicated poor metacognitive self -regulation skills of students in this sample. This has been argued by Pintrich (2000b) self-regulated learning framework where metacognitive knowledge activation can be either automatic, prompted through a given task or context, or can be employed in a more precise and attentive manner. These discussions on academic motivation and cognition (motivation/self-regulation) can have an important influence on CT skills learning and instruction research (Moseley et al., 2005).

In this study, students' lack of motivation and self-regulation may further be interpreted in the context of highly teacher-centred and teacher-controlled learning environments such as this classroom in a public teacher education university in Pakistan where one can see that the assistance or support provided by the class teacher in building the learning environment was insufficient for checking and correcting their behaviour as they proceeded on a task. The classrooms that lack in activating learners' cognition with positive reinforcement and clear instructions, the students' performance visibly declines especially in learning CT skills.

Austin and Vancouver (1996) argued that specific content and the nature of the goals serve to motivate and direct behaviour in the classroom, and this study found that student goal orientation beliefs positively predicted learning of CT. This sample confirms that they lack the dispositional factors and practice necessary to learn CT skills. It seems individuals as well as the environment, affect the learning of CT skills in this study. Further research is needed.

Facione (2000, 2011) argued the relationship between consistent internal motivation and the use of CT skills where motivation/self-regulation is an independent disposition and motivation may come within as well as from external environment. According to Martinez (2006), the first steps are students being aware of metacognition and its rules, second teacher's 'making thinking audible', second teachers model metacognition using social interaction where student think critically and the role of effort in cultivating metacognition emotionally and rationally. In the case of this research study, students and teacher (intrinsic or extrinsic) motivation/self-regulation was inadequately imminent, and that is why the results are unexpected but not surprising.

7.3.2 Classroom learning environment influenced the learning of CT skills

Influence of classroom learning environment on the learning of CT skills

The effective CT instruction and learning cannot be separated from its classroom context and the learning environment provided to students thereof (Creemers and Reezigt, 1999). Instruction and classroom environment can be said as most influential aspect where all ingredients of intervention are implemented and learning takes place. Relativeness of learning environment; that is, study features (Tiruneh et al., 2014) is often left out when discussing the effect of CT skills interventions. This discussion has implications for intervention effect and in terms of effectiveness of CT skills instruction.

The statistical results indicated a significant relationship between students' performance on CT skills, metacognition and learning environment. The analysis established that learning environment failed to positively influence students in their learning, the learning environment was negatively affecting students' CT skills learning. The questionnaire that was used to measure learning environment had three sections about learning environment: teacher presence, cognitive presence and social presence asking students if the learning environment was adequate in terms of the purpose of CT skills. The findings suggested no particular effect of any of these aspects on students' learning of CT skills. The evidence from qualitative follow-up provided with the explanations of why this was the case in this study.

Teacher's presence is a key feature for learning and instruction to take place in a traditional classroom (face-to-face). Teaching presence in terms of providing timely feedback, clear communication and instructions guiding students towards productive process of engagement with course materials was not evident. As mentioned in students' accounts of *main theme 5 and 6*, and from the observations of *what happens and how it is taught.* Teacher's control over learning materials, professional characteristics; for instance, commitment and attitudes towards profession, his micro-behaviours in the classroom regarding teaching skills and the resultant classroom climate that evolved as a combination of these factors could very well be the reason of negative association of learning environment with students' gain scores in this CT skills intervention.

The purpose of learning environment was the engineering of a social environment and therefore, another important aspect of the systematic design of the intervention. A classroom's social presence is concerned with creating opportunities where discussion in the form of communities of inquiry takes place and students' practice group work, collaboration and deep learning of curricular topics.

Although the students said that they liked the group work, especially when combined with AM of curricular discussion topics, they felt that encouragement and reward was lacking for many of them from the teacher. There were very few instances when the teacher actually became a facilitator rather than *strict and authoritative*. In this research study, the social presence component was lacking from the learning environment. The research datum from observations of *Main themes IF and OCE,* clearly pointed out that the *lack of interest and attendance, lack of reinforcement and feedback* and improper use of *learning materials, resources and medium of instruction* were posing challenges for both the teacher and the students, hence the required social presence was not formed in this study.

A cognitive presence of participants in a learning environment acts as fuel for the flow of classroom tasks and achievement of the goals set for each lesson. The students may not be interested, are having difficulties understanding materials or feel that there was no reward for good work or working together is not working *(Main theme 1: learning experience, main theme 6: types of challenges).* Perhaps they simply do not see the value in the tasks presented to them in terms of their professional development in knowledge, attitudes and performance. In this case, it would be unlikely that they are cognitively motivated. Synthesizing the results from the motivation/self-regulation when students' value beliefs were showing low value and goal orientation towards the intervention, it would be beyond consideration that most of the time the classroom environment definitely supported cognitive presence during the teaching and learning of CT skills.

This study found that the classroom learning environment in this context was not rich enough to promote class social, cognitive and teaching goals and could not encourage students to set goals or plans, or to try to monitor or control their own cognition, motivation and behaviour (Pintrich, 2000a,b; Zimmerman, 2002). As a result, the lack of a powerful learning environment was a moderating factor that did lead to an absence of encouragement for academic goal orientation and achievement of goals among students. The study results are consistent with Mathews and Lowe (2011), who have argued that environmental factors inhibit the CT disposition. This study further helped in identifying those environmental factors such as classroom environment relating to the teacher presence, social presence and cognitive presence of both the students and teacher.

The teacher's effectiveness has been discussed by McBer (2000), stating that the teacher's control of three factors of professional characteristics, teaching skills and classroom climate can significantly influence students' progress. It would be interesting to discuss and research, in the Pakistani and other developing countries' teacher education university context, ineffective CT skills interventions to compare the outcomes with factors related to ineffective teacher micro-behaviours and professional characteristics, and the resulting classroom atmosphere. In general, further research can help in working around black boxes and building connections between failed classroom interventions in CT skills and links between teacher characteristics associated with student learning, as explained by McBer (2000), Westbrook et al., (2013), Tiruneh et al., (2014) and Lai (2011).

The study results also highlight that creative CT involves cognitive processes that occur in a context (Halpern, 2003, p.398). This emphasizes the need for constructivist learning environments, but with essential teacher education for the effectiveness of classroom. Effective classrooms for learning and instruction of CT skills are those that provide a learning environment where there are opportunities to learn – for instance, working in groups and discussion in the form of CoIs. Hence, again, the focus comes back to the powerful role of teachers as interventionists and leaders in the classrooms, and students' characteristics of value beliefs (motivation) about learning CT skills.

This study supports Mulnix's (2012) conclusion that learning environments that not only help in the development of CT skills but also promote a disposition among students and potentially among *teachers* to think critically are more likely to produce gains in students' critical thinking skills. The study provided additional data as evidence of how CT skills intervention implementation fidelity, the multifactorial nature of the CT skills learning and instruction and *teacher effectiveness* influence the classroom climate, resulting in ineffective learning environment and low student achievement. Mulnix (2012) has presented an interesting dimension to think about learning environments in educational settings - and the present findings of the study are consistent with those conclusions; that is, the powerful role that these play in the learning and instruction of CT skills.

7.4 Participants' experiences and implementation fidelity explain the outcomes of CT skills intervention effectiveness

Participants' experience, and how and why the intervention was not successful in increasing students' CT skills?

In this study, onsite observations and participants' expression of their experiences brought in a compelling balancing explanatory evidence for the failure of the first phase. Beyond that, the second phase inductively brought information about how and why the intervention outcomes were as they were in relation to 'where', the context of the study. It should be noted that these explanations are limited to the participants, the classroom and the timing of the study (during and after the first phase). It takes us from 'it failed because the design and implementation were not coordinated, learning environment was not positive, students' motivation/self-regulation had no relationship with learning environment and learning of CT skills', to beyond. It urges is to reflect on the issue in a holistic way to derive a fuller picture of the how, why and where of the phenomenon under study.

In Research Question 2a, the implementation fidelity of the intervention, the role of the teacher, diversions from actual plan of study and students' interest influenced the results of the study. Results from researcher's observations and participants' experience (Research Question 2b) of the usefulness of the proposed teaching model appeared helpful in certain aspects but had limitations in others.

For Research Question 2b, the participants' accounts showed that a number of factors such as the personal beliefs/interest of the learners, and the class teacher, facilities in learning environment, deviation from instructional plan, complexity of learning materials and inappropriate resources, and lack of time hindered the success of the CT skills intervention. The opinions of the students and the class teacher were mixed; while liking the proposed design of instruction at the same time they found it challenging, difficult and effortful.

Participants' experience about features of the intervention design, learning materials, teacher, student, implementation fidelity, measurement (specific instructional model), how and why the intervention was not successful to increase students' CT skills? (RQ 2, 2a, 2b)

The following section discusses the study findings with relevance to the context of the study; that is, a classroom in a public teacher education university in Pakistan.

7.4.1 The case of a classroom

Explaining the inadequacy of the effectiveness of CT skills intervention for initial teacher education students in Pakistan

The setting of the classroom

The classroom contextual factors; for instance, the teacher and the learning environment, were recorded to understand and inform the reader about this specific sample population. The context of the study is a classroom in a public teacher education university in Lahore, Punjab, Pakistan. Two groups of students were studied. The education mode is co-education at this university, but female students outnumber male students in teacher education programmes. This is due to the low popularity of the profession for men due to the low pay and the perception that teaching is a respectable profession only for women. The intake of this university is comparatively lower-middle class and low-achieving students from Lahore and elsewhere. The merit requirements of the university are 50 per cent marks on an upper-secondary degree.

Most of the educational activity at a teacher education university is in a classroom for teaching and learning. The classrooms are spacious, square rooms with comfortable (but not cushioned) chairs and tables, mostly set in rows, the floor is cemented (chips, not carpeted), the walls are painted (cream/off white), the windows are iron framed and painted a wood colour), large and a good source of light and air for the class.

A typical class lecture last from 45-60 minutes. The class has a whiteboard, a chair and a table in the centre for the class teacher to sit. The table is also used to set the multimedia overhead projector and classwork purposes. Occasionally, a fellow teacher may also come, disrupt the class for any reason at all and sit in the class to chat with the teacher. The typical learning environment of the class and teaching-learning process is that the students go to inform the teacher that the class time has started, then the teacher enters the class, all the students greet him and wait to be greeted back. Then the class teacher, depending on the time (if he/she is late or not), takes the register and calls students' attendance. If the teacher is late, sometimes a paper register is circulated without any live teaching taking place, since handouts may have been provided. Normally, after the attendance register, the teacher announces the day's topic and starts reading from the slides or lecturing about the topic in the related subject course outline. At the end, students are advised to collect the slide notes, printed by the photocopier. Rarely does a student ask a question. Mostly, students do not bother to note down more than a few points, and in between the teacher discussing assignment dates, exam dates and so on, and after the topic had been lectured upon, the class is adjourned ten minutes early so that students can be ready for the next class, needless to say delivered in the same fashion**.**

Testing the effectiveness of CT skills intervention for ITE students in Pakistan

The overall results of testing an instructional intervention in this classroom lead to rethinking the dispositional and environmental variables for CT skills instructional interventions for future researchers. There is a possibility of overlooking or over-emphasizing certain variables of learning of CT skills in general or in a subject-specific mode. Therefore, more research is required to relate to metacognitive skills and strategies in learning CT skills as well as the role of teacher in the learning environment. There is also a possibility that these variables do not relate to teaching CT skills from a mixed approach (Ennis, 1999), as rather more specific traits of the learning environment design affect their learning. For example, a positive linear relationship of goal orientation, metacognitive self-regulation and learning environment points towards variables that are more related to attention, interest, discipline and willingness to learn.

The confounding variables selected for this study seem to have no statistical influence or relationship on the learning of CT skills. Use of technology-supported teaching-learning strategies and methods that were appreciated by both teacher and students, such as video lectures and AM software, suffered from the lack of appropriate functioning of the software. The computer lab was reported as a challenge that was hindering learning through AM. While these elements of the instructional intervention were positively associated with the learning of CT, they were also related to the implementation challenges.

The data from interviews and observations helped to draw conclusions about the intervention fidelity of implementation informs us about specific context-related issues at the site where the research was conducted. Overall, I wanted to learn how the CT intervention may be dealt with when put into the hands of a teacher in the traditional environment. The data from classroom observations, field notes and participants' interviews inform us that implementation fidelity was compromised due to various environmental factors and the lack of teacher competency. Therefore, when working with a CT instructional intervention, the prior training of the class teacher needs to be more exhaustive so that the curriculum prepared can be delivered to the minimum possible standards. The aspects of the instructional intervention that were not found helpful for this sample were the audio-visual lessons on CT skills. The participants found that their unfamiliarity with the language and quality of the multimedia made it difficult to listen and fully benefit from the lessons. Students found the accent and flow of the videos quite fast and were unable to catch up with the speed/ideas/materials in the videos. I conclude that the quality of learning materials for example, the quality of the audio-visual material, needs improvement to cater to the language ability and context of the sample population.

Teacher-student communication and delivery of the curriculum came up as major issues affecting the implementation of the intervention, leading to poor fidelity of implementation of the teaching programme. The teacher's competency and interest raise questions about the teacher effectiveness and professional development necessary to promote CT skills in teacher education institutes. The class teacher found that the model was quite extensive and in detail, yet required more time and preparation than to teach a conventional class at his institution. Therefore, he expressed that it was too much to comprehend and organize, and that he was not willing to make the effort. On the other hand, the teacher agreed on the usability of the model and found it useful for teaching the educational psychology curriculum effectively. The teacher felt that his lack of proficiency in English and lack of time were barriers to the implementation of the intervention.

The aspects of teaching with the support of AM, using explicit lesson plans for teaching of CT skills and classroom discussion, were seen as interesting, new and useful by the class teacher. The teacher's lack of competence, and the poor instructional technology facilities and management of the institution affected the fidelity of implementation of the intervention. Consequently, these compromised the quality of the intervention implementation and hindered its effect on students' CT skills learning.

This study also drew attention to the disconnect between what is felt to be useful and what the observations and actual behaviour of the participants showed. For example, the data showed that all participants were positive about the study and its usability. However, they were somehow unable to cope with its design and its requirements of the course successfully to teach and learn CT skills.

With respect to the question about unexpected variables influencing the intervention process, I come to know that a number of elements can be involved in working with traditional classrooms and complex construct such as CT skills. The variables affecting the CT intervention implementation other than the selected variables related to students' interest, and the teacher's effectiveness, time and practice. These are consistent with Iqbal and Shayer's (2000) study, which found teacher variation (teacher characteristics, teaching style), student characteristics (interest, participation) as either favourable or non-favourable conditions for such intervention programmes in Pakistan.

No single strategy is enough to teach one kind of CT. Strategies need to be comprehensive and multidimensional, because the elements of cognition involved in CT skills are complex, and a curriculum designed to enhance these skills is also complex and multidimensional, so needs to be imparted to the students in a sequenced and structured way. The expertise reversal effect can explain many incredible results found in CT research. The study also found the expertise reversal effect of our analysis to be important in dealing with unsuccessful interventions. The students who are better at self-regulation might become more demotivated and lose interest in learning CT skills due to a negative classroom learning environment and unsystematic teaching. Critics of CT skills-related interventions need to consider that, due to the complex nature of the construct, the teaching/learning methods and materials are also complex.

By understanding more about students' prior knowledge, the teacher's effectiveness, a well-prepared mixed-approach CT curriculum (benefiting from both domain specificity and general CT teaching) and ICT-supported teaching strategies may lead to improved results of CT skills interventions. For this, students, teachers and researchers must undertake rigorous research based on both domain-specific teaching of CT and explicit courses of CT, preferably using the mixed approach defined by Ennis. Along with this, one needs to be patient and should not a have high expectations of dramatic CT changes from CT interventions in less time. In such contexts there are no quick fixes, and introducing policies and mission statements cannot ensure that the existing teacher and the infrastructure and mechanism of teaching and learning would automatically change (Fullan, 2007). Increasing teacher effectiveness, teacher quality needs to be closely related to teaching for quality learning at university level. Also, reflection needs to be promoted not only among the faculty but in classrooms where students, as future teachers, learn professional knowledge, attitudes and skills by reflection on practice.

Interaction between learning and instruction

The relationship and interaction between learning and instruction can result in two types of outcomes: a) congruence; or b) destructive friction. Congruence occurs when a teacher's teaching and students' learning/understanding are compatible with each other, and friction is when they are not, and there is a negative effect of instruction on student learning.

The purpose of teaching is to stimulate learners to apply suitable thinking activities to construct, change or use their knowledge: this requires a process-oriented teaching that did not seem to be evident in this study. I noted in the field notes that not following the plan and not preparing for the class might be crucial reasons for the ineffectiveness of the teaching programme in this sample. This would be consistent with the meta-analysis conclusion of Abrami et al. (2008), that successful CT skills instruction requires professional development of teachers focused on teaching critical thinking.

Similarly, students' perceptions of the instruction can affect or threaten the intended outcome of instruction. For example, when students were asked for their opinion of the instructional intervention, some said that most of the class were not interested and felt it was an extra burden, time consuming and too difficult to grasp. Moreover, the lack of reinforcement and reward in terms of marks made it less attractive in students' perceptions.

The students realized that the *instructional approach* (Main theme 2) needed a great amount of time to be spent on tasks, demanded collaboration, group work, discussion and building argument maps using computer software, and also a substantial amount of independent learning, which the students said in the interviews that they could not make time for, for various reasons (e.g. *exam pressure, lack of resources*). I had outlined in the procedure of the intervention implementation the scores that students would be given: two marks for participation and three for the sessional work, so in total five marks for various tasks and activities as a reward and reinforcement strategy. However, these were not given to the students or announced clearly in the instructions by the class teacher. This is another example of friction in learning and instruction, and the negative effect of instruction on learning.

Along with that, a great deal of the *instructional approach* required the *teacher's role (Main theme 3)* in a non-traditional way, where the teacher is a facilitator with extensive subject knowledge and pedagogical skills so that he or she can create a classroom environment conducive to student learning. Based on prior communication with the class teacher where feedback on learning materials and instructional demands of the intervention were discussed before data collection, certain attributes were assumed. These were based on the teacher's assurances and the researcher's (my) communication, that he was familiar with content, had sufficient subject knowledge in educational psychology and was an experienced, qualified teacher with pedagogical expertise at university level (post-doctorate in education and more than fifteen years of teaching experience).

About the *learning materials* of the intervention, the teacher and the students both said that the audio-video lectures were not effective and that poor English language proficiency made listening difficult. They preferred to read materials than listen and watch, because the accent and speed of the videos were not helpful. When asked whether they tried to listen to the videos again after the class or replay them before doing the homework, the students responded that they did not study after the class. They did not copy the audio-files to listen to again. This shows a lack of interest and clearly insufficient practice. In addition, the class teacher's lack of technology handling and teaching skills made the delivery of content even poorer.

The null effect observed could be explained by students' non-responsiveness, lack of interest and practice, but the reasons for the ineffectiveness of the *careful design* under these circumstances are more likely to be due to the underlying contextual factors, such as the study culture and teaching quality at this university, characterized by rote learning, note cramming and passing exams without much effort in a semester system, and a lack of awareness and value orientation as to why these skills are important to an aspiring teacher.

The opinions that students expressed after the intervention contrasted with their self-declared English language ability prior to the intervention. They also contradicted that the university's prescribed mode of instruction was English or bilingual at most times. More importantly, these English language issues contradicted what the class teacher had communicated to me in prior meetings on the suitability of the materials for the ITE students. The teacher's belief in the suitability of the learning material was flawed, in terms of its vocabulary, pace and ease of listening in English, and lesson plans being in line with the course outline topics. In reality, none of this turned out to be true in the field.

The interplay between learning and instruction can also affect the impact of an intervention. For example, the learning environment, the class teacher and student interaction, the learning materials, classroom activities, students' perception and approach to learning, and individual differences all serve to mediate and can affect the implementation of the intervention (Vermetten et al., 2002). Perhaps the reason why the students declined rather than improved might be this friction between learning and teaching. The concept of friction between learning and instruction has been discussed by Vermunt and Verloop (1999). Larkin (2015) studied the role of the learning environment and metacognition in developing CT skills, and how skills development can be hindered due to unclear goal direction, disorganization and friction. Recently, the role of metacognition and teacher characteristics is regaining its place in the academic discussions of student learning and achievement (see Muijs et al., 2014) and the classroom-level factors are becoming prominent in explaining the variation in CT skills research especially (Huber and Kuncel, 2015; Tiruneh et al., 2015; Tsui, 2002)

The interplay between learning and instruction is a complex phenomenon that cannot be fully explored within the scope of this study, but the results strongly suggest a destructive friction between teaching/learning of CT skills in this classroom.

The useful conclusions drawn from this are the importance of testing on site and working in an organic way with the teacher to see what works in practice and what does not, and for similar studies in future to revise and improve the learning and instruction materials, and carefully tailor the language to suit the ability of both instructor and learners.

Role of the teacher as interventionist

The role of the teacher appeared as one of the strongest factors influencing the null effect of the intervention. The constructive and progressive nature of the intervention design based on principles and systematic classroom learning activities should have worked - as portrayed in the literature, it should have had the ability to create a powerful learning environment (McGuiness, 1999, 2000, 2005, 2006; De Corte et.al., 2004). On the other hand, a teacher's personal perception of CT can hinder any policy efforts to inculcate such quality-enhancing prescriptions. Some writers suggest that it is easier to recruit a good teacher than to train one (Chingos and Peterson, 2011). This underlines the massive challenge of reshaping the entire system of education and assessment in any given context. Because existing systems themselves will be playing an antagonistic role towards change, it may also be interesting to test what teacher educators themselves think about such change and the place of CT in teacher education. Hager and Kaye (1991) have already speculated on the possibility that the process of CT has had no currency in traditional, mechanistically driven teacher education curricula (Hager and Kaye, 1992, p.30). When the perceptions (nature, acquisition and application) of educators on critical thinking were explored from a multidisciplinary perspective in Pakistan, three categories appeared important from participants' data, namely ideas related to the nature of CT, the acquisition of CT and the application of CT (Cassum et al., 2013). There was consensus among participants over the meaning, nature and acquisition of CT in education. The study also identified a comparable list of Urdu terms, phrases and expressions that were similar to research literature findings in English language literature describing CT, its principles and procedures. This could be useful when teaching native students and explaining and describing CT. However, the members of education faculty seemed to believe that CT skills are more important for health education than education in general. Overall, Pakistani teacher educators put low value on the need for teachers to be critical thinkers, so there is clearly further investigation needed into the current practice of ignoring or downplaying this area of competency (Hager and Kaye, 1991; Iqbal and Shayer, 2000).

The observations of the teacher's role previously mentioned in the sections above, for instance, *unsystematic implementation of the instructional intervention and ineffective role of the teacher as an interventionist*, show the evidence of a weak teacher presence, professional characteristics and teacher skills. The teacher was the *internal locus of control* for the implementation fidelity and effectiveness of methods and learning strategies proposed. However, as an implementer of the instruction, he appeared to pervert the intervention in the context of this classroom at a Pakistani teacher education university. The study results are consistent with Iqbal and Shayer's (2000) intervention outcomes, which found teacher variation to be a major factor in success or a potentially flawed impact.

If the teacher is not involved, then regardless of the good materials and effective theoretical principles, the outcomes will be compromised. With reference to the *instructional approach* (Main theme T3), the teacher did realize that design was useful (*useful design*), but perhaps not convinced to put in the required effort and change the mundane routine of his teaching. The role of the teacher in this intervention was crucial to student learning, and demanded him to be *facilitator, mentor and mediator.* Previous research from Pakistan on this topic is limited, but in one study by Cassum et al. (2013), a survey of university teachers found that existing teachers lack actualization of the CT skills concept. This study results are consistent with this finding.

The teacher commented that 'he had to do a lot' *(performance pressure*: *role of the teacher (*sub-theme T3.1b.) The findings from *main themes IF and OCE of implementation fidelity (IF) and observing the classroom environment (OCE)* indicated that for CT skills instructional intervention to be successful, the teacher's role and participation throughout the research activity are both essential.

The results of the intervention follow-up told a different story. It was observed during the implementation that the teacher's professional characteristics were affecting the intervention more than the language issues or issues with the learning material issues. The teacher was unprepared, tea meetings were preferred to classroom time and at work he was dealing with personal matters, and not paying much attention to his job. The observations in the control group showed that his relaxed, day-to-day teaching style was sitting on a chair with a laptop open in front of him, reading the slides to the students.

For a moment, we should set aside the problems with learning materials and language in this study, and look at its findings through the students' feedback. The recurring comments on the questionnaire about the learning environment and my observations in various sections of the analysis give clear, compelling evidence that the actual reasons might be very different from merely the complexity of the intervention, time and the language barrier. They fall under the headings of *intent long process* (Main theme 1), *active learning and lack of reinforcement and reward for good work* (Main theme 2)*, teacher's role* (Main theme 3)*,* and, from *feedback on intervention implementation* (Main theme 5), *implementation fidelity (IF) and observing the classroom environment (OCE)* (Main themes IF and OCE).

Still more tellingly, in the follow-up interview the teacher expressed his own unfamiliarity not only with the concept/curriculum that was being taught but also that 'they' (his group of teachers or the organization) are not used to teaching/learning in this style and are not in the habit of thinking and working hard in this way and, therefore, it needed more time and practice. I did wonder whether he had ever opened the teacher kit that I sent him several weeks before the data collection. In my view, looking at the research evidence from previous meta-analytic studies, for instance Abrami et al. (2008, 2015), the teacher's professional development for teaching CT skills is the key if instruction is to be improved, and it has to be rigorous and longer, with more senior teachers.

During the intervention implementation, most of the learning materials and resources were already prepared and provided to the teacher, for instance the permissions, arranging computer labs, installation of software, providing photocopies of learning materials and the course outline was all done by the researcher. Despite this, the class teacher expressed in a subtle way that the *methodologica*l demand of the intervention was too high for him (work load and performance pressure). As Willingham (2007) argued, you cannot just teach CT; it seemed that the Skype training meeting of 240 minutes (4 hours) and the three days' onsite training prior to the intervention implementation was simply not enough for this teacher, in this context. The research evidence on *instructional approach* (Main theme 2) and *what happens or how it is taught* (Main theme IF and OCE) further supported the ineffective role of the teacher.

Perhaps, a lack of awareness of the NPST 2009 policy at this institution and the lack of legislation informing and training for existing teachers about developing CT skills as part of professional training of ITE students were reasons why the class teacher was unfamiliar with the concept. It could also be the case that the class teacher felt no ownership of the intervention and thus did not value it, and that his lack of engagement resulted in a classroom atmosphere that did not cultivate CT skills. The teacher's expression of not only his teaching, but the curricular content limitations and his reluctance to change, plus low expectations, indicated little interest, and perhaps a lack of involvement in and ownership of the project.

These triangulated perspectives of what was tested, what was said and what was observed show that the instruction and learning were not harmonized in this classroom context. The traditional setting of the learning environment (teacher in control and students only following notes, memorizing and reproducing materials in exams), with a focus on superficial learning rather than deep learning in this classroom, is no different from that at most educational institutions in Pakistan. The new instructional approach was not adopted or implemented to an extent sufficient to allow it to result in any change. Abrami et al. (2015) concluded that teacher quality and the interaction between the teacher and students are unexplored areas in the research of CT. The calls for more time for this study were to some extent reasonable, but were also a shield to compensate for the lack of effort and to cover both the teacher's and students' own poor performance.

Intervention implementation fidelity

The intervention design based on principles recommended in the literature (*design principles*) employed a systematic and simultaneous delivery. This is theoretically a complex design, as discussed above under 'Complexity of the instructional intervention'. The design of the delivery and the necessary learning materials need to complement each other harmoniously for the desired effect to occur in student learning and performance on CT skills. The intervention fidelity of implementation provided evidence of inconsistencies and poor delivery of content. The study outcomes are consistent with O'Donnell et. al., (2007) and O'Donnell (2007), who found that poor implementation can be a moderator for curriculum effectiveness. This study not only considered the importance of implementation fidelity but also used structured and unstructured observations to enhance the validity of visual evidence observed in the field.

The systematic design yet flawed implementation (Higgins et al., 2005) also draw our attention to what was different or unique in this classroom to make the innovative instruction fail to work. All the classroom factors (teacher, students and interaction of these with learning materials) that explain why the intervention did not work have been discussed. Besides the intervention curriculum, student and teacher factors, quite surprisingly, I had to reflect on the university as an organization, the culture of teaching and learning, and the system as a whole when interpreting the data to make sense of the ineffectiveness of the intervention.

The students' and class teacher's narratives showed that this research study was perceived as being alien and temporary, therefore they were not truly involved in it. The qualitative analysis showed how the students' and class teacher's CT learning experience, contextual challenges and, most importantly, the direct effect of the interwoven intervention implementation fidelity and classroom context were the factors hindering the effectiveness of the intervention. This could not have been established and measured merely by testing.

Most of the lack of understanding of the intervention was explained through listening to and observing the students' and class teacher's experience of the intervention. The *exposure* of the intervention provided to students was poor in quality, due to several departures from the objectives of the lesson, the teacher's evident lack of professional teaching skills and the ineffective presentation of the intervention learning materials. The sequence of the instruction was interrupted many times. The learning materials and language barrier could have been handled better, or well compensated for, if the teacher had done preparation and planning in advance of lesson delivery.

The accounts of needing more time and practice by the students and the class teacher are understandable (this is addressed as a research limitation), but are not grounds for overlooking the significant evidence of compromised intervention implementation, the crucial role of the teacher, the students' motivation/self-regulation and, last but not least, the resulting learning environment. The case for more practice and time is understandable and reflects on the need for an organic adoption of CT skills learning and instruction that is responsive to context.

This study's results also support the concept of harmonized instructional programmes for improved student learning (Newmann, Smith, Allensworth and Bryk, 2001). Institutions that show strong coherence in improvement efforts ('instructional programme coherence') are more likely to advance student achievement and learning. If we take the instructional coherence programme concept and analyse intervention outcomes with reference to the introduction of NPST 2009, curriculum changes, and so on, then through the example of this intervention, one can see that such effort cannot be successful if there is a lack of coherence between classroom-level implementation and institutional-level instructional programmes.

The level of English proficiency seemed to affect the teacher's and students' understanding of various concepts. This was unexpected, their self-reported level of English proficiency was much higher than the level observed by the researcher during lesson delivery. Most of them rated themselves as average or good at English reading, writing and paraphrasing, but the actual levels were quite low. There is a lack of research on the effect of English as a second language for teaching CT skills (Coleman, 2010), therefore firm conclusions cannot be drawn from such a small sample.

The null-effect could have been caused partly by the difficulty and challenges that the participants faced. The challenges are not only at classroom level but are representative of the institution. An intervention is executed at classroom level, but it cannot be ignored that the classroom is part of a department or faculty (Education), and that this faculty is part of an organization. The relationship between teaching and learning culture is therefore nested in the behaviour of a larger community or institution. This study results are consistent with the findings of Gul et al. (2014), in that educators must have structured training to use and foster CT in their teaching practices in Pakistan. Gul et al. trained a group of teachers through an intervention for health sciences educators, whereas in this study the instructional programme (intervention for ITE) involved training an existing teacher. This study was employed in a classroom in order to look at the intervention's effect, showing an advanced application of CT skills research in a new context as well as providing first-hand knowledge about how a teacher actually teaches a CT skills embedded curriculum.

7.4.2 Summary of the case

In terms of the concept of CT (skills + dispositions), we need to modify our conceptual understanding of care ful design. From the empirical observations of this study, it seems that CT skills cannot be put on track without the 'engine' (Marzano, 1998) – that is, metacognition or, in other words, motivation/self-regulation. Therefore, future studies must also include self-regulatory learning strategies in their careful design, and for teachers as well as students.

This study's qualitative data observations provided insights into the classroom, the interaction of the teacher effectiveness, teaching quality and organizational infrastructure (e.g. intake of students, lack of updated computer labs, and teacher's competency of using technology, sudden changes in exam schedule, tea meetings and staff workload). These factors although need more research to establish causal links for the success or failure of systematic instruction, do indicate that the institutional support and structured and sustained learning environment conditions are an important part for successful delivery of the instruction. For raising the quality of future teachers, the teacher education university needs to raise its physical infrastructure and most importantly existing teachers' pedagogical skills. An effective pedagogy at institutional level as observed by Tusi 2002 can be a step forward towards ensuring that teachers learn critical thinking skills as a professional competency.

For ITE students - who are our future teachers - the first important step is for them to see the value and applicability of CT in their professional training as a preparation for the profession. The second step is to realize that effective teachers display effective thinking in their professional characteristics and teaching skills, and as a result create an effective classroom atmosphere for learning. Above all else, existing teachers (those already in teacher education universities) need to act as role models of good thinking attitudes. A lengthy and painstaking task, but not an impossible one, this can be done through reflective practice and awareness, and lessons of good organizational leadership, such as in Latin America (Hunt, 2011).

Looking at the unsystematic implementation and ineffective role of the teacher in this study, it is clearly important that a teacher, as the implementer, works closely with the researcher or intervention team, and that the intervention and strategies evolve during the implementation. More on-site training would have been useful to achieve better involvement and delivery of the intervention. This study reinforces what Westbrook et al., (2013) and Loughran (2002) concluded in separate studies, namely that a) teachers' professional development needs to be aligned with classroom practice and enhanced through follow-up support, and b) reflective practice in pedagogy, curriculum, teaching practices and teacher education through teacher preparation programmes can be effective in making learning meaningful.

This study's qualitative data observations provided insights into the classroom, teacher-student interaction, teacher effectiveness, teaching quality and organizational infrastructure (e.g. intake of students, lack of up-to-date computer labs, poor teacher competency in using technology, sudden changes in exam schedule, tea meetings and staff workload). Although these factors need more research to establish definitive causal links to the success or failure of systematic instruction, they do indicate that institutional support and structured and sustained learning environment conditions are important in the successful delivery of interventions. To raise the quality of future teachers, the teacher education university needs to improve its physical infrastructure and, most importantly, existing teachers' pedagogical skills. An effective pedagogy at institutional level as observed by Tusi (2002) can be an important step towards ensuring that teachers learn CT skills as a professional competency.

The careful design of this study included the classroom learning environment and CT skills learning and instruction design as its core focus, understanding the teacher as merely the communicator of that careful design. The careful design was thought to be sufficient to produce the desired effect of the intervention on increasing students' CT skills learning. On the contrary, it appeared that carefully designed principles for curriculum planning are not enough, and that the mutual effect of the intervention materials, teacher and teacher characteristics and students' participation as part of the careful design need to be part of future studies. Studies must include the teacher as a key variable of the careful design of CT skills interventions. On a wider level, if the teacher education standards policies are there only for decorative purposes, and are not communicated and ingrained in practice in the teaching/learning environment, no outside effort such as this study can be successful or sufficient to modify individuals, especially in terms of classroom practices or institutional culture in a context such as Pakistan.

In the next chapter, conclusions are drawn on an extended, comprehensive account of testing the effectiveness of CT skills instructional interventions, its relationship to contextual elements (classroom) and contribution to knowledge. The implications, limitations and direction for further research are presented. The bigger picture is elaborated in the sense of raising the quality of teachers in respect of CT skills as part of professional teacher standards, the consequences of incoherent institutional involvement in policy introduction, adaptation and implementation, and its relationship to quality of teaching and learning at classroom level.

Chapter 8: Conclusions

> We do not learn from experience... we learn from reflecting on experience. – John Dewey

Introduction

This chapter has five sections: conclusion; contribution to knowledge; implications; limitations; and further research. This study was undertaken with the objectives of testing the effectiveness of a CT skills intervention and understanding its application in a Pakistani teacher education programme, drawing conclusions about how and why the CT instructional intervention works or not under certain circumstances. The previous chapter, on findings and a discussion of the study, covered the quality of the intervention design and implementation, the role of motivation and the learning environment, participants' experience of the intervention, and observations of the issues and reasons why the intervention did not work in this study.

The findings and discussion bring out useful insights into CT learning and instruction studies in terms of the theoretical and practical realities of a situation. The discussion also highlights the key factors affecting the intervention effectiveness in a Pakistani teacher education context, reflecting on the wider spectrum of intervention research in CT skills provision. The later section deals with the study's contribution to knowledge.

8.1 Principal conclusions

This section briefly elaborates on main conclusions of this study in terms of objectives, findings and discussion of the study, and what we learned from research questions rose earlier.

1. CT skills are core literacy skills for quality education of young people (UNESCO, 2015) and for ITE/ in-service teachers' professional development in knowledge, skills and performance (NPST, 2009, Pakistan). However, practical learning and instruction of CT skills in classrooms are difficult endeavours that require competent teachers, supportive infrastructure and institutional support. The class teacher in this study needed additional professional development. A university can provide in-house reflective professional development opportunities to improve their staff's awareness, knowledge and pedagogical skills about teaching CT skills effectively. Only a reflective teacher can help the students to develop and practise their thinking skills in the classroom.

2. CT dispositions are an important part of CT skills learning (Ennis, 2015; Facione and Facione, 1992; Halpern, 1999; Profetto-McGrath, 2005). Value orientation (extrinsic

and intrinsic goal orientation) towards learning CT skills and the ability to think about strategies to learn (self-regulation) are tools for academic achievement (Cheng, 2011; Marzano, 1998; Pintrich, 2000b; Pintrich and Zusho, 2002; 2007). This study provided evidence that the inability of the class teacher to promote the CT dispositions and learning environment in his classroom needs additional attention. The classroom learning environment, as the outcome of teacher effectiveness and student engagement, is a 'black box' of CT skills interventions. Only a teacher who can engage and encourage students in activities and thinking about metacognitive awareness, regulation of cognition, motivation, behaviour aligned to context in ITE teacher education classrooms can implement an intervention effectively.

3. CT skills and dispositions are associated with how instruction is delivered (Abrami et al., 2008). This study provides evidence of the importance of the role of a teacher and its direct impact on the effectiveness of teaching CT skills in the classroom. Only instruction in a systematic and structured manner can ensure the effective delivery of the content and activities so that the effect of the intervention may be measured. Pedagogical training of the teacher specifically to deliver CT skills instruction will help in enhancing the quality of teaching and the impact of CT skills intervention (Muijs et al., 2014).

4. Positive classroom environments and teacher-focused interventions (Leat, 1999) with a broader perspective of including stakeholders, are promising (Burden and Nichols, 2000; Burden, 2015). The evidence of potential flaws in the study revealed that perhaps there was not enough consultation and involvement of department leadership and preparation with the class teacher before initiating curricular and pedagogical changes, in a somewhat autocratic manner, through this intervention (Darling-Hammond, 1999, 2000a and b;Muijs et al., 2014; Wegerif, 2008).

5. Successful CT skills provision in an ITE programme at classroom level demands a grassroots commitment from teachers. Finally, changes in the classroom can be brought about with research into this commitment that is more teacher focused, prior, during and after involvement in the learning and instruction of CT skills.

6. The dynamic relationship between the experience of using CT skills approach and teachers' professional learning frequently exceeds their expectations (Leat, 1999; Baumfield, 2015). The evidence showed that a lack of experience in using a CT skills approach disrupted the flow of the class and teaching. A powerful part was played by

contextual factors (the teacher's professional skills and experience of teaching CT skills, the classroom learning environment and the institutional learning culture), and the rigid structure (systematic multidimensional CT skills instruction) inherent in the intervention's design. Working in partnership with colleagues in an inquiry manner would allow the class teacher to go beyond 'I had to do a lot', towards a shared experience of learning.

7. The reception and readiness of both teacher and students to embrace the intervention contextually require a shift from the usual lecture-listening methods to a constructive, self-regulated, situated and collaborative learning process (Burden and Nichols, 2001; De Corte et al., 2004). However, finding teacher readiness and a shared vision for high-quality learning and CT skills teaching in ITE modules is a rare event in this context. Even though self-regulation is highly student oriented, the extrinsic motivation of a teacher can make a difference (Abrami et al., 2008; Moseley et al., 2004; Tiruneh et al., 2014). It is thought provoking that the teacher's behaviour in the classroom is extremely important in modelling CT skills for ITE students.

8. Teacher variations (teacher characteristics, teaching styles) in grasping the underlying philosophy and methodology of intervention, institutional variations (administration and teachers' response) and student characteristics (interest, participation) are either favourable or unfavourable for intervention programmes (Iqbal and Shayer, 2000). For the organic adaptation of the idea, more effort and time are required at this institution, with greater collaboration and commitment from the institutional leadership. Contextualized teaching and measurement strategies with well-trained teachers and a shared control of the acquisition of adaptive competence would positively help the reception of and readiness for a CT skills-oriented learning environment in teacher education programmes (Abrami et.al., 2008; Tiruneh et al. 2014; Wegerif,2008).

9. Testing the effectiveness of this CT skills instructional intervention at classroom level enabled us to look at the wider connections with teacher effectiveness at classroom level (McBer, 2000; Creemers and Reezigt, 1999; Cotter and Tally, 2009; Muijs et al., 2014) and its nested nature in the institutional culture (Muijs et al., 2014; Tusi, 2002), hence the need for a broader, fully institution-led approach to teaching CT skills to ITE students in Pakistan and elsewhere (Baumfield, 2015; Burden, 2015).

10. A policy on professional standards is not enough; universities of teacher education

need to implement such policy, and there should be accreditation for the steps taken, aligned to the process of teaching and learning at classroom level.

8.2 Contribution to knowledge

Applying CT skills learning and instruction research in teacher education research

By taking an existing approach into a new field – a CT skills intervention for ITE students' learning and teacher effectiveness - this study combined conceptual or theoretical literature resources in a novel way to address CT skills interventions and teachers' professional development in Pakistan. It uses a conventional sequential explanatory mixed-methods research design in which the first phase is quantitative and the second qualitative. Essentially, the study did not make expert use of the research design, but used the design/methods to arrive at a conclusion on the effectiveness of a CT skills intervention in the field of teacher education research. This study for the first time addresses the multidimensionality of the CT skills (educational perspective) concept with a focus on classroom level, on students, teacher, learning materials, student motivation/self-regulation and the learning environment. This bridged the gap between CT skills intervention effectiveness and the school effectiveness and improvement literature.

The study suggests that research into CT skills interventions in teacher education is urgently needed in Pakistan, because it addresses the question of whether a carefully designed intervention works or not by testing and by explaining the intervention's ineffectiveness, its fundamental gaps and what affects effectiveness in a classroom, existing teacher education practice, and the lack of policy awareness, adaptation and implementation at university level. Moreover, due to his lack of pedagogical skills for teaching CT and classroom management, the existing teacher at the study site needed continuing professional development.

The study investigated the teaching and learning of CT skills in teacher education programmes. It filled the gap in the literature on its teaching and learning by pre-service professional development of teachers.

Intervention studies often do not take into consideration elements affecting data collection in the instructional environment, such as the presence of a systematic instructional programme and learning environment, with motivation/self-regulation. Rarely do they report much on the design and measurement tools, implementation fidelity and the design in practice and in situ. This study has worked through some of the 'black boxes' in CT skills intervention research, as well as indirectly shedding light on the quality of teacher education (ITE and professional development). There has been little visibility, not only of what is happening inside the classroom, but also of the actual situation in teacher education programmes in Pakistan, student-teacher interaction in the classroom for effective learning and instruction, and the quality of professional experience that students were provided with at this university.

The study brings together the disciplinary concepts of CT skills learning approaches, concepts of education and learning sciences, and concepts of teacher education and professional development to improve professional and pedagogical practices in teacher education. This has shed new light on CT skills learning and instruction in mainstream teacher education programmes to enhance the future teachers of Pakistan.

'Black boxes' of CT skills intervention research and a holistic view

My research has added to what is known about CT skills interventions, learning and instruction. Most importantly, it has explored the effectiveness of CT skills instructional interventions, not only with reference to the effect but to the design, implementation, measurement and response, in a holistic view.

Very few studies have taken a holistic view of CT skills interventions. Exemplary studies such as by De Corte et al. (2004), Kaufman and Burden (2004), Shayer and Adey (2002), and Burke and Williams (2008) were all either well-funded or researched by a team, or both. Due to the challenges of the endeavour, the multidimensional and multifactorial nature of this field is not often tried by a solo researcher. Nonetheless, I have queried the field as a solo researcher in a context in which the field challenges, in practice, mount up for various contextual reasons.

The holistic view of this study is that the teaching and learning of CT skills are not separate from the users (teachers, students), their motivation/self-regulation, the classroom learning environment and the context in which they are applied. Regardless of the limitations in the methods and measurement instruments of this research, I have built previous knowledge of the CT skills literature, including most relevant dimensions, principles for good teaching and learning of CT skills, into the intervention materials. I did so by designing a complementary holistic intervention (teacher-researcher consulted) in which each dimension was given its due place not only in the activities and materials, but also in their measurement. The study filled gaps in the literature by reporting on details of all former aspects, implementation fidelity and participants' opinions of the intervention for a deeper, richer understanding.

This work can further serve as a guide to what to take into account in designing such interventions, and also the challenges and pitfalls, and how to deal with them in the field. The way that the variables were framed and constructed in this study and the approach to analysis may provide future researchers with guidelines on how to look for patterns and answers in the data using greater powers of statistical analysis approaches, such as gain score analysis and mediation analysis, as well as qualitative content analysis, an holistic case study approach via observation, field notes and interviews for an interpretation of the results.

The study has contributed by taking a critical look at the literature in the field of CT skills learning and instruction. It has simplified the complexity by synthesizing design principles for effective CT skills teaching. The study then creatively devised methods and materials, piloting them to develop the best possible set of intervention materials, procedures for implementation and measurement, tools of inquiry, statistical and interpretive analysis approaches, and rigorous application, both in the field and in the development of the thesis.

The steps and care taken at each stage of the research study have not been attempted by many doctoral candidates, at least from Pakistan, in the field of educational research and teacher education research. By doing so, I have not only addressed asking research questions in the best possible way, but have also shown how difficult it is to pursue such ambitious research in challenging contexts such as Pakistan. The role as a researcher becomes more dynamic and demanding. Therefore, the challenge was not only to execute the project effectively but to test my abilities as a researcher.

Theoretical foundations of intervention design and systematic application

There is lack of research that is based on theory-driven intervention principles to teach CT skill (careful design) in small-scale intervention studies. This study attempted to tailor an intervention at the teacher and classroom level. Tailoring to the context of classroom and testing that design using a mixed-methods research approach are rare in the teacher education research field at university level in Pakistan and elsewhere.

Research approach and design

Using the traditional quantitative traits of a quasi-experimental design as a springboard, the study advances the field of testing intervention by merging sequential explanatory analysis using qualitative approaches. It looked at the effect and effectiveness of CT skills interventions as not being detached from their environment of application. In Pakistan, in general, there are few attempts to test and evaluate the effectiveness of CT skills instruction with relevance to the design of interventions using a mixed approach ‘what teacher does, what students do’, and how and to what extent it is appropriate in this classroom context for ITE programmes.

The study showed an optimal utilization of classroom observations and interviews with post-test performance. While this may not be unusual in educational studies in Western research communities, presenting a combined understanding of ineffective intervention outcomes is not usual in a South-East Asian context. For example, use of mixed methods allowed exploring and identifying some of the issues of CT skills instructional research with relevance to the classroom context, implementation fidelity and role of the teacher that are important to the intervention results. The approach proved to suitable for the field of research in learning and instruction of CT skills, where there is unexplained variance aplenty.

A shared lens on learning and instruction

Looking at *learning CT skills* as knowledge acquired from purposeful instruction and learning experience, where *instruction* is the purposeful direction of the learning process, the study contributed by advancing a shared lens at classroom-level learning and instruction of CT skills as a dynamic whole, rather than as separate fields.

The intervention was designed on principles derived by synthesizing the literature review, again linking knowledge from both theory and practice. Further studies may be conducted on the research findings of this study to enhance the curriculum, and learning and instruction for CT skills in this subject. The preparation, implementation and evaluation of the instructional intervention in a teacher education programme were important aspects of this study. This study can help us to understand the practice of teaching/learning of CT skills on a small scale at classroom level in the Pakistani context.

For educational research, the study contributed its research design, which can be replicated elsewhere to validate the literature on CT skills and build our knowledge of the learning and instruction of CT skills.

8.3 Implications of the research

The implications of the study can be described under the following main sections.

a. Implications for teacher education programme in Pakistan

The integration of CT skills in the subject of Educational Psychology in ITE Curriculum in Pakistan

In this study, the objectives for the educational psychology curriculum were identified with the help of the class teacher, then converted into teachable and assessable classroom goals. Unfortunately, the immediate results did not turn out well. However, the objectives can be used in a replication of the same module at this university. Moreover, other subjects of ITE programmes may be designed following the same design principles.

The study has identified a specific pedagogical approach and teaching methods for the teaching-learning of CT skills in ITE programmes in Pakistan. These can be used to provide training in this approach for teaching thinking, together with specific teaching methods and techniques.

The design principles and theoretical frameworks identified for the ITE programmes in a Pakistani context can be used further for the development and assessment of learning how to think and support student learning and provide comprehensive curriculum objectives, pedagogy and assessment, at least at this university.

Intervention design

Together, the theoretical frameworks considered the educational aspects of teaching and learning of CT skills in teacher education institutions. These provided the conceptual foundation for the instructional design principles on which CT skills modules can be prepared and delivered in a teacher education programme.

The module for the current study was also prepared in one of the teacher education modules based on these six principles for teaching CT skills. The study used students' metacognitive aspects and the learning environment as confounding variables. The results showed that metacognition may be a key variable for students to think critically and regulate their learning, rather than a confounding variable. Similarly, regarding the learning environment, it was assumed that the teacher would implement it as intended, yet it came about that there were variations in understanding what was planned and what was implemented, despite the prior training of the class teacher. The teacher happened predominantly to moderate the learning environment. Further studies may study aspects related to metacognition, the learning environment and teacher interventionist as key variables in the teaching and learning of CT skills in teacher education programmes.

Of the six design principles, the first three were theoretically related to specifying the field of CT skills and CT skills instructional approach. The remaining are: 4: Design principle collaboration and group work (learning activity: communities of inquiry stage based discussions); 5: Design principle formative feedback (teacher guiding and encouraging student learning), and; 6: Design principle visual representation (concept mapping and AM) used to design systematic instructional activities. Most students (of those interviewed) and the class teacher liked the AM, but found discussion more useful for learning CT skills.

While no causal relation of the effectiveness of the design of instructional plan could be established, the students and the class teacher expressed positive opinions about the integrity of the instructional design. Based on observations and the participants' opinion, it is suggested that to decrease the complexity of the intervention, perhaps only discussion of Design principle 5, or only AM with Design principle 5, could be a way to lessen the cognitive load and simplify classroom instruction, and should be further researched. An intervention based on these two instructional principles could be tried. This will improve the design of the instructional intervention for the purposes of replication at this university.

Intervention design needs to be flexible so that it can evolve according to local need. The best way perhaps could be to work organically with the class teacher in a reflective practice manner, and include or exclude instructional principles according to the group's characteristics and demands of time and curriculum.

Policy vs implementation

The research study in broader respect showed, in terms of the importance of practical efforts to realize institutional NPST policy, that coherent, strong visionary efforts from the institutional leadership are required to start a culture of thinking classrooms. Beforehand, much rigorous policy adaptation and many implementation steps must be taken. First of these is the in-house professional development of university teachers in teaching CT skills in their relevant modules. The results pointed to a crucial need for in-service training for the existing teacher in this institution or working on a programme of professional development in a reflective practice manner. Once they have the confidence to execute the systematic CT skills instruction in modules, this type of design can be applied elsewhere.

Along with reflective practice for teachers and students in terms of teacher education and CT research in Pakistan, breaking the cycle of ineffectiveness and alien policies being introduced with little support and groundwork demands them to make the changes their own, as interventionists.

Theory vs practice

Theoretically, there are many 'best possible' ways to teach and learn CT skills. For the discipline of teacher education, it becomes even more important to consider the multidisciplinary nature and pedagogical preparation of future teachers when training them. Researchers can draw models in the theoretically best possible way to teach CT skills, but the ground realities play an important role in altering their impact. Therefore, it is important to keep on testing the theories and adjusting these. Further research can be carried out on testing the theory of design principles to see how these work in practice to instill CT skills in ITE students.

b. Contextual factors interacting with the phenomenon of study

ITE programmes and in-service professional development

Intervention implementation fidelity in the classroom is a mirror of institutional practice and an organization's learning culture. ITE programmes do not work independently of the university. Therefore, the improvement in their quality at classroom level is not directly connected with university-level initiatives from programme directors or institutional leadership. University-labelled mission statements about NPST cannot do the magic; it will need rigorous follow-up implementation policies for ITE programmes to become effective and for the quality of instruction to be improved. This will require major development of the existing staff at this university through some form of in-service advanced professional development course with follow-up classroom observation, or working with a coach or trainer in effective pedagogy.

If universities of education want to increase the quality of teachers and teacher education programmes, they must chalk out the procedural policies and action plans at institutional level to ensure that the existing teachers and institutional infrastructure are in place to provide a standardized, quality education for ITE students. This shift in institutional learning cultures and the support of leadership are important to realize the value of CT skills in teacher education programmes. Teachers as the gatekeeper for instruction and modelling thinking are an important factor in the Pakistani context. Therefore, extensive training of teachers in teaching thinking is important, before any implementation of CT skills instruction in classrooms.

c. Suitability of methods used

Mixed-method sequential explanatory design

Sequential explanatory mixed-methods designs may prove beneficial in challenging contexts, as reported in this study. They provide a fixed yet flexible approach. The quasi-experimental method helped in testing a design and reflecting on what may work and what was needed more time and modification. The case study analysis, though limited to only the experimental classroom, provided an in-situ description of how interventions worked. Mixed-methods research design helped greatly in achieving the objectives of testing the effectiveness of the intervention, the unexpected results, and understanding why the learning and instruction of CT skills did not work in this study.

The application of sequential design could be challenging for a solo researcher in terms of execution when the quantitative phase is an intervention, as observations are desirable, for triangulation and an explanation of the effect, and conducting interviews shortly afterwards could be exhausting. If the observations are video-recorded and then analysed for implementation fidelity, it would strengthen the integrity of the design and lessen the fatigue, researcher bias and the effect of the researcher's presence on site.

Moreover, the case study was bounded by the first phase, the timing and the place of study as only the classroom. This could be improved by looking at the classroom as a part of its institution, gathering data from programme directors on the vision of policy and practice, institutional involvement and so on. This could enhance the practical relevance of contextual factors that may be influencing classroom instruction. Classroom and organizational culture are at the meso level (the spine) in an education system. Therefore, a focus on classroom characteristics in relation to organizational culture design in Pakistani context would bring about a vivid description of the teacher education programme's quality and effectiveness of teacher education at the macro level and how to transform it with CT.

Suitability of data collection methods

The study used valid instruments, but the fact is that several contextual factors affected the intervention impact, so it certainly was not that the variance in outcomes was due to the measurement tools themselves being applied in a new context, or sample variation. Moreover, the language was expressed as a concern by both the class teacher and students. It is advisable either to undertake wide sample testing of the instruments before further use in this context, to check the reliability of measurement, or use a translated version to enhance the understanding and validity of their content.

Language and intervention materials may be translated or provided in both languages for learners to choose. This seems to be a reasonably relevant implication from this research study. Measurement instruments should be widely validated (tested for the context and translated) and validation of the learning materials' replicability is needed. It is advisable to do so on a wider scale before using these measurement tools in any further studies in ITE universities in Lahore, Pakistan.

The study had a limited sample that is not generalizable to a wider population of teacher education students or existing teacher education university teachers. A larger sample to compare instructional interventions, teacher effectiveness and student characteristics may take the form of a mixed-method study. Institutional case studies from Pakistan teacher education will bring valuable knowledge to this field.

d. Implications for further research in learning and instruction of CT skills

Design experiments (value-added approach with interpretive qualitative component in teacher education for learning and instruction of CT skills)

Design experiments or value-added models alone cannot explain the teacher effect on student achievement in a classroom. Additionally, there is a risk in the instrumental description of teacher effect through only student achievement. Design experiments, by definition, combine the features of theoretical orientations and a pragmatic bent to educational research. Design experiments such as this involving the qualitative study of the environment of experiment, due to their reflective and prospective nature in teaching and learning of CT skills, can bring a deep understanding of unaccountable variance in the domain-specific learning processes of classroom design experiments. Such study designs for research and analysis can fill this gap, because they are accountable to the activity of the design.

Research lessons from this research study may be the need for *effective classrooms for effective CT skills learning and instruction.* Therefore, when researching learning and instruction of CT skills, greater emphasis on the metacognitive learning environment and teaching strategies, greater teacher engagement with the intervention as an interventionist, and institutional involvement in terms of policy awareness and dissemination will provide opportunities to create a powerful learning environment. Further research in this direction is required for effective CT skills interventions.

8.4 Limitations of the study

i. The study is limited in its data collection and statistical/inquiry methods. For both qualitative and quantitative parts, purposive sampling techniques were employed. The study is also limited by its non-probabilistic sampling choice and size: one teacher and two groups of students at a teacher education university in a developing country; two classrooms and one class teacher. Therefore, generalizations may not be made far beyond this population. This sampling helped to observe and understand completely a process of intervention implementation and response by studying the population closely. This choice was made partly because the research questions needed a uniform sample.

ii. A critical thinking skills intervention was taken as an independent variable, and data were collected on students' CT ability in the form of pre- and post-test scores. This limited the analysis tests that could be run with the data. For example, if the scores for individuals' CT elements of argument analysis, evaluation, inference and judgement were measured separately, a comparative analysis of the gain on each CT sub-skill would have helped to assess novice learners' learning of CT in a detailed manner. In future studies, measurement of the CT construct of each sub-skill could be helpful in drawing relationships among the effects of CT instruction on each sub-skill separately.

iii. The study was limited by its test instruments and observational tools. Testing of the tools in the actual context was not possible before the intervention, due to the doctoral time frame for completion. The data collection tools selected were valid, but limited in reliability. Therefore, the statistical findings may also be limited in their generalizability. The qualitative tools, too, were limited by their ability to provide information only during and after the intervention, as observed by the researcher. The study could only collect dispositional data from the experimental group, and could not explain the motivation and learning environment of the control group. This limitation can be avoided in future studies by taking into account the motivation and learning environment measures of both the control and experimental groups to help in navigating the differences and similarities of the two groups, video-recording the intervention implementation, if possible.

iv. The study had a limited duration, so the analysis is restricted to the effect of instruction for a short time. In natural settings, individuals tend to take time to become familiar and get into their stride with new concepts, so the report of the absence of any gain in CT skills after a four-week intervention should be treated with caution. Due to the timeline of this doctorate and arrangements with the site of the study, it was not possible to extend the test period. In future studies, a semester-long study would help to mitigate this limitation, and the results of CT interventions over a longer period may reveal information that was not discovered on this occasion.

v. Studies report little about particular aspects of CT skills interventions' implementation and use within classrooms (Burden, 2015; Higgins et al., 2005;

Moseley et al., 2004, 2005a). This study offers evidence that a major factor for the intervention's failure was programme fidelity throughout the implementation. The data on the implementation fidelity of the intervention procedures, adherence, exposure, quality of delivery, programme specification and student responsiveness, combined with quantitative outcomes and classroom observations, provide a fine-grained analysis to identify exactly what kind of input led to this specific outcome. It leads to a more in-situ application of interventions, with greater collaboration by the participating teacher/teachers and the institution.

vi. The study encourages reflection. After using this post-hoc analytical tool to derive a full and accurate picture of what occurred (due to the design of the study), it seems that it arose from its multiple perspectives. This effort has indicated possible links that were not clear in previous studies or not put on the table for discussion. The questions that research in learning and instruction of CT skills should be asking and investigating are clearer now, especially for the success or effectiveness of CT skills interventions and for the quality of teachers and teacher education in this sample. By questioning its own processes of research for example, methods used, intervention designed, how it was implemented, the compromises made on the selection of instruments of measurements, my study has put forward that all this matters, along with the context in which it is applied. What matters is not only what is taught, but how it is taught and where.

vii. Conclusions may not be generalizable on a large scale due to the study's design limitations. However, they do provide thought-provoking points for the teaching/learning of CT skills, especially at this teacher education institute, with respect to teaching quality at university level in a developing country. For teacher education programmes in Pakistan, it bears important policy and practice-related conclusions.

8.5 Further research

Broader and full circle approach for testing the effectiveness of CT skills instructional interventions

- The previously discussed conjectures mostly explain how and why the intervention could not produce the desired effect, and it became clear that not only what is being taught, how it is taught and who is teaching are important, but where it is taught. This is an important variable that mediates the whole process when researching the learning and instruction of CT skills. These can be further researched with relevance to the classroom and organizational culture. The unintended results of this instructional intervention also indicate that the relationship of institutional culture and mechanisms to classroom practice is important to explore, in order to reduce the gap between policy and practice. It was evident that the intervention implementation's fidelity was greatly affected by the instructional approach, the students and teacher facing challenges of time and language, and maybe indirectly by the newness of the experiment in the context and culture of teaching and learning at this organization.

- The research direction could be to change views on instructional research and the measurement of CT skills. These need to be adjusted for a broader, full-circle approach. This could be further researched and discussed in terms of complex interventions, and the need for more time and more rigorous practice. The full circle approach is also needed to consider the measurement of CT skills learning beyond the traditional way of testing the effect only through pre-test post-test, to integrate the assessment of more metacognitive learning strategies, the learning environment and teacher effectiveness.

- Any single measurement can be defective, biased and show only one side of the picture. Educational research in CT skills and dispositions needs to embrace the strengths of both types of inquiry to grasp the learning, not only in the paper-and-pencil performance of students but also in their metacognitive understanding and awareness of thinking critically as a habit of mind.

- We need to shift the perspective that 'it's learnable, but may not be measurable' because, if CT skills are definable and learnable, the skills attached to disposition maybe need to be measured differently. More intuitive ways to look at the learning and progress of students may, for example, be through pre- and post-test, estimating students' and teachers' engagement, open mindedness and openness to an increased number of questions in a certain classroom, and visual evidence of deep-learning strategies in classroom. They should further be triangulated by describing the improvement in experience that cannot always be captured by traditional self-answer questionnaires, marked essays or a score on a test.

How things could be improved without obvious fixes to the existing process?

It is inexplicable that no one has tried to look at the design and the implementation of CT skills interventions in their prime habitat – the classroom learning environment. The potential of these three factors is closely connected to teacher effectiveness. As such, we need to untangle what works and how it works in the learning and instruction of CT skills, and – perhaps even more important – why it does not work. By doing so, we can learn what it is like to teach CT skills and how it is like to learn CT skills. And when we know that, we can design better instruction and better learning experiences.

What my study, in its humble way, has put out for educational researchers and people interested in designing learning environments is this first step in untangling the muddle that is developing CT skills in ITE students by testing it in real-life scenarios.

Once the directions for *CT skills learning and instruction research* are clear, the execution in a different context will help to build on the strengths and weaknesses of one or the other in different contexts. Knowledge is not fixed and it has a growing quality. If one can look beyond the limitation of this study's data, it seems that six principles are most likely to be beneficial 'ways of teaching CT skills' with instruction, and the provision of prior onsite side-by-side training for the existing teacher, as interventionist. This provides hints on what needs to be presented in an adaptive process, rather than directly suggesting increasing the effectiveness of CT skills instructional intervention.

The study, due to its limited sample and statistical methods, may not be an exemplary study in the sense of 'successful' results. However, it is sufficient to show the possibility of inculcating CT skills as a professional competency in ITE programmes in Pakistan and elsewhere, and demonstrates a zest to approach research problems in a scholarly manner.

8.6 Final thoughts

The result of the educative process is capacity for further education. – John Dewey

The study results shed light on the complexity and challenges borne of such pedagogical research in education. There need to be more micro-studies to understand the multifaceted nature of the design of a learning environment for teaching CT skills, as well as for the variables under study: CT skills; motivation/self-regulation; the learning environment; and the instructional interventions.

Educational research related to pedagogy, or in other words learning and instruction in the field of CT skills studies, calls for a shift in how CT skills teaching-learning research is undertaken and an emphasis on process-based studies with a strong theoretical orientation and practical insights into both the micro- and the meso-level (classrooms-institutions).

Teachers' professional standards were introduced in 2009 as part of reforms for the improvement of teacher education. CT skills were identified as a core standard for teachers' professional development, both in pre-service and in-service training. Still, efforts to embed CT in practice are scarce. Teacher education is based on two types of training: pre-service and in-service. While Higher Education Commission Pakistan (HEC) has made efforts to introduce and train in-service teachers through various types of training, and in-service support is there, there is no direct or explicit effort to provide and cultivate CT skills in pre-service teacher education. This research is an attempt to realize their importance to pre-service teacher education and the findings enlightened that teachers professional development is a gradual process rather than a reform oriented quick fix, a lot needs to be done with reference to CT skills for teachers professional development.

The question of raising quality of education has been of interest for a long time. Quality of education is associated with many internal and external factors, but pays specific attention to teacher quality. As reviewed by Graue, Delaney and Karch (2013), the discussion on quality of education has focused on three aspects of practice relating to teacher quality: inputs, outputs, and process. Inputs include specific elements related to high-quality teaching; for instance, per pupil expenditure, class size, and teacher credentials, education level and degrees earned. This implies that, from the input perspective, the quality of education depends on the characteristics of individuals and investment in the education process (Pianta et al., 2007; Rice, 2003, in Graue et al., 2013). Outputs of teaching are measured as effective teaching and student outcomes, such as achievement/learning, promotion, higher grades or fewer demands of special education referrals (identifying low-achieving students for special education) as indicators of effective teaching. By observing four schools in different contexts, the study suggests that the quality education/quality teaching cannot be described by indicators of teacher effectiveness or some measure of test scores (value-added scores) alone.

Graue et al. (2013) identified resources and coherence as important indicators of improvement in teaching, and hence for improved quality education. Resources include the physical, human, emotional, environmental and leadership resources that are available, and by coherence the researchers mean the balance in planning, implementation and follow up. Resources and coherence of teacher quality can vary in different parts of the world. Based on this, the researchers identified context, resources and coherence as relating to improvement in teacher quality. Together, they are termed the ecologies of an education institution. The study concludes that, for understanding and improving quality of education through quality teaching, the better approach is to understand the ecological context of an institution.

Education schools/institutions are established with the purpose of helping teachers to learn how to teach, and have influence over teacher quality. Evidence from the past thirty years of research suggests that even with the shortcomings of current education training programmes, trained and certified teacher do perform better than those without such preparation (Ashton and Crocker, 1986; Evertson, Hawley and Zlotnik, 1985; Greenberg, 1983; Haberman, 1984; Olsen, 1985, in Hammond, 2000; Rowan, Correnti and Miller, 2002). One can assert that quality education is directly related to the quality and effectiveness of teachers. A wide range of literature has recognized teachers as the sole variable of school improvement and student achievement (Darling-Hammond, 1999; Rivkin et al., 2005; Sanders et al., 1997).

If we want to improve Pakistan's education quality, then teachers must first have a boost to their basic professional competencies, skills and knowledge about the profession. This requires fundamental paradigmatic changes in how pre-service and in-service teacher education is currently perceived. According to Chapman and Mählck (1997), pre-service training is 'the single most widely employed strategy (by itself or with other strategies) to improve instructional quality', and Shulman (1986) reinforces this idea by stating that all three types of knowledge – content knowledge, pedagogical content knowledge and curricular knowledge – should be included in pre-service teacher training programmes (in Kulshrestha and Pandey, 2013). We are familiar with terms such as logical thinking, rational thinking, reflective thinking, and so on. A need for developing thinking through teaching and learning has been expressed by educationists and researchers continuously, at least since John Dewey's time (Glaser, 1983, p. 3).

In this context, the intervention experience – that is, testing the effectiveness of CT skills instructional intervention in ITE – proved to be 'testing the waters'. It brought out useful data that can guide future research in this direction, and others can avoid the pitfalls of research in learning and instruction in thinking skills with special focus on ITE programmes in Pakistan. Effectiveness in CT skills intervention cannot be separated from effective implementation, teacher effectiveness, and the right amount of treatment and time for the context. Most importantly, to increase the level of CT skills in teachers' professional development, CT skills interventions should not be seen as 'quick fixes' but a mirror to reflect what is happening in the classroom and how to move towards a better quality (better suited to the context) version of ITE of programmes. For this, ITE pedagogy, curriculum and teaching practice need a fundamental shift towards the professional development of teachers. Change and adoption of this type of shift need an organizational level of awareness and initiative. Efforts in this study to promote CT skills at the classroom level can help to point out the nested nature of classroom in a faculty, and a faculty in an institution. The influence of environmental factors and the policy and implementation gap cannot be responded to without the harmonious collaboration of leadership, administration, resources and teachers.

According to Biggs (2003: p. 2):

> Teaching and learning take place in a whole system, which embraces classroom, departmental and institutional levels. A poor system is one in which the components are not integrated, and are not tuned to support high-level learning. In such a system, only the 'academic' students use higher-order learning processes. In a good system, all aspects of teaching and assessment are tuned to support high level learning, so that all students are encouraged to use higher-order learning processes. 'Constructive alignment' (CA) is such a system. It is an approach to curriculum design (learning environment) that optimizes the conditions for quality learning.

References

Abimbola, I.O. (1997). Gender influence on Biology students' concept mapping ability and achievement in evolution. *Journal of Science Teaching and Learning*, *3*(1and2), pp.8-17.

Abrami, P.C., Bernard, R.M., Borokhovski, E., Waddington, D.I., Wade, C.A. and Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research*, *85*(2), pp.275-314.

ACT. *CAAP Technical Handbook (*2007–2008). Iowa City: ACT, 2008.

Abrami, P.C., Bernard, R.M., Borokhovski, E., Wade, A., Surkes, M.A., Tamim, R. and Zhang, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research*, *78*(4), pp.1102-1134.

Ahmed, M.E.R. (2012). Factors affecting initial teacher education in Pakistan: Historical analysis of policy network. *International Journal of Humanities and Social Science*, *2*(13), pp.104-113.

Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and Instruction*, *16*(3), pp.183-198.

Ali, T. (2011). Understanding how practices of teacher education in Pakistan compare with the popular theories and theories and narrative of reform of teacher education in international context. *International Journal of Humanities and Social Sciences*, *1*(8), p.208-222. Retrieved from http://ecommons.aku.edu/pakistan_ied_pdck/84

Alston, K. (2001). Re/thinking critical thinking: The seductions of everyday life. *Studies in Philosophy and Education*, *20*(1), pp.27-40.

Aly, J.H. (2007). *Education in Pakistan: A white paper (revised)*. Document to Debate and Finalize the National Education Policy. Islamabad: Government of Pakistan, National Education Policy Review Team.

Anaya, G. (1999). College impact on student learning: Comparing the use of self-reported gains, standardized test scores, and college grades. *Research in Higher Education*, 40, pp.499–526.

Anderman, L.H. (1999). Classroom goal orientation, school belonging and social goals as predictors of students' positive and negative affect following the transition to middle school. *Journal of Research and Development in Education*, *32*(2), pp.89-103.

Anderson, L.W., Krathwohl, D.R. and Bloom, B.S. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Boston: Allyn and Bacon.

APA: American Philosophical Association. (1990). *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*. ERIC document ED 315-423.

Arbaugh, J.B., Cleveland-Innes, M., Díaz, S.R., Garrison, D.R., Ice, P., Richardson, J.C. and Swan, K.P. (2008). Developing a community of inquiry instrument: Testing a measure of the community of inquiry framework using a multi-institutional sample. *The Internet and Higher Education*, *11*(3), pp.133-136.

Ashraf, H. and Rarieya, J.F. (2008). Teacher development through reflective conversations – possibilities and tensions: a Pakistan case. *Reflective Practice*, *9*(3), pp.269-279.

Ashton, P. and Crocker, L. (1986). Does teacher certification make a difference? *Florida Journal of Teacher Education*, 3, pp.73-83. In Joerger, R.M. and Bremer, C.D. (2001). *Teacher Induction Programs: A Strategy for Improving the Professional Experience of Beginning Career and Technical Education Teachers*. St. Paul, MN: National Research Centre for Career and Technical Education, University of Minnesota.

Aslam, M., Bari, F. and Kingdon, G. (2012). Returns to schooling, ability and cognitive skills in Pakistan. *Education Economics*, *20*(2), pp.139-173.

Austin, J.T. and Vancouver, J.B. (1996). Goal constructs in psychology: Structure, process, and content. *Psychological Bulletin*, *120*(3), pp.338-375.

Bailin, S. (2002). Critical thinking and science education. *Science and Education*, *11*(4), pp.361-375.

Bailin, S., Case, R., Coombs, J.R. and Daniels, L.B. (1999). Common misconceptions of critical thinking. *Journal of Curriculum Studies*, *31*(3), pp.269-283.

Bandura, A. (1997). Editorial. *American Journal of Health Promotion*, *12*(1), pp.8-10. doi: http://dx.doi.org/10.4278/0890-1171-12.1.8

Barrett, A., Ali, S., Clegg, J., Hinostroza, J.E., Lowe, J., Nikel, J., Novelli, M., Oduro, G., Pillay, M., Tikly, L. and Yu, G. (2007). Initiatives to Improve the Quality of Teaching and Learning: A Review of Recent Literature. Bristol, UK: Edqual.

Bassey, M. (1998). Fuzzy generalisation: An approach to building educational theory. *Paper presented at the British Educational Research Association Annual Conference, 20th-30th August (1998), The Queen's University of Belfast, Northern Ireland*.

Bassey, M. (2001). A solution to the problem of generalisation in educational research: Fuzzy prediction. *Oxford Review of Education*, *27*(1), pp.5-22.

Baumert, J., Kunter, M., Blum, W., Brunner, M., Voss, T., Jordan, A., Klusmann, U., Krauss, S., Neubrand, M. and Tsai, Y.M. (2010). Teachers' mathematical knowledge, cognitive activation in the classroom, and student progress. *American Educational Research Journal*, *47*(1), pp.133-180.

Baumfield, V. (2015). Tools for inquiry: The role of thinking skills approaches in developing pedagogy as theory, pp.60-64. In R. Wegerif, L. Li, and J.C. Kaufman (Eds.), *The Routledge International Handbook of Research on Teaching Thinking*. Abingdon: Routledge.

Baxter, P. and Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The Qualitative Report*, *13*(4), pp.544-559.

Bembenutty, H. and Karabenick, S.A. (2004). Inherent association between academic delay of gratification, future time perspective, and self-regulated learning. *Educational Psychology Review*, *16*(1), pp.35-57.

Behar-Horenstein, L.S. and Niu, L. (2011). Teaching critical thinking skills in higher education: A review of the literature. *Journal of College Teaching and Learning*, *8*(2), p.25.

Ben, J., Andrés, S.H. and Steffen, K. (2012). *The experience of new teachers: Results from TALIS 2008.* OECD Publishing.

Ben-Hur, M. (2000). Feuerstein's Instrumental Enrichment: Better Learning for Better Students*. New Horizons for Learning*. Retrieved from http://education.jhu.edu/PD/newhorizons/strategies/topics/Instrumental%20Enrichment/hur.htm

Bennett, N. (1992). *Managing Learning in the Primary Classroom*. Stoke-on-Trent, UK: Trentham Books. In Galton, M., Hargreaves, L., Comber, C., Wall, D. and Pell, T. (1999).

Changes in Patterns of Teacher Interaction in Primary Classrooms: 1976-96. *British Educational Research Journal*, *25*(1), pp.23-37.

Biggs, J. (1996). Enhancing teaching through constructive alignment. *Higher Education*, *32*(3), pp.347-364.

Biggs, J. (2003). *Teaching for Quality Learning at University* (2nd edn.), Buckingham, UK: SRHE and Open University Press.

Black, P. and Wiliam, D. (2004). The formative purpose: Assessment must first promote learning. *Year book of the National Society for the Study of Education*, *103*(2), pp.20-50.

Black, P. and Wiliam, D. (2009). Developing the theory of formative assessment. *Educational Assessment, Evaluation and Accountability, 21*(1), p.5-31.

Blomberg, J., Giacomi, J., Mosher, A. and Swenton-Wall, P. (1993). Ethnographic field methods and their relation to design. In D. Schuler and A. Namioka (Eds.), *Participatory Design: Principles and Practices*, pp.123-155.

Bloom, B., Englehart, M. Furst, E., Hill, W., and Krathwohl, D. (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain*. New York, Toronto: Longmans, Green.

Bokhove, C. and Drijvers, P. (2010). Digital tools for algebra education: Criteria and evaluation. *International Journal of Computers for Mathematical Learning*, *15*(1), pp.45-62.

Bokhove, C. and Drijvers, P. (2012). Effects of a digital intervention on the development of algebraic expertise. *Computers and Education*, *58*(1), pp.197-208.

Bonk, C.J. and Smith, G.S. (1998). Alternative instructional strategies for creative and critical thinking in the accounting curriculum. *Journal of Accounting Education*, *16*(2), pp.261-293.

Bonney, C.R. and Sternberg, R.J. (2011). Learning to think critically. pp.166-198. In R.E. Mayer and P.A. Alexander (Eds.). (2011) *Handbook of Learning and Instruction*, New York: Routledge.

Brannen, J. (2005). *Mixed-Methods Research: A Discussion Paper*. NCRM Methods Review Papers, NCRM/005. Retrieved from http://eprints.ncrm.ac.uk/89/

Brewer, J. and Hunter, A. (1989). *Multimethod Research: A Synthesis of Styles*. Thousand

Oaks, CA: Sage.

Broadbear, J.T. (2003). Essential elements of lessons designed to promote critical thinking. *The Journal of Scholarship of Teaching and Learning*, *3*(3), pp.1-8.

Brown M.N. and Kelley S.M. (1986). Asking the Right Questions: A Guide to Critical Thinking, (7th edn.) Englewood Cliffs, NJ: Prentice Hall. In Snyder, L.G. and Snyder, M.J. (2008). Teaching critical thinking and problem solving skills. *Journal of Research in Business Education*, *50*(2), p.90.

Browne, M.N. and Freeman, K. (2000), Distinguishing features of critical thinking classrooms, *Teaching in Higher Education*, *5*(3), pp.301-309.

Bryman, A. (2004). Qualitative research on leadership: A critical but appreciative review. *Leadership Quarterly*, *15*(6), pp.729-769.

Burden, R. and Nichols, L. (2000). Evaluating the process of introducing a thinking skills programme into the secondary school curriculum. *Research Papers in Education*, *15*(3), pp.293-306.

Burden, R. (2015). Do they really work? Evidence for the efficacy of thinking skills approaches in affecting learning outcomes: the need for broader perspective. pp.291-304. In R. Wegerif, L. Li and J.C. Kaufman, J.C. (Eds.). *The Routledge International Handbook of Research on Teaching Thinking*. London: Routledge.

Burgh, G., Field, T. and Freakley, M. (2006). *Ethics and the Community of Inquiry: Education for Deliberative Democracy*. Melbourne: Thompson Social Science Press. In Garrison, D.R., Anderson, T. and Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education, *American Journal of Distance Education*, *15*(1), pp.7-23.

Butchart, S., Bigelow, J., Oppy, G., Korb, K. and Gold, I. (2009). Improving critical thinking using web-based argument mapping exercises with automated feedback. *Australasian Journal of Educational Technology*, *25*(2), pp.268-291.

Butler, D.L. (1998a). A strategic content learning approach to promoting self-regulated learning by students with learning disabilities. In D.H. Schunk and J.B. Zimmerman (Eds), *Self-Regulated Learning: From Teaching to Self-Reflective Practice*, pp.160-183. London: The Guilford Press.

Butler, D.L. (1998b). The strategic content learning approach to promoting self-regulated learning: A report of three studies. *Journal of Educational Psychology*, *90*(4), p.682-697.

Butler, H.A. (2015). Assessing critical thinking in our students, pp. 205-210. In R. Wegerif, L. Li and J.C. Kaufman (Eds). *The Routledge International Handbook of Research on Teaching Thinking*. Abingdon: Routledge.

Buysse, V., Sparkman, K.L. and Wesley, P.W. (2003). Communities of practice: Connecting what we know with what we do. *Exceptional Children*, *69*(3), pp. 263-277.

Cabrera, A.F., Colbeck, C.L. and Terenzini, P.T. (2001). Developing performance indicators for assessing classroom teaching practices and student learning. *Research in Higher Education*, *42*(3), pp.327-352.

Caena, F. (2011). Literature review, Quality in teachers' continuing professional development. *Education and Training, 2020*. European Commission, pp.2-20.

Case, R. (2005). Moving critical thinking to the main stage. *Education Canada*, *45*(2), pp.45-49.

Cassum, S.H., Profetto-McGrath, J., Gul, R.B., Dilshad, A. and Syeda, K. (2013). Multidimensionality of critical thinking: A holistic perspective from multidisciplinary educators in Karachi, Pakistan. *Journal of Nursing Education and Practice*, *3*(7), pp.9-23.

Cauley, K.M. and McMillan, J.H. (2010). Formative assessment techniques to support student motivation and achievement. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas*, *83*(1), pp.1-6.

Chapman, D.W. and Mählck, L.O. (1997). Changing what happens in schools: Central–level initiatives to improve school practice. In D.W. Chapman, L.O. Mählck and A.E.M. Smulders, (Eds.), *From Planning to Action: Government Initiatives for Improving School Level Practice*, pp.1-31. Paris: UNESCO. In Kulshrestha, A.K. and Pandey, K. (2013). Teacher training and professional competencies. *Voice of Research*, *1*(4), pp.29-33.

Cheema, A.B. and Mirza, M.S. (2013). Effect of concept mapping on students' academic achievement. *Journal of Research and Reflections in Education*, *7*(2), pp.125-132.

Cheng, V.M. (2011). Infusing creativity into Eastern classrooms: Evaluations from student perspectives. *Thinking Skills and Creativity*, *6*(1), pp.67-87.

Cheng Cheong, Y. and Mo Ching Mok, M. (2007) School-based management and paradigm shift in education: an empirical study. *International Journal of Educational Management, 21*(6), pp.517-542, doi: 10.1108/09513540710780046

Chin, D.B., Dohmen, I.M. and Schwartz, D.L. (2013). Young children can learn scientific reasoning with teachable agents. *IEEE Transactions on Learning Technologies*, *6*(3), pp.248-257.

Chingos, M.M. and Peterson, P.E. (2011). It's easier to pick a good teacher than to train one: Familiar and new results on the correlates of teacher effectiveness. *Economics of Education Review*, *30*(3), pp.449-465.

Coe, R., Aloisi, C., Higgins, S. and Major, L.E. (2014). *What Makes Great Teaching? Review of the Underpinning Research*. CEM, Durham University, The Sutton Trust.pp.2-58.

Cohen J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.) Hillsdale, New Jersey: Erlbaum.

Cohen, D.K. and Hill, H.C. (2001). *Learning Policy: When State Education Reform Works*. New Haven, CT: Yale University Press.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), p.155-159.

Cohen, L., and Manion, L. (1994). *Research Methods in Education* (4th ed.). London: Routledge.

Cole, F. (1988). Content Analysis: Process and Application. *Clinical Nurse Specialist,* 2(1). In Elo, S. and Kyngäs, H. (2008). The qualitative content analysis process, *Journal of Advanced Nursing*, *62*(1), pp.107-115.

Coleman, H. (2010). *Teaching and Learning in Pakistan: The Role of Language in Education*. Islamabad: The British Council.

Cook, T.D. and Campbell, D.T. (1986). The causal assumptions of quasi-experimental practice. *Synthese*, *68*(1), pp.141-180.

Cotter, E.M. and Tally, C.S. (2009). Do critical thinking exercises improve critical thinking skills? *Educational Research Quarterly*, *33*(2), p.3-14.

Covington, M.V. (1992). *Making the grade: A self-worth perspective on motivation and school reform*. Cambridge: Cambridge University Press.

Crang, M. and Cook, I. (2007). *Doing Ethnographies*. London: Sage.

Credé, M. and Phillips, L.A. (2011). A meta-analytic review of the Motivated Strategies for Learning Questionnaire. *Learning and Individual Differences*, *21*(4), pp.337-346.

Creemers, B.P. and Reezigt, G.J. (1999). The role of school and classroom climate in elementary school learning environments. In H.J. Freiberg (Ed.) *School Climate: Measuring, Improving and Sustaining Healthy Learning Environments*, pp.30-47. London: Routledge Falmer.

Creswell, J.W. and Plano Clark, V.L. (2007). *Designing and Conducting Mixed Methods Research*. London: Sage.

Creswell, J.W. and Plano Clark, V.L. (2011). *Designing and Conducting Mixed Methods Research,* (2nd ed.). London: Sage.

Creswell, J.W. (1994). *Research design: Quantitative and qualitative approaches*. Thousand Oaks, CA: Sage.

Creswell, J.W. (2003). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches,* (2nd ed.) Thousand Oaks: Sage.

Creswell, J.W. (2009a). Editorial: Mapping the field of mixed methods research. *Journal of Mixed Methods Research*, *3*(2), pp.95-108. Sage.

Creswell, J.W. (2009b). *The Selection of a Research Design. Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. Thousand Oaks, CA: Sage.

Creswell, J.W., (2013). *Research Design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). Los Angeles, United States: Sage.

Creswell, J.W. (2014). *A Concise Introduction to Mixed Methods Research*. London: Sage.

Creswell, J.W., Fetters, M.D., Plano Clark, V.L. and Morales, A. (2009). Mixed methods intervention trials. *Mixed Methods Research for Nursing and the Health Sciences*, pp.161-180.

Creswell, J.W., Plano Clark, V.L., Gutmann, M.L. and Hanson, W.E. (2003a). An expanded typology for classifying mixed methods research into designs. In A. Tashakkori and C. Teddlie (Eds.), (2010), Editors' Introduction*, Handbook of Mixed Methods in Social and Behavioral Research*, pp.159-160. Sage.

Creswell, J.W., Shope, R., Plano Clark, V.L. and Green, D.O. (2006). How interpretive qualitative research extends mixed methods research. *Research in the Schools*, *13*(1), pp.1-11.

Crotty, M. (1998). *The Foundations of Social Research: Meaning and Perspective in the Research Process*. London: Sage.

Darling-Hammond, L. (1999). *Reshaping Teaching Policy, Preparation, and Practice. Influences of the National Board for Professional Teaching Standards*. American Association of Colleges for Teacher Education, Washington: AACTE Publications.

Darling-Hammond, L. (2000a). Teacher quality and student achievement. *Education Policy Analysis Archives*, 8, pp.1-44. DOI: http://dx.doi.org/10.14507/epaa.v8n1.2000

Darling-Hammond, L. (2000b). How teacher education matters. *Journal of Teacher Education*, *51*(3), pp.166-173.

Darling-Hammond, L. (2010). Teacher education and the American future. *Journal of Teacher Education*, *61*(1-2), pp.35-47.

Darling-Hammond, L., Holtzman, D. J., Gatlin, S. J., and Heilig, J. V. (2005). Does teacher preparation matter? Evidence about teacher certification, teach for America, and teacher effectiveness. *Education Policy Analysis Archives,* 13(42), pp.1-55.

Davies, M. and Barnett, R. (Eds.), (2015). *The Palgrave Handbook of Critical Thinking in Higher Education*. New York, United States: Springer.

Davies, M., (2013). Critical thinking and the disciplines reconsidered. *Higher Education Research and Development*, *32*(4), pp.529-544.

Davies, W.M. (2006). An 'infusion' approach to critical thinking: Moore on the critical thinking debate. *Higher Education Research and Development*, *25*(2), pp.179-193.

Davies, W.M. (2009). Computer-assisted argument mapping: A rationale approach. *Higher Education*, *58*(6), pp.799-820.

DBRC: Design-Based Research Collective (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, pp.5-8.

De Corte, E. (2003). Designing learning environments that foster the productive use of acquired knowledge and skills. In: E. De Corte, L. Verschaffel, N. Entwistle, and J. van Merriënboer (Eds.), *Powerful learning environments: Unraveling basic components and dimensions* (pp. 21–33). Oxford, UK: Elsevier Science Ltd. (Advances in Learning and Instruction Series).

De Corte, E., Verschaffel, L. and Masui, C. (2004). The CLIA-model: A framework for designing powerful learning environments for thinking and problem solving. *European Journal of Psychology of Education*, *19*(4), pp.365-384.

Delphi Report (1990). Delphi Report, Committee on Pre-College Philosophy. (ERIC Doc. No. ED 315 423). American Philosophical Association, Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction. Fullerton: American Philosophical Association.

Dendato, K.M. and Diener, D. (1986). Effectiveness of cognitive/relaxation therapy and study-skills training in reducing self-reported anxiety and improving the academic performance of test-anxious students. *Journal of Counselling Psychology*, *33*(2), p.131-135.

Denzin, N.K. and Lincoln, Y.S. (2005). Paradigms and perspectives in contention. *The SAGE Handbook of Qualitative Research*, pp.183-190. Thousand Oaks, CA: Sage.

Denzin, N.K. and Lincoln, Y.S. (2011). *The Sage Handbook of Qualitative Research*. London: Sage.

Derry, S.J. and Lajoie, S.P. (Eds.), (1993). *Computers as Cognitive Tools*. New Jersey: Lawrence Erlbaum Associates.

Desimone, L.M. (2009). Improving impact studies of teachers' professional development: Toward better conceptualizations and measures. *Educational Researcher*, *38*(3), pp.181-199.

Dewey, J. (1910). Science as subject-matter and as method. In *Science*, *31*(787) pp.121-127.

Dewey, J. (1910). *The Influence of Darwin on Philosophy.* New York: Henry Holt and Company. Retrieved from http://thenewschoolhistory.org/wp-content/uploads/2013/09/Dewey_The_Influence_of_Darwin_on_Philosophy.pdf

Dewey, J. (1925). What I believe. In J.A. Boydston (Ed.), *The Later Works*, *1925-1953*, 1, Experience and Nature, pp.1929-1930. Carbondale, IL: Southern Illinois University Press. Retrieved from https://books.google.co.uk/books?id=nu_B91DQiRcCandprintsec=frontcoverandsource=gbs_ge_summary_randcad=0#v=onepageandqandf=false

Dewey, J. (1933). *How we think: A Restatement of the Relation of Reflective Thinking to the Educative Process*. Boston: DC Heath.

Dewey, J. (1938). Experience and education. *Educational Forum*, *50*(3), pp. 241-252. Taylor and Francis Group.

DfES (2004a). *Teaching and Learning in the Foundation Subjects*, DfES 09-2004, DfES 0123-2004. Nottingham: DfES Publications.

DfES (2004b). *Excellence and Enjoyment, Learning and Teaching in the Primary Years*. DfES 09-2004, DfES 0518-2004. Nottingham: DfES Publications.

Dilshad, M. and Iqbal, H.M. (2010). Quality indicators in teacher education programmes. *Pakistan Journal of Social Sciences (PJSS)*, *30*(2), pp.401-411.

Dilshad, R.M. (2010). Assessing quality of teacher education: A student perspective. *Pakistan Journal of Social Sciences*, *30*(1), pp.85-97.

Dimsdale, T. and Kutner, M. (2004). Becoming an Educated Consumer of Research: A Quick Look at the Basics of Research Methodologies and Design. *Paper presented at the Meeting of the Minds Practitioner-Researcher Symposium, American Institutes for Research.* pp.1-31.

Duron, R., Limbach, B. and Waugh, W. (2006). Critical thinking framework for any discipline. *International Journal of Teaching and Learning in Higher Education*, *17*(2), pp.160-166.

Dwyer, C. P., Hogan, M. J., and Stewart, I. (2010). The evaluation of argument mapping as a learning tool: Comparing the effects of map reading versus text reading on comprehension and recall of arguments. *Thinking Skills and Creativity*, *5*(1), pp.16-22.

Dwyer, C.P., Hogan, M.J. and Stewart, I. (2012). An evaluation of argument mapping as a method of enhancing critical thinking performance in e-learning environments. *Metacognition and Learning*, *7*(3), pp 219-244.

Dwyer, C.P., Hogan, M.J. and Stewart, I. (2015). The effects of argument mapping-infused critical thinking instruction on reflective judgement performance. *Thinking Skills and Creativity*, 16, pp.11-26.

Eccles, J.S. and Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*(1), pp.109-132.

Eccles, J.S., Wigfield, A. and Schiefele, U. (1998). Motivation to succeed. In J.S. Eccles, A. Wigfield, U.D. Schiefele, W. Damon and Nancy Eisenberg (Eds.). *Handbook of Child Psychology: Social, Emotional, and Personality Development*, 3, (5th ed.) pp.1017-1095. Hoboken, New Jersey, US: John Wiley and Sons.

Economic Survey of Pakistan (2012) Education, Government of Pakistan. Ministry of Finance. Available at: http://www.finance.gov.pk/survey_1011.html, accessed: 10-06-15.

EFA Review Report: Education for All (2015) National Review Report: Pakistan. Retrieved from http://unesdoc.unesco.org/images/0022/002297/229718E.pdf.

Elder, L. and Paul, R. (2007). Critical thinking: The nature of critical and creative thought, Part II. *Journal of Developmental Education*, *30*(3), pp.36-37.

Elo, S. and Kyngäs, H. (2008). The qualitative content analysis process. *Journal of Advanced Nursing*, *62*(1), pp.107-115.

Ennis, R.H. (1963). Needed: Research in critical thinking. *Educational Leadership*, *21*(1), pp.17-20, 39.

Ennis, R.H. (1985a). A logical basis for measuring critical thinking skills. *Educational Leadership*. *43*(2), pp.44-48.

Ennis, R.H. (1985b). Goals for a critical thinking curriculum. *Developing minds: A Resource Book for Teaching Thinking*. Alexandria, VA: Association for Supervision and Curriculum Development.

Ennis, R.H. (1989). Critical thinking and subject specificity: Clarification and needed research. *Educational Researcher*, *18*(3), pp.4-10.

Ennis, R.H. (1990). The extent to which critical thinking is subject-specific: Further clarification. *Educational Researcher*, 19(4), pp.13-16.

Ennis, R.H. (1992). The degree to which critical thinking is subject specific: clarification and needed research. In S. Norris (Ed.), *The Generalizability of Critical Thinking: Multiple Perspectives on an Educational Ideal*, pp.21–37. New York: Teachers College Press. Retrieved from http://faculty.education.illinois.edu/rhennis/CritThinkPubs.html

Ennis, R.H. (1993a). Critical thinking assessment. *Theory into Practice*, *32*(3), pp. 179-186.

Ennis, R.H. (1993b). Critical thinking: What is it? In H.A. Alexander (Ed.), *Philosophy of Education*, pp.76-80. Urbana, IL: Philosophy of Education Society.

Ennis, R.H. (1996). Critical thinking dispositions: Their nature and assessability. *Informal Logic*, *18*(2).pp.165-168. DOI: http://dx.doi.org/10.22329/il.v18i2.2378.

Ennis, R.H. (1998). Is critical thinking culturally biased? *Teaching Philosophy*, *21*(1), pp.15-33.

Ennis, R.H. (2011). Critical thinking: reflection and perspective - Part I. *Inquiry: Critical Thinking Across the Disciplines*, *26*(1), pp.4-18.

Ennis, R.H. (2015). In Davies, M. and Barnett, R. (Eds.), (2015). *The Palgrave Handbook of Critical Thinking in Higher Education*. New York, United States: Springer.

Ennis, R.H., (1982). Identifying implicit assumptions. *Synthese*, *51*(1), pp.61-86.

Facione, P.A. and Facione, N.C. (1992). *The California Critical Thinking Disposition Inventory*. The California Academic Press, Millbrae: CA.

Facione, P.A. and Facione, N.C. (2007). *Thinking and Reasoning in Human Decision Making: The Method of Argument and Heuristic Analysis*. The California Academic Press, Millbrae: CA. Retrieved from Insight Assessment https://www.insightassessment.com/Resources/Teaching-Training-and-Learning-Tools/Books-by-Insight-Assessment-Researchers/Thinking-and-Reasoning-in-Human-Decision-Making.

Facione, P.A. (1990a). *Critical Thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*. Research findings and recommendations. The Complete American Philosophical Association Delphi Research Report. The California Academic Press, Millbrae: CA.

Facione, P.A. (1990b). *The California Critical Thinking Skills Test - College Level. Technical Report #2. Factors Predictive of CT Skills*. The California Academic Press, Millbrae: CA.

Facione, P.A. (2000). The disposition toward critical thinking: Its character, measurement, and relationship to critical thinking skill. *Informal logic*, *20*(1).pp.61-84.
DOI: http://dx.doi.org/10.22329/il.v20i1.2254.

Facione, P.A. (2011). *Critical thinking: What it is and why it counts*. The California Academic

Press: Millbrae, CA. Retrieved from Insight Assessment https://www.insightassessment.com/About-Us/Measured-Reasons/pdf-file/Critical-Thinking-What-It-Is-and-Why-It-Counts-PDF

Facione, P.A., Facione, N.C. and Giancarlo, C.A.F. (1996). The motivation to think in working and learning. *New Directions for Higher Education*, 96, pp.67-79.

Feilzer, M.Y. (2010). Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. *Journal of Mixed Methods Research*, *4*(1), pp.6-16.

Felder, R.M. and Brent, R. (2004, June). The ABCs of engineering education: ABET, Bloom's Taxonomy, cooperative learning, and so on. In *Proceedings of the 2004 American Society for Engineering Education Annual Conference and Exposition*, pp.674-681.

Fetters, M.D., Curry, L.A. and Creswell, J.W. (2013). Achieving integration in mixed methods designs - principles and practices. *Health Services Research*, *48*(6) Pt 2, pp.2134-2156.

Feuerstein et al. (1980). In Ben-Hur, M. (2000). Feuerstein's Instrumental Enrichment: Better learning for better students. *New Horizons for Learning,* Retrieved from http://education.jhu.edu/PD/newhorizons/strategies/topics/Instrumental%20Enrichment/hur.htm.

Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. London: Sage.

Firestone, W.A. (1993). Alternative arguments for generalizing from data as applied to qualitative research. *Educational Researcher*, *22*(4), pp.16-23.

Fisher, A. and Scriven, M. (1997). *Critical thinking its Definition and Assessment*, University of East Anglia, Centre for research in Critical Thinking.

Fisher, A. (2011). *Critical Thinking: An Introduction*, (2nd ed.). Cambridge: Cambridge University Press.

Flavell, J.H. (1979). Metacognition and cognitive monitoring: A new area of cognitive–developmental inquiry. *American Psychologist*, *34*(10), pp.906-911. http://dx.doi.org/10.1037/0003-066X.34.10.906

Flores, K. L., Matkin, G. S., Burbach, M. E., Quinn, C. E., and Harding, H. (2012). Deficient critical thinking skills among college graduates: Implications for leadership. *Educational Philosophy* *and Theory*, *44*(2), pp.212-230.

Foundation for Critical Thinking (2014). In *Proceedings of the 34th Annual International Conference on Critical Thinking and Educational Reform 2014*. Retrieved from http://www.criticalthinking.org/

Friedrich, A., Flunger, B., Nagengast, B., Jonkmann, K. and Trautwein, U., (2015). Pygmalion effects in the classroom: Teacher expectancy effects on students' math achievement. *Contemporary Educational Psychology*, *41*, pp.1-12. https://doi.org/10.1016/j.cedpsych.2014.10.006

Fullan, M.G. (1993). Why teachers must become change agents. *Educational Leadership*, *50*(6), pp.1-13.

Fullan, M.G. (1999). *Change Forces: The sequel*. London: Falmer Press.

Fullan, M.G. (2007). *The New Meaning of Educational Change*, (4th ed.). London: Routledge.

Gage, N.L., (1989). The paradigm wars and their aftermath a 'historical' sketch of research on teaching since 1989. *Educational researcher*, *18*(7), pp.4-10.

García, T. and Pintrich, P.R. (1992, August). Critical Thinking and Its Relationship to Motivation, Learning Strategies, and Classroom Experience. Paper presented at the Annual Meeting of the American Psychological Association (100th), Washington DC. National Center for Research to Improve Postsecondary Teaching and Learning, Ann Arbor, MI. Spons. Agency: Office of Educational Research and Improvement (ED), Washington DC.

Gardner, S. (1996). Inquiry is no mere conversation (or discussion or dialogue) facilitation of inquiry is hard work! *Analytic Teaching*, *16*(2). pp.102-111.

Garrison, D.R., Anderson, T. and Archer, W. (2001). Critical thinking and computer conferencing: A model and tool to assess cognitive presence. *American Journal of Distance Education*, *15*(1). pp.1-18.

Garrison, D.R., Anderson, T. and Archer, W. (2010). The first decade of the community of inquiry framework: A retrospective. *The Internet and Higher Education*, *13*(1), pp.5-9.

Gay, L.R. (1996). *Educational Research: Competencies for Analysis and Applications*. Berkeley: Merrill.

Gelder, T.V. (2005). Teaching critical thinking: Some lessons from cognitive science. *College Teaching*, *53*(1), pp.41-48.

Giancarlo, C.A. and Facione, P.A. (2001). A look across four years at the disposition toward critical thinking among undergraduate students. *Journal of General Education*, *50*(1), pp.29-55.

Gill, P., Stewart, K., Treasure, E. and Chadwick, B. (2008). Methods of data collection in qualitative research: Interviews and focus groups. *British Dental Journal*, *204*(6), pp.291-295.

Glaser, E.M. (1941). *An Experiment in the Development of Critical Thinking,* No. 843. Teachers College, New York: Columbia University.

Gliner, J.A., Morgan, G.A., Harmon, R.J. and Harmon, R.J. (2000). Introduction to inferential statistics and hypothesis testing. *Journal of the American Academy of Child and Adolescent Psychiatry*, *39*(12), pp.1568-1570.

Gokhale, A.A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education*, *7*(1). pp.22-30 Retrieved from http://scholar.lib.vt.edu/ejournals/JTE/v7n1/gokhale.jte-v7n1.html?ref=Sawos.Org.

Grant, G.E. (1988). *Teaching Critical Thinking*. New York: Praeger.

Graue, B., Delaney, K.K. and Karch, A.S., (2013). Ecologies of education quality. *Education Policy Analysis Archives*, *21*(8), pp.1-38. This article is part of EPAA/AAPE's Special Issue on Value Added: What America's Policymakers Need to Know and Understand, Ed. Beardsley and Assistant, Collins, Polasky and Sloat. Retrieved from http://epaa.asu.edu/ojs/article/view/1163.

Green, L., Condy, J. and Chigona, A. (2012). Developing the language of thinking within a classroom community of inquiry: pre-service teachers' experiences. *South African Journal of Education*, *32*(3), pp.319-330.

Greenberg, J.D. (1983). The case for teacher education: Open and shut. *Journal of Teacher Education*, *34*(4), pp.2-5.

Greene, J.C., Caracelli, V.J. and Graham, W.F. (1989). Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, *11*(3), pp.255-274.

Gregory, M.R. (2007). A framework for facilitating classroom dialogue. *Teaching Philosophy*, *30*(1), pp.59-84.

Gribbons, B. and Herman, J. (1997). *Practical Assessment: Research and evaluation*, 5, p. 14. Retrieved from http://ericae.net/paregetvn.asp

Gribbons, B. and Herman, J. (1997). *True and Quasi-Experimental Designs.* ERIC/AE Digest. ERIC Clearinghouse on Assessment and Evaluation. Washington.

Guba, E.G. and Lincoln, Y.S. (Eds.). (1994). Competing paradigms in qualitative research. In *Handbook of Qualitative Research*, 2(163-194), p.105. Thousand Oaks, CA: Sage.

Gul, R., Cassum, S., Ahmad, A., Khan, S., Saeed, T. and Parpio, Y. (2014). Enhancement of critical thinking in curriculum design and delivery: A randomized controlled trial for educators. *Procedia-Social and Behavioral Sciences*, *2*(2), pp.3219-3225.

Haberman, M. (1984). An Evaluation of the Rationale for Required Teacher Education: Beginning Teachers with or without Teacher Preparation. Paper prepared for the National Commission on Excellence in Teacher Education, University of Wisconsin-Milwaukee. In Darling-Hammond, L. (2000). How teacher education matters. *Journal of Teacher Education*, *51*(3), pp.166-173.

Hager, P. and Kaye, M. (1991). Critical thinking ability and teacher effectiveness. *Higher Education Research and Development*, *10*(2), pp.177-186.

Hager, P. and Kaye, M. (1992). Critical thinking in teacher education: A process-oriented research agenda. *Australian Journal of Teacher Education*, *17*(2), pp.26-33. http://dx.doi.org/10.14221/ajte.1992v17n2.4.

Hager, P., Sleet, R. and Kaye, M. (1994). The relation between critical thinking abilities and student study strategies. *Higher Education Research and Development*, *13*(2), pp.179-188.

Haider, S.Z. (2008). Challenges in Higher Education: Special reference to Pakistan and South Asian developing countries. *Nonpartisan Education Review / Essays*, *4*(2). Retrieved from http://www.nonpartisaneducation.org/Review/Essays/v4n2.pdf

Halpern, D.F. (1993). Assessing the effectiveness of critical-thinking instruction. *Journal of General Education*, pp.238-254.

Halpern, D.F. (1994). *A national assessment of critical thinking skills in adults: Taking steps toward the goal.* In The National Assessment of College Student Learning: Identification of the Skills to be Taught, Learned, and Assessed. *In Proceedings of the Study Workshop. Arlington*.

Halpern, D.F. (1998). Teaching critical thinking for transfer across domains: Disposition, skills, structure training, and metacognitive monitoring. *American Psychologist*, *53*(4), pp.449-445.

Halpern, D.F. (1999). Teaching for critical thinking: Helping college students develop the skills and dispositions of a critical thinker. *New Directions for Teaching and Learning,* 80, pp.69-74.

Halpern, D.F. (2001). Assessing the effectiveness of critical thinking instruction. *The Journal of General Education*, *50*(4), pp.270-286.

Halpern, D.F. (2003). *Thinking Critically About Creative Thinking*. Retrieved from http://psycnet.apa.org/psycinfo/2003-02671-008

Halpern, D.F. (2014). *Thought and Knowledge: An Introduction to Critical Thinking* (5th ed.). NY: Psychology Press.

Halpern, D.F. and Nummedal, S.G. (Eds.), (1995). *Psychologists Teach Critical Thinking*. New Jersey: Lawrence Erlbaum Associates.

Halpern, D.F. (1997). *Critical Thinking Across the Curriculum: A Brief Edition of Thought and Knowledge.* Mahwah, NJ: Lawrence Erlbaum Associates.

Hamers, J.H.M. and Csapó, B., (1999). Teaching thinking. *Teaching and learning thinking skills*, pp.11-37. Lisse: Swets and Zeitlinger.

Hamers, J.H.M., van Luit, J.E.H. and Csapó, B. (1999). Teaching and learning thinking skills. In Csapó, B., Improving thinking through the content of teaching. *Teaching and Learning Thinking Skills*, pp.37-62. Lisse: Swets and Zeitlinger.

Harrell, M. (2007). Using argument diagramming software to teach critical thinking skills. In *Proceedings of the 5th International Conference on Education and Information Systems, Technologies and Applications.* Paris.

Harrell, M. (2011). Argument diagramming and critical thinking in introductory philosophy. *Higher Education Research and Development*, *30*(3), pp.371-385.

Hasan, A. (2013). Attitude of BEd students at VBS Poorvanchal University Jaunpur towards internal evaluation: A comparative study. *Educational Research International*, *1*(1), pp.155-162.

Hatcher, D.L. (2006). Stand-alone versus integrated critical thinking courses. *Journal of General Education*, *55*(3–4), pp.247–72.

Hattie, J. and Marsh, H.W. (1996). The relationship between research and teaching: A meta-analysis. *Review of Educational Research*, *66*(4), pp.507-542.

Hattie, J., Biggs, J. and Purdie, N. (1996). Effects of learning skills interventions on student learning: A meta-analysis. *Review of Educational Research*, *66*(2), pp. 99-136.

Hatton, N. and Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and Teacher Education*, *11*(1), pp.33-49.

Hayes, L.D. (1987). *The Crisis of Education in Pakistan, Delegate Brief, Ministry of Education*. Lahore: Vanguard. In Ali, T. (2011). Understanding how practices of teacher education in Pakistan compare with the popular theories and theories and narrative of reform of teacher education in international context. *International Journal of Humanities and Social Sciences*, *1*(8), pp.208-222.

Head, G. and O'Neill, W. (1999). Introducing Feuerstein's Instrumental Enrichment in a school for children with social, emotional and behavioural difficulties. *Support for Learning*, *14*(3), pp.122-128.

Hemming, H.E. (2000). Encouraging critical thinking: 'But... what does that mean?' *McGill Journal of Education, 35*(2), pp.173-186.

Higgins S, Hall E, Baumfield V, and Moseley D. (2005). A meta-analysis of the impact of the implementation of thinking skills approaches on pupils. In *Research Evidence in Education Library.* London: Institute of Education, University of London.

Higgins, S. (2015). A recent history of teaching thinking. In R. Wegerif, L. Li and J.C. Kaufman (Eds.), *The Routledge International Handbook of Research on Teaching Thinking,* pp.19-28. Abingdon: Routledge.

Higher Education Academy (2014). *Critical Thinking*. Retrieved from https://www.heacademy.ac.uk/sites/default/files/resources/critical_thinking.pdf

Hill, H.C., Rowan, B. and Ball, D.L. (2005). Effects of teachers' mathematical knowledge for teaching on student achievement. *American Educational Research Journal*, *42*(2), pp.371-406.

Holloway, I. and Todres, L. (2003). The status of method: flexibility, consistency and coherence. *Qualitative Research*, *3*(3), pp.345-357.

Hoodbhoy, P. (Ed.), (1998) E*ducation and the state: Fifty years of Pakistan*. Karachi: Oxford University Press.

Hou, H.T., Chang, K.E. and Sung, Y.T. (2007). An analysis of peer assessment online discussions within a course that uses project-based learning. *Interactive Learning Environments*, *15*(3), pp.237-251.

Hsieh, H.F. and Shannon, S.E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), pp.1277-1288.

Huber, C.R. and Kuncel, N.R. (2015). Does college teach critical thinking? A meta-analysis. *Review of Educational Research, 86*(2). Retrieved from http://journals.Sagepub.com/doi/abs/10.3102/0034654315605917?ssource=mfrandrss=1

Huma, A. (2013). Adaptable program evaluation strategies for teacher education in Pakistan: *International Journal of Humanities and Social Science*, *3*(7).pp.298-305.

Hunt, M.J., (2011). UK teachers' and learners' experiences of CLIL resulting from the EU-funded project ECLILT. *Latin American Journal of Content and Language Integrated Learning*, *4*(1), pp.27-39.

Iqbal, A. (2004). *Problems and prospects of higher education in Pakistan* (Doctoral dissertation), PMAS-Arid Agriculture University, Rawalpindi.

Iqbal, H.M. and Shayer, M. (2000). Accelerating the development of formal thinking in Pakistan secondary school students: Achievement effects and professional development issues. *Journal of Research in Science Teaching*, *37*(3), pp.259-274.

Iqbal, H.M. and Shayer, M. (1995). Distribution of Piagetian cognitive levels in middle school students and its match with science curricula. *Bulletin of Education and Research, Lahore, XVII–XVIII*, pp.42-48. In Iqbal, H.M. and Shayer, M. (2000). Accelerating the development of formal thinking in Pakistan secondary school students: Achievement effects and professional development issues. *Journal of Research in Science Teaching*, *37*(3), pp.259-274.

Iqbal, M. and Arif, M.I. (2011). Globalization and paradigm changes in teacher education: Revolutionizing teaching learning process at school level in Pakistan. *International Education Studies*, *4*(4), pp.99-110.

Ivankova, N.V., Creswell, J.W. and Stick, S.L. (2006). Using mixed-methods sequential explanatory design: From theory to practice. *Field Methods*, *18*(1), pp.3-20.

Jaffer, R. (2005). *Teacher Education. Donor Support to Education: Lessons Learned Meeting,* June, Islamabad. Final Report. In USAID (2006) report Strategic Framework for Teacher Education and Professional Development Pakistan.

Jennings, J. (2009). *Asia and the Pacific Education for All (EFA) Mid-Decade Assessment: South Asia Sub-Region Synthesis Report*. Bangkok: UNESCO Bangkok. Retrieved from http://www.uis.unesco.org/Library/Documents/South%20Asia.pdf

Jick, T.D. (1979). Mixing qualitative and quantitative methods: Triangulation in action. *Administrative Science Quarterly*, *24*(4), pp.602-611.

Johnson, B. and Christensen, L. (2012). *Educational research: Quantitative, qualitative, and mixed approaches.* Thousand Oaks, CA: Sage.

Johnson, R.B. and Onwuegbuzie, A.J. (2004). Mixed methods research: A research paradigm whose time has come. *Educational Researcher*, *33*(7), pp.14-26.

Johnson, R.B., Onwuegbuzie, A.J. and Turner, L.A. (2007). Toward a definition of mixed methods research. *Journal of mixed Methods Research*, *1*(2), pp.112-133.

Jonassen, D.H. (1997). Instructional design models for well-structured and III-structured problem-solving learning outcomes. *Educational Technology Research and Development*, *45*(1), pp.65-94.

Jonassen, D.H. (1999). Designing constructivist learning environments. In C. M. Reigeluth (Ed.), *Instructional Design Theories and Models: A new paradigm of instructional theory,* pp.215-239. Mahwah, NJ: Lawrence Erlbaum.

Jonassen, D.H., Carr, C. and Yueh, H.P. (1998). Computers as mindtools for engaging learners in critical thinking. *TechTrends, 43*(2), pp.24-32.

Kalyuga, S., Ayres, P., Chandler, P. and Sweller, J. (2003). The expertise reversal effect. *Educational Psychologist*, *38*(1), pp.23-31.

Kalyuga, S., Chandler, P. and Sweller, J. (2001). Learner experience and efficiency of instructional guidance. *Educational Psychology, 21*(1), pp.5-23.

Kanu, Y. (2005). Tensions and dilemmas of cross-cultural transfer of knowledge: post-structural/postcolonial reflections on an innovative teacher education in Pakistan. *International Journal of Educational Development*, *25*(5), pp.493-513.

Kaufman, R. and Burden, R., (2004). Peer tutoring between young adults with severe and complex learning difficulties: The effects of mediation training with Feuerstein's Instrumental Enrichment programme. *European Journal of Psychology of Education*, *19*(1), pp.107-117.

Kennedy, M., Fisher, M.B. and Ennis, R.H. (1991). Critical thinking: Literature review and needed research. *Educational Values and Cognitive Instruction: Implications for Reform*, 2, pp.11-40.

Khan, A. (2010). *A case study exploring perceived professional development needs for secondary school principals in Pakistan* (Doctoral dissertation, University of Pittsburgh).

Khan, A.H. and Mahmood, N. (1997). Education in Pakistan: Fifty Years of Neglect [with Comments]. *The Pakistan Development Review*, pp.647-667.

Khan, M. (2012). A study of primary school teachers' professional development programme : The translation of theory into practice in schools. *In Search of Relevance and Sustainability of Educational Change : An International Conference at Aga Khan University Institute for Educational Development, November 1-3, 2012*, pp.147-153. Retrieved from http://ecommons.aku.edu/pakistan_ied_pdck/239

Khan, M. (2014). The factors influencing women to become teachers in Pakistan, Centre for Employment Studies Research (CESR), University of the West of England, Bristol pdf html http://www2.uwe.ac.uk/faculties/BBS/BUS/Research/CESR/Sept_2014_Khan.pdf. Accessed on 06/11/2015

Khan, S.H. and Saeed, M. (2010). Evaluating the quality of BEd programme: Students' views of their college experiences. *Teaching and Teacher Education*, *26*(4), pp.760-766.

Klesius, J.P. and Searls, E.F. (1990). A meta-analysis of recent research in meaning vocabulary instruction. *Journal of Research and Development in Education*, *23*(4), pp.226-235.

Kohlbacher, F. (2006). The use of qualitative content analysis in case study research. *Forum Qualitative Sozialforschung / Forum*: *Qualitative Social Research, 7*(1). Retrieved from http://www.qualitative-research.net/index.php/fqs/article/view/75/153

Komatsu, T. (2009). Qualitative inquiry into local education administration in

Pakistan. *International Journal of Educational Development*, *29*(3), pp.219-226.

Krathwohl, D.R., (2002). A revision of Bloom's taxonomy: An overview. *Theory into practice*, *41*(4), pp.212-218.

Krippendorff, K. (2012). *Content analysis: An introduction to its methodology*. Thousand Oaks: Sage.

Kucuk, S. and Sahin, I. (2013). From the perspective of community of inquiry framework: An examination of Facebook uses by pre-service teachers as a learning environment. *TOJET: Turkish Online Journal of Educational Technology, 12*(2). pp.142-156.

Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher*, *28*(2), pp.16-46.

Kuhn, T. (1970). *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press.

Kulshrestha, A.K. and Pandey, K. (2013). Teachers training and professional competencies. *Voice of Research*, *1*(4), pp.29-33.

Kumar, I.A. and Parveen, S. (2013). Teacher education in the age of globalization. *Research Journal of Educational Sciences*, *1*(1), pp.8-12.

Kviz, F.J., (1977). Toward a standard definition of response rate. *The Public Opinion Quarterly*, *41*(2), pp.265-267.

Ladyshewsky, R.K. (2006). Peer coaching: a constructivist methodology for enhancing critical thinking in postgraduate business education. *Higher Education Research and Development, 25*(1), pp.67-84.

Lai, E.R. (2011). *Critical thinking: A literature review*. Pearson's Research Reports, 6, pp.40-41. Retrieved from http://images.pearsonassessments.com/images/tmrs/CriticalThinkingReviewFINAL.pdf

Larkin, S. (2015). An approach to metacognition research. *The Routledge International Handbook of Research on Teaching Thinking*. In R. Wegerif, L. Li, and J.C. Kaufman (Eds.), *The Routledge International Handbook of Research on Teaching Thinking*. Abingdon: Routledge.

Leat, D. (1999). Rolling the stone uphill: Teacher development and the implementation of thinking skills programmes. *Oxford Review of Education*, *25*(3), pp.387-403.

Leff, S.S., Hoffman, J.A. and Gullan, R.L. (2009). Intervention integrity: New paradigms and applications. *School Mental Health*, *1*(3), pp.103-106.

Levine, A. (2006). *Educating School Teachers*. Education Schools Project. Washington. Retrieved from http://edschools.org/teacher_report.htm

Lewis, A. and Smith, D. (1993). Defining higher-order thinking. *Theory into Practice*, *32*(3), pp.131-137.

Lincoln, Y. and Guba, E. (1986). But is it rigorous? Trustworthiness and authenticity in naturalistic evaluation. In D. Williams (Ed.). *Naturalistic Evaluation* (pp. 73-84). San Francisco: Jossey-Bass.

Lincoln, Y. and Guba. E. (1985). *Naturalistic Inquiry* (vol. 75). Beverly Hills. CA: Sage.

Lincoln, Y.S. (1995). Emerging criteria for quality in qualitative and interpretive research. *Qualitative Inquiry*, *1*(3), pp.275-289.

Lipman, M. (1988). *Critical thinking: What can it be?* Resource Publication, Series 1, No.1. Retrieved from https://eric.ed.gov/?id=ED352326

Lipman, M. (1991). *Thinking in Education*, (2nd ed.). New York: Cambridge University Press.

Lipman, M. (2003). *Thinking in Education*. Cambridge: Cambridge University Press.

Lipsey, M.W. and Hurley, S.M. (2009). Design sensitivity. *The Handbook of Applied Social Research Methods*, pp.44-76. Thousand Oaks, CA: Sage.

Liu, M., Bera, S., Corliss, S.B., Svinicki, M.D. and Beth, A.D. (2004). Understanding the connection between cognitive tool use and cognitive processes as used by sixth graders in a problem-based hypermedia learning environment. *Journal of Educational Computing Research*, *31*(3), pp.309-334.

Liu, P.L., Chen, C.J. and Chang, Y.J., (2010). Effects of a computer-assisted concept mapping learning strategy on EFL college students' English reading comprehension. *Computers and Education*, *54*(2), pp.436-445.

Longhurst, R. (2003). Semi-structured interviews and focus groups. *Key Methods in Geography*, pp.117-132.

Loucks, S.F. (1983). Defining Fidelity: A Cross-Study Analysis. Paper presented at *The Annual*

Meeting of the American Educational Research Association: Montreal, Quebec. Retrieved from https://eric.ed.gov/?id=ED249659

Loughran, J.J. (2002). Effective reflective practice: In search of meaning in learning about teaching. *Journal of Teacher Education*, *53*(1), pp.33-43.

Lundquist, R. (1999). Critical thinking and the art of making good mistakes, *Teaching in Higher Education 4*(4), pp.523-530.

Lynd, D. (2007). *The Education System in Pakistan*: *Assessment of the National Education Census*, 30, pp.2012. UNESCO Islamabad: Pakistan. Retrieved from http://www.dphu.org/uploads/attachements/books/books_4661_0.pdf

Mackenzie, N. and Knipe, S. (2006). Research dilemmas: Paradigms, methods and methodology. *Issues in Educational Research*, *16*(2), pp.193-205.

Malik, A.B., Shah, D., Saqlain, S.M., Hanif, M., Hussain, K.S. and Bano, S. (2014). *Inclusive Education and Relevance* (AEPAM Publication No.262). For 10th E-9 Ministerial Review Meeting Academy of Educational Planning and Management Ministry of Federal Education and Professional Training Islamabad. Islamabad: AEPAM. Retrieved from library.aepam.edu.pk

Marin, L.M. and Halpern, D.F. (2011). Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. *Thinking Skills and Creativity, 6*(1), pp.1-13.

Marshall, C. and Rossman, G.B. (2014). *Designing Qualitative Research*. London. Sage.

Martin, J.R. (1992). Critical thinking for a humane world. In S.P. Norris (Ed.), *The Generalizability of Critical Thinking*, pp.163-180. New York: Teachers College.

Martinez, M.E. (2006). What is metacognition? *Phi Delta Kappan*, *87*(9), pp.696-699.

Marzano, R.J. (1992). *A Different Kind of Classroom: Teaching with Dimensions of Learning*. Association for Supervision and Curriculum Development, Alexandria: VA 22314. Retrieved from https://eric.ed.gov/?id=ED350086

Marzano, R.J. (1998). *A Theory-Based Meta-Analysis of Research on Instruction*. Aurora, Colorado: Mid-continent Regional Educational Laboratory.

Masui, C. and De Corte, E. (1999). Enhancing learning and problem solving skills: orienting and self-judging, two powerful and trainable learning tools. *Learning and Instruction*, *9*(6), pp.517-542.

Mathews, S.R. and Lowe, K. (2011). Classroom environments that foster a disposition for critical thinking. *Learning Environments Research*, *14*(1), pp.59-73.

Maxcy S. (2003). Pragmatic threads in mixed methods research in the social sciences: The search for multiple modes of inquiry and the end of the philosophy of formalism. In A. Tashakkori and C. Teddlie (Eds.), (2003)*, Handbook of Mixed Methods in Social and Behavioral Research*, pp.51-89. Sage.

Mayer, R.E. and Alexander, P.A. (Eds.). (2011). *Handbook of Research on Learning and Instruction*. New York: Routledge.

Mayer, R.E. (2002). A step toward redesigning Bloom's Taxonomy. In Moseley, D., 2005. *Frameworks for Thinking: A Handbook for Teaching and Learning*. Cambridge: Cambridge University Press.

Maykut, P. and Morehouse, R. (1994). *Beginning Qualitative Research: A Philosophic and Practical Approach*. Bristol, PA: Falmer.

McBer, H. (2000). A model of teacher effectiveness. *Department for Education and Employment. Recuperado el*, *15*, pp.01-06.

McBer, H. (2001). *Research into Teacher Effectiveness, Early Professional Development of Teachers,* 68, p.69. Norwich: DfEE.

MCC General Education Initiatives, p.3. Retrieved from http://isites.harvard.edu/fs/docs/icb.topic204027.files/Critical_thinking_definitions.pdf

McCombs, B.L. and Marzano, R.J. (1990). Putting the self in self-regulated learning: The self as agent in integrating will and skill. *Educational Psychologist*, *25*(1), pp.51-69.

McGuiness, C. (1999). *From Thinking Skills to Thinking Classrooms: A Review and Evaluation of Approaches for Developing Pupils' Thinking.* Nottingham: DfEE.

McGuinness, C. (2000). ACTS: A methodology for teaching thinking skills across the curriculum, *Teaching Thinking*, 2, pp.1–12.

McGuinness, C. (2005). Teaching thinking: Theory and practice, *British Journal of Educational Psychology*, *Monograph Series II* (3) pp.107–126.

McGuinness, C. (2006). *Building thinking skills in thinking classroom*: *ACTS (Activating Children's Thinking Skills) in Northern Ireland*. Teaching and Learning Research Briefing (No.18), for Teaching and Learning Research Programme. Retrieved from www.tlrp.org.

McGuinness, C., Curry, C., Greer, B., Daly, P. and Salters, M. (1997). *Final report on the ACTS project*. Phase 2, Belfast Northern Ireland Council for Curriculum Examinations and Assessments.

McPeck, J.E. (1990). Critical thinking and subject specificity: A reply to Ennis. *Educational Researcher*, *19*(4), pp.10-12.

Memon, G.R. (2007). Education in Pakistan: The key issues, problems and the new challenges. *Journal of Management and Social Sciences*, *3*(1), pp.47-55.

Merriam, S.B. (1995). What can you tell from an N of 1?: Issues of validity and reliability in qualitative research. *PAACE Journal of Lifelong Learning*, 4, pp.50-60.

Merriam, S.B. (2009). Qualitative case study research. *Qualitative research: A guide to design and implementation*, pp.39-54. CA: John Wiley and Sons.

Mertens, D.M. (2003). Mixed methods and the politics of human research: The transformative-emancipatory perspective. In A.M. Tashakorri and C.B. Teddlie (Eds.), *Handbook of Mixed Methods in Social and Behavioral Research*, pp.135-164. Thousand Oaks, CA: Sage.

Mertens, D.M. (2005). *Research Methods in Education and Psychology: Integrating Diversity with Quantitative and Qualitative Approaches.* (2nd ed.) Thousand Oaks: SAGE.

Meyers, C. (1986). *Teaching Students to Think Critically. A Guide for Faculty in All Disciplines. Jossey-Bass Higher Education Series*. San Francisco: Jossey-Bass Inc.

Miles, M.B. and Huberman, A.M. (1994). Qualitative Data Analysis: A Sourcebook. Beverly Hills: Sage.

Mitchell, M. and Jolley, J. (2012). Research design explained. Belmont, CA: USA, Cengage Learning. Retrieved from http://www.jolley-mitchell.com/StudyRDE/default.html

Moos, D.C. and Honkomp, B. (2011). Adventure learning: Motivating students in a Minnesota middle school. *Journal of Research on Technology in Education*, *43*(3), pp.231-252.

Morgan, D.L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research*, 8, pp.362-376.

Morgan, K. (2007). The learning region: Institutions, innovation and regional renewal. *Regional Studies*, *41*(S1), pp.S147-S159.

Morse, J.M. and Niehaus, L. (2009). *Principles and Procedures of Mixed Methods Design*. Walnut Creek, CA: Left Coast Press.

Morse, J.M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research*, 40, pp.120-123.

Moseley D, Baumfield V, Elliott J, Higgins S, Miller J. and Newton D.P. (2005a). *Frameworks for Thinking: A Handbook for Teachers and Learning*. Cambridge: Cambridge University Press.

Moseley, D. (2005). *Frameworks for Thinking: A Handbook for Teaching and Learning*. Cambridge: Cambridge University Press.

Moseley, D., Baumfield, V., Higgins, S., Lin, M., Miller, J., Newton, D., Robson, S., Elliott, J. and Gregson, M. (2004). *Thinking Skill Frameworks for Post-16 Learners: An Evaluation. A Research Report for the Learning and Skills Research Centre*. Learning and Skills Development Agency. London: Available from: Learning and Skills Network.

Moseley, D., Elliott, J., Gregson, M. and Higgins, S. (2005b). Thinking skills frameworks for use in education and training. *British Educational Research Journal*, *31*(3), pp.367-390.

Muijs, D. and Reynolds, D. (2010). *Effective Teaching: Evidence and Practice*. London, Sage.

Muijs, D., Kyriakides, L., van der Werf, G., Creemers, B., Timperley, H. and Earl, L. (2014). State of the art – teacher effectiveness and professional learning. *School Effectiveness and School Improvement*, *25*(2), pp.231-256.

Mulhall, A. (2003). In the field: Notes on observation in qualitative research, *Journal of Advanced Nursing*, *41*(3), pp.306-313.

Mulnix, J.W. (2012). Thinking critically about critical thinking. *Educational Philosophy and Theory*, *44*(5), pp.464-479.

NACTE: National Accreditation Council for Teacher Education (2009). Pakistan. Retrieved from http://www.nacte.org.pk/#/main

NACTE: National Accreditation Council for Teacher Education (2010). http://unesco.org.pk/education/teachereducation/files/Nacte.pdf

National Report (2011). *Pakistan and Commitments to Education: Implementing the internationally agreed goals and commitments to education*, The Economic and Social Council (ECOSOC) of the United Nations. Retrieved from http://www.un.org/en/ecosoc/newfunct/pdf/2011_amr_pakistan_june_2011.pdf

Nausheen, M. (2016). An adaptation of the Motivated Strategies for Learning Questionnaire (MSLQ) for postgraduate students in Pakistan: Results of an Exploratory Factor Analysis. *Bulletin of Education and Research*, *38*(1). pp.1-16

Nawaz, N. (2013). *Perspectives on the status of the teaching profession in Pakistan: An investigation of trainee teachers' reasons for choosing the teaching profession, the role of the teacher and problems faced by trainee teachers*. (Doctoral dissertation, University of Huddersfield).

NCRI: National Center on Response to Intervention. (2010). *Essential Components of RTI: A Closer Look at Response to Intervention*. Retrieved from http://www.rti4success.org/pdf/rtiessentialcomponents_042710.pdf

Ndaruhutse S. (2009). *The centrality of teacher management to quality education: Lessons from developing countries*. Report, VSO, CfBT. Retrieved from http://www.cedol.org/wp-content/uploads/2012/02/128-132-2009.pdf

Nelson-Walker, N.J., Fien, H., Kosty, D.B., Smolkowski, K., Smith, J.L.M. and Baker, S.K., (2013). Evaluating the effects of a systemic intervention on first-grade teachers' explicit reading instruction. *Learning Disability Quarterly*, *36*(4), pp.215-230.

NEP, 1998-2010: Pakistan, Ministry of Education (1998). *National Education Policy 1998–2010*. MOE, Islamabad.

NEP, 2009: National Education Policy (2009). Retrieved from http://unesco.org.pk/education/teachereducation/files/National%20Education%20Policy.pdf

Newmann, F.M., King, B. and Youngs, P. (2000). Professional development to build organizational capacity in low achieving schools: Promising strategies and future challenges. *University of Wisconsin-Madison: Wisconsin Centre for Education Research*.

Newmann, F.M., Smith, B., Allensworth, E. and Bryk, A.S. (2001). *School Instructional Program Coherence: Benefits and Challenges*. Report, Improving Chicago's Schools. Chicago, IL: Consortium on Chicago School Research.

Nickerson, R.S. (1988). On improving thinking through instruction. *Review of Research in Education*, 15, pp.3-57.

Nicole, D. and Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: model and seven principles of good feedback. *Studies in Higher Education,* 34, pp.199-218.

Niu, L., Behar-Horenstein, L.S. and Garvan, C.W. (2013). Do instructional interventions influence college students' critical thinking skills? A meta-analysis. *Educational Research Review*, 9, pp.114-128.

Nordstrum, L.E. (2011). *Beyond the doors of learning: user fees, school finance and education demand in the new South Africa* (Doctoral dissertation, University of Cambridge).

Norman, G. (2010). Likert scales, levels of measurement and the 'laws' of statistics. *Advances in Health Sciences Education*, *15*(5), pp.625-632.

Norris, S.P. (1985). Synthesis of research on critical thinking. *Educational Leadership*, *42*(8), pp.40-45.

NPST: National Professional Standards for Teachers in Pakistan (2009). Retrieved from http://unesco.org.pk/education/teachereducation/files/National%20Professional%20Standards%20for%20Teachers.pdf

NRC: National Research Council, J.Confrey and V.Stohl (Eds.) (2004). *On Evaluating Curricular Effectiveness: Judging the Quality of K-12 Mathematics Evaluations. Committee for a Review of the Evaluation Data on the Effectiveness of NSF-Supported and Commercially Generated Mathematics Curriculum Materials*. Washington, DC: The National Academies Press.

O'Donnell, C., Lynch, S., Lastica, J. and Merchlinsky, S. (2007). Analyzing the relationship between Fidelity of Implementation (FOI) and student outcomes in a quasi-experiment. In *Symposium conducted at the Annual Meeting of the American Educational Research Association*, Chicago, IL.

O'Donnell, C.L. (2008). Defining, conceptualizing, and measuring fidelity of implementation and its relationship to outcomes in K–12 curriculum intervention research. *Review of Educational Research*, *78*(1), pp.33-84.

O'Donnell, C.L. (2007). Fidelity of implementation to instructional strategies as a moderator of curriculum unit effectiveness in a large-scale middle school science quasi-experiment. *Dissertation Abstract International*, *68* (08) (UMI No. AAT 3276564). Retrieved from ProQuest Dissertations and Theses Database. The George Washington University.

O'Leary, Z. (2004). *The Essential Guide to Doing Research*. London: SAGE.

Olsen, D. G. (1985). The quality of prospective teachers: Education vs. noneducation graduates. *Journal of Teacher Education*, *36*(5), pp.56-59. In Darling-Hammond, L. (2000). How teacher education matters. *Journal of Teacher Education*, *51*(3), pp.166-173.

Olufunke, B.T. and Blessing, O.O. (2014). Achievement in physics using Mastery Learning and Mind Mapping approaches: Implication on gender and attitude. *International Journal of Humanities Social Sciences and Education (IJHSSE) 1*(12), pp.154-161.

Onwuegbuzie, A.J. and Collins, K.M. (2007). A typology of mixed methods sampling designs in social science research. *The Qualitative Report*, *12*(2), pp.281-316.

Onwuegbuzie, A.J. and Johnson, R.B. (2006). The validity issue in mixed research. *Research in the Schools*, *13*(1), pp.48-63.

Papanikolaou, K. (2014). How authoring content for personalised learning may cultivate learning design skills. In *2014 IEEE 14th International Conference on Advanced Learning Technologies* (pp.94-98). IEEE.

Paris, S.G. and Paris, A.H. (2001). Classroom applications of research on self-regulated learning. *Educational Psychologist*, *36*(2), pp.89-101.

Parveen, A., Rashid, K., Iqbal, M.Z. and Khan, S. (2011). System and reforms of Higher Education in Pakistan. *International Journal of Business and Social Science*, *2*(20), pp.260-267.

Pascarella, E.T., Wang, J.S., Trolian, T.L. and Blaich, C. (2013). How the instructional and learning environments of liberal arts colleges enhance cognitive development. *Higher Education*, *66*(5), pp.569-583.

Patrick, H. (1997). Social self-regulation: Exploring the relations between children's social relationships, academic self-regulation, and school performance. *Educational Psychologist*, *32*(4), pp.209-220.

Patton, M.Q. (1990). *Qualitative Evaluation and Research Methods*. London: Sage.

Paul, R. (1992). Critical thinking: What, why, and how. *New Directions for Community Colleges*, 77, pp.3-24.

Paul, R. (2005). The state of critical thinking today. *New Directions for Community Colleges*, 130, pp.27-38.

Paul, R. and Elder, L. (2002). *Critical thinking: Tools for Taking Charge of Your Professional Life*. Upper Saddle River, NJ: Financial Times Prentice Hall. Retrieved from http://library.tebyan.net/fa/Viewer/Text/143334/3

Paul, R. and Elder, L. (2006). Critical thinking: The nature of critical and creative thought. *Journal of Developmental Education*, *30*(2), p.34.

Pea, R.D. (1985). Beyond amplification: Using the computer to reorganize mental functioning. *Educational Psychologist*, *20*(4), pp.167-182.

Perkins, D.N. and Salomon, G. (1989). Are cognitive skills context-bound? *Educational Researcher*, *18*(1), pp.16-25.

Pintrich, P.R. and Zusho, A. (2002). The development of academic self-regulation: The role of cognitive and motivational factors. In A. Wigfield and J.S. Eccles (Eds.) (2002). *Development of Achievement Motivation*, pp.249-284. San Diego: Academic Press.

Pintrich, P.R. and Zusho, A. (2007). Student motivation and self-regulated learning in the college classroom. In *The Scholarship of Teaching and Learning in Higher Education: An Evidence-Based Perspective,* pp. 731-810, Netherlands: Springer.

Pintrich, P.R. (1999). The role of motivation in promoting and sustaining self-regulated learning. *International Journal of Educational Research*, *31*(6), pp.459-470.

Pintrich, P.R. (2000). Educational psychology at the millennium: A look back and a look forward. *Educational Psychologist*, *35*(4), pp.221-226.

Pintrich, P.R. (2000a). The role of goal orientation in self-regulated learning. In M. Boekaerts,

P. R. Pintrich, and M. Zeidner (Eds.). *Handbook of self-regulation: Theory, research, and applications* (pp.451-502). San Diego, CA: Academic Press.

Pintrich, P.R. (2000b). An achievement goal theory perspective on issues in motivation terminology, theory, and research. *Contemporary Educational Psychology*, *25*(1), pp.92-104.

Pintrich, P.R. (2003). A motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology*, *95*(4), pp.667-686.

Pintrich, P.R., Smith, D.A., García, T. and McKeachie, W.J. (1991). *A manual for the use of the Motivated Strategies for Learning Questionnaire*, (Technical Report 91-B-004). The Regents of the University of Michigan.

Pintrich, P.R., Smith, D.A., García, T. and McKeachie, W.J. (1993). Reliability and predictive validity of the Motivated Strategies for Learning Questionnaire (MSLQ). *Educational and Psychological Measurement*, *53*(3), pp.801-813.

Pithers, R.T. and Soden, R. (2000). Critical thinking in education: A review. *Educational Research*, *42*(3), pp.237-249.

Plano Clark, V.L. and Creswell, J.W. (2008). *The Mixed Methods Reader*. Thousand Oaks, CA: Sage.

Pollard, H., Minor, M. and Swanson, A. (2014). Instructor social presence within the community of inquiry framework and its impact on classroom community and the learning environment. *Online Journal of Distance Learning Administration*, *17*(2), p.41.

Prestage, S. and Perks, P. (1999). Towards a pedagogy of teacher education: A model and a methodology. MER11 Editorial. *Mathematics Education Review*, 11, pp.1-5.

Profetto-McGrath, J. (2005). Critical thinking and evidence-based practice. *Journal of Professional Nursing*, *21*(6), pp.364-371.

Punch, K.F. and Oancea, A. (2014). Introduction to Research Methods in Education. Thaousand Oaks, CA: Sage.

Purvis, C.A. (2009). *Factors That Influence the Development of Critical Thinking Skills in Associate Degree Nursing Students*, (Doctoral dissertation, University of Georgia). Retrieved from Proquest Dissertations.

Reed, J.H. (1998). *Effect of a model for critical thinking on student achievement in primary* *source document analysis and interpretation, argumentative reasoning, critical thinking dispositions and history content in a community college history course*, (unpublished Doctor of Philosophy thesis, University of South Florida).

Remler, D.K. and Van Ryzin, G.G. (2010). *Research Methods in Practice: Strategies for Description and Causation*. SAGE Publications Inc.

Remler, D.K. and Van Ryzin, G.G. (2011). Natural and quasi-experiments. In *Research Methods in Practice, Strategies for Description and Causation (*2nd ed.)*,* pp.427-464.

Renaud, R.D. and Murray, H.G. (2008). A comparison of a subject-specific and a general measure of critical thinking. *Thinking Skills and Creativity*, *3*(2), pp.85-93.

Richardson, V. (1998). How teachers change: What will lead to change that most benefits student learning. *Focus on Basics*, *2*(4), pp.7-11.

Rivkin, S. G., Hanushek, E. A., and Kain, J. F. (2005). Teachers, schools, and academic achievement. *Econometrica*, *73*(2), pp.417-458.

Robinson, V.M. (1998). Methodology and the research-practice gap. *Educational Researcher*, *27*(1), pp.17-26.

Rog, D.J. (2012). When background becomes foreground: Toward context-sensitive evaluation practice. *New Directions for Evaluation*, 135, pp.25-40.

Rossman, G.B. and Wilson, B.L. (1985). Numbers and words combining quantitative and qualitative methods in a single large-scale evaluation study. *Evaluation Review*, *9*(5), pp.627-643.

Rotgans, J.I. and Schmidt, H.G. (2008). Cross-cultural validation of self-regulated learning in Singapore. pp.245-266. In *What the West can learn from the East: Asian perspectives on the psychology of learning and motivation*, USA. IAP-Information Age Publishing, Inc.

Rotgans, J.I. and Schmidt, H.G. (2010). The Motivated Strategies for Learning Questionnaire: A measure for students' general motivational beliefs and learning strategies. *The Asia-Pacific Education Researcher*, *19*(2), pp.357-369.

Rowan, B., Correnti, R. and Miller, R. (2002). What large-scale survey research tells us about teacher effects on student achievement: Insights from the prospects study of elementary schools. *The Teachers College Record*, *104*(8), pp.1525-1567.

Rubie-Davies, C.M., Flint, A. and McDonald, L.G. (2012). Teacher beliefs, teacher characteristics, and school contextual factors: What are the relationships? *British Journal of Educational Psychology*, *82*(2), pp.270-288.

Salomon, G., Perkins, D.N. and Globerson, T. (1991). Partners in cognition: Extending human intelligence with intelligent technologies. *Educational Researcher*, *20*(3), pp.2-9.

Sanders, W.L., Wright, S.P. and Horn, S.P. (1997). Teacher and classroom context effects on student achievement: Implications for teacher evaluation. *Journal of Personnel Evaluation in Education*, *11*(1), pp.57-67.

Sanjek, R. (1990). (ed.) *Fieldnotes: The Makings of Anthropology*, pp.92-121. Ithaca: Cornell University Press.

Schmidt, C. (2004). The analysis of semi-structured interviews. In Flick, U., von Kardorff, E. and Steinke, I. (Eds.) *A Companion to Qualitative Research*, *Pt 4 Qualitative Methods and Doing Qualitative Research*, pp.253-258. Thousand Oaks, CA: Sage.

Schoenfeld, A.H. (2006). What doesn't work: The challenge and failure of the What Works Clearinghouse to conduct meaningful reviews of studies of mathematics curricula. *Educational Researcher*, *35*(2), pp.13-21.

Schunk, D.H. and Gunn, T.P. (1986). Self-efficacy and skill development: Influence of task strategies and attributions. *The Journal of Educational Research*, *79*(4), pp.238-244.

Schunk, D.H. (2005). Self-regulated learning: The educational legacy of Paul R. Pintrich. *Educational Psychologist*, *40*(2), pp.85-94.

Shadish, W.R., Cook, T.D. and Campbell, D.T. (2002). Statistical conclusion validity and internal validity. pp.45-48. *Experimental and Quasi-Experimental Designs for Generalized Causal Inference*, New York: Houghton Mifflin Company.

Shah, S.M.A., Kiani, K.M., Mahmood, Z. and Hussain, I. (2011). In-service Training of Secondary Level Teachers: A Follow Up of Teachers' Performance in Comparative Perspective. *Journal of Education and Practice*, *2*(11-12), pp.40-49.

Shayer, M. and Adey, P. eds., 2002. *Learning intelligence: Cognitive acceleration across the curriculum from 5 to 15 years*. Milton Keynes: Open University Press.

Shea, P. and Bidjerano, T. (2010). Learning presence: Towards a theory of self-efficacy, self-regulation, and the development of a communities of inquiry in online and blended learning environments. *Computers and Education*, *55*(4), pp.1721-1731.

Shenton, A.K. (2004). Strategies for ensuring trustworthiness in qualitative research projects. *Education for Information*, *22*(2), pp.63-75.

Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, *15*(2), pp.4-14.

Shute, V.J. (2008). Focus on formative feedback. *Review of Educational Research*, *78*(1), pp.153-189.

Siddique, S. (2007). *Rethinking Education in Pakistan: Perceptions, Practices, and Possibilities*. Lahore: Paramount Publishing Enterprise.

Siegel, H. (1993). Not by skill alone: The centrality of character to critical thinking. *Informal Logic*, *15*(3), pp.163-177.

Siegel, H. (1999). What (good) are thinking dispositions? *Educational Theory*, *49*(2), pp.207-221.

Silverman, D. (1998). Qualitative research: meanings or practices? *Information Systems Journal*, *8*(1), pp.3-20.

Silverman, D. (2001). *Interpreting Qualitative Data: Methods for Analysing Talk, Text and Interaction.* London: Sage.

Sipe, T.A. and Curlette, W.L. (1996). A meta-synthesis of factors related to educational achievement: A methodological approach to summarizing and synthesizing meta-analyses. *International Journal of Educational Research*, *25*(7), pp.583-698.

Snilstveit, B., Gallagher, E., Phillips, D., Vojtkova, M., Eyers, J., Skalidou, D., Stevenson, J., Bhavsar, A. and Davies, P. (2014). *Education interventions for improving the access to, and quality of, education in low and middle income countries: A systematic review*. International Initiative for Impact Evaluation . The Campbell Collaboration. pp.1-23.

Snyder, L.G. and Snyder, M.J. (2008). Teaching critical thinking and problem solving skills. *The Journal of Research in Business Education*, *50*(2), pp.90-99.

Soden, R., Kenesson, S., Seagraves, L., Campbell, D., Brady, K. and McKay, J. (2007). *Evaluation* *of Scottish Borders Council's Feuerstein Partnership Project*. University of Strathclyde: Scottish Executive.

Song, M.K., Happ, M.B. and Sandelowski, M. (2010). Development of a tool to assess fidelity to a psycho-educational intervention. *Journal of Advanced Nursing*, *66*(3), pp.673-682.

Stanovich, P.J. and Stanovich, K.E. (2003). *Using Research and Reason in Education: How Teachers Can Use Scientifically Based Research to Make Curricular and Instructional Decisions.* NH: RMC Research Corporation. Retrieved from https://lincs.ed.gov/publications/pdf/Stanovich_Color.pdf

Sternberg, R.J. (1986). *Critical Thinking: Its Nature, Measurement, and Improvement*. Information Analysis, Sponsors: National Institute of Education (ED), Washington: DC. Retrieved from http://files.eric.ed.gov/fulltext/ED272882.pdf

Sternberg, R.J. (1988). A three-facet model of creativity. *The Nature of Creativity: Contemporary Psychological Perspectives*, p.125. Cambridge: Cambridge University Press.

Summerfelt, W.T. (2003). Program strength and fidelity in evaluation. *Applied Developmental Science*, *7*(2), pp.55-61.

Swann, J. (2010). A dialogic approach to online facilitation. *Australasian Journal of Educational Technology*, *26*(1), pp.50-62.

Tahir, T. and Taylor, P.C. (2013). Comparison of the responses of teacher trainers and researcher's classroom observation on the effectiveness of teacher training Program in Pakistan. *International Journal of Learning and Development*, *3*(1), pp.93-99.

Tajuddin and Khan, M. (2012). A study of primary school teachers' professional development programme : The translation of theory into practice in schools. *In Search of Relevance and Sustainability of Educational Change : An International Conference at Aga Khan University Institute for Educational Development,* pp.147-153.
Retrieved from http://ecommons.aku.edu/pakistan_ied_pdck/239

Tanveer-ul-Zaman. (2000). *Teacher Education in Pakistan*. Islamabad, Pakistan: Allama Iqbal Open University Press.

Tashakkori, A. M. and Teddlie, C.B. (Eds.), (2010). Second edition. *Handbook of Mixed Methods in Social and Behavioral Research,* pp.51-90. Thousand Oaks, CA: Sage.

Tashakkori, A.M. and Teddlie, C.B. (2003). Issues and dilemmas in teaching research methods courses in social and behavioural sciences: US perspective. *International Journal of Social Research Methodology*, *6*(1), pp.61-77.

Taylor, R.T. (2012). *Review of the Motivated Strategies for Learning Questionnaire (MSLQ) using reliability generalization techniques to assess scale reliability* (Doctoral dissertation, Auburn University).

Teddlie, C.B. and Tashakkori, A.M. (2010). Overview of contemporary issues in mixed methods research.pp.1-41.*Handbook of Mixed Methods in Social and Behavioral Research*, Thousand Oaks, CA: Sage.

Teddlie, C.B. and Tashakkori, A.M. (Eds.) (2009). *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*. Thousand Oaks, CA: Sage.

Teddlie, C.B. and Tashakkori, A.M. (2003). Major issues and controversies in the use of mixed methods in the social and behavioral sciences. *Handbook of Mixed Methods in Social and Behavioral Research*, pp.3-50.

Teddlie, C.B. and Yu, F. (2007). Mixed methods sampling a typology with examples. *Journal of Mixed Methods Research*, *1*(1), pp.77-100.

Thayer-Bacon, B.J. (1993). Caring and its relationship to critical thinking. *Educational Theory*, *43*(3), pp.323-340.

Thayer-Bacon, B.J. (1998). Transforming and redescribing critical thinking: Constructive thinking. *Studies in Philosophy and Education*, *17*(2-3), pp.123-148.

Thayer-Bacon, B.J. (2000). *Transforming Critical Thinking: Thinking Constructively*. New York: Teachers College Press.

Thayer-Bacon, B.J. (2001). Radical democratic communities always-in-the-making. *Studies in Philosophy and Education*, *20*(1), pp.5-25.

Tindal, G. and Nolet, V. (1995). Curriculum-based measurement in middle and high schools: Critical thinking skills in content areas. *Focus on Exceptional Children*, *27*(7), pp.1-22.

Tiruneh, D.T., Verburgh, A. and Elen, J. (2014). Effectiveness of critical thinking instruction in higher education: A systematic review of intervention studies. *Higher Education Studies*, *4*(1), pp.1-17.

Tiruneh, D.T., Weldeslassie, A.G., Kassa, A., Tefera, Z., Cock, M. and Elen, J. (2016). Systematic design of a learning environment for domain-specific and domain-general critical thinking skills. *Educational Technology Research and Development*, *64*(3), pp.481-505.

Topping, K.J. and Trickey, S. (2014). The role of dialog in philosophy for children. *International Journal of Educational Research*, 63, pp.69-78.

Traver, A.E., Volchok, E., Bidjerano, T. and Shea, P. (2014). Correlating community college students' perceptions of community of inquiry presences with their completion of blended courses. *The Internet and Higher Education*, 20, pp.1-9.

Tsui, L. (2002). Fostering critical thinking through effective pedagogy: Evidence from four institutional case studies. *Journal of Higher Education*, *73*(6), pp.740-763.

Turner, J.C. (1995). The influence of classroom contexts on young children's motivation for literacy. *Reading Research Quarterly*, pp.410-441.

U.S. Department of Education (2003b). *What Works Clearinghouse Study Review Standards.* Institute of Education Sciences, Washington, DC. Retrieved from http://ies.ed.gov/ncee/pubs/evidence_based/appendix_a.asp

U.S. Department of Education (2003a). *Identifying and Implementing Educational Practices Supported by Rigorous Evidence: A User-Friendly Guide.* Institute of Education Sciences, Washington, DC. Retrieved from http://www.ed.gov/print/rschstat/research/pubs/rigorousevid/guide.html.

UNESCO (2006a). *Situation Analysis of Teacher Education and Professional Development: Pakistan*. USAID/Teacher Education and Professional Development Project.

UNESCO (2006b). *Strategic Framework for Teacher Education and Professional Development Project.*

UNESCO (2006c). *Roundtable on Teacher Education: Major Objectives of Teacher Education*.

UNESCO (2008). *Status of Teacher Education in the Asia Pacific Region*. International Reading Association: Bangkok. Retrieved from http://www.unescobkk.org/education/apeid/programme

UNESCO (2010). Secondary Education, Regional Information Base: Country Profile. Retrieved from http://www.uis.unesco.org/Library/Documents/Pakistan.pdf

UNESCO EFA Global Monitoring Report (2010). *Reaching the Marginalized*. Oxford, Paris: Oxford University Press.

UNESCO Report (2012). *Closing the Trained Teacher Gap*. Retrieved from http://www.uis.unesco.org/Education/Documents/gce-teachers-report-2012.pdf

UNESCO (2015). Adult and Youth Literacy. *UNESCO Institute for statistics. Available at: http://www. uis. unesco. org/literacy/Documents/fs32-2015-literacy. pdf*.html: www.uis.unesco.org/literacy/Documents/UIS-literacy-statistics-1990-2015-en.pdf accessed on 20/08/16

UNESCO/USAID (2008). *Status of Teachers in Pakistan*. Lahore, Pakistan: Idara-e-Taleem-o-Aagahi.

UNICEF (2007). Statistics, Pakistan. Retrieved from http://www.unicef.org/infobycountry/pakistan.html.

USAID (2004). Pakistan teacher education and professional development programme (PTEPDP): Performance gap analysis and training needs assessment of teacher training institutes. Retrieved from http://pdf.usaid.gov/pdf_docs/Pnadi362.pdf

USAID (2006). *Situation Analysis of Teacher Education in Pakistan: Towards a Strategic Framework for Teacher Education and Professional Development*. Sponsor: UNESCO. Retrieved from http://files.eric.ed.gov/fulltext/ED497052.pdf

Valanides, N. and Angeli, C. (2005). Effects of instruction on changes in epistemological beliefs. *Contemporary Educational Psychology*, *30*(3), pp.314-330.

Van Gelder, T. and Rizzo, A. (2001). Reason! Able across the curriculum. In *Is IT an Odyssey in Learning? Proceedings of the 2001 Conference of the Computing in Education Group of Victoria*.

Van Gelder, T. (2003). Enhancing deliberation through computer supported argument visualization. In *Visualizing Argumentation*, pp.97-115, London: Springer.

Van Gelder, T. (2007a). Rationale: Making people smarter through argument mapping. *Law, Probability and Risk*, *6*(1-4), 23-42.

Van Gelder, T. (2007b). The rationale for Rationale™. *Law, Probability and Risk*, *6*(1-4), pp.23-42.

Van Gelder, T. (2001). How to improve critical thinking using educational technology. In *Meeting at the crossroads: Proceedings of the 18th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (pp. 539-548). Melbourne.

Van Gelder, T., Bissett, M. and Cumming, G. (2004). Cultivating expertise in informal reasoning. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *58*(2), pp.142-152.

Van Maanen, J. and Barley, S. (1983). *Cultural organization: Fragments of a Theory.* (No. TR-25-ONR). Cambridge, MA: Alfred P. Sloan School of Management.

Vermetten, Y.J., Vermunt, J.D. and Lodewijks, H.G. (2002). Powerful learning environments? How university students differ in their response to instructional measures. *Learning and Instruction*, *12*(3), pp.263-284.

Vermunt, J.D. and Verloop, N. (1999). Congruence and friction between learning and teaching. *Learning and Instruction*, *9*(3), pp.257-280.

Volkwein, J.F. and Lorang, W.G. (1996). Characteristics of extenders: Full-time students who take light credit loads and graduate in more than four years. *Research in Higher Education*, *37*(1), pp.43-68.

Volkwein, J.F. (1991). Improved measures of academic and social integration and their association with measures of student growth. In *Annual meeting of the Association for the Study of Higher Education, Boston, MA*.

Voss, T. Kunter, M. and Baumert, J. (2011). Assessing teacher candidates' general pedagogical/psychological knowledge: Test construction and validation. *Journal of Educational Psychology*, *103*(4), p.952.

WDI: *World Development Indicators (2016): Pakistan online*. Retrieved from http://data.worldbank.org/country/pakistan

Wegerif, R. (2008). Dialogic or dialectic? The significance of ontological assumptions in research on educational dialogue. *British Educational Research Journal*, *34*(3), pp.347-361.

Wegerif, R., Li, L. and Kaufman, J.C. (Eds.) (2015). *The Routledge International Handbook of*

Research on Teaching Thinking. Routledge.

Wegerif, R., Mercer, N. and Dawes, L. (1999). From social interaction to individual reasoning: An empirical investigation of a possible socio-cultural model of cognitive development. *Learning and Instruction*, *9*(6), pp.493-516.

Weiner, B. (1986). An attributional theory of achievement motivation and emotion, pp.159-190. Springer: US. In Moseley, D. (2005). *Frameworks for thinking: A Handbook for Teaching and Learning*. Cambridge: Cambridge University Press.

Wentzel, K.R. (1991). Social and academic goals at school: Motivation and achievement in context. *Advances in Motivation and Achievement*, 7, pp.185-212.

Wentzel, K.R. (1999). Social-motivational processes and interpersonal relationships: Implications for understanding motivation at school. *Journal of Educational Psychology*, *91*(1), pp.76-79.

Wentzel, K.R. (2000). What is it that I'm trying to achieve? Classroom goals from a content perspective. *Contemporary Educational Psychology*, *25*(1), pp.105-115.

Westbrook J, Durrani N, Brown R, Orr D, Pryor J, Boddy J, Salvi F. (2013). Pedagogy, Curriculum, Teaching Practices and Teacher Education in Developing Countries. Final Report. Education Rigorous Literature Review. Department for International Development. This paper can be found on the DFID Research for Development website: http://r4d.dfid.gov.uk/ and the EPPI-Centre website: http://eppi.ioe.ac.uk/

Wheeler, L.A. and Collins, S.K. (2003). The influence of concept mapping on critical thinking in baccalaureate nursing students. *Journal of Professional Nursing*, *19*(6), pp.339-346.

Wigfield, A. and Eccles, J.S. (1992). The development of achievement task values: A theoretical analysis. *Developmental Review*, 12(3), pp.265-310.

Williams, M. and Burden, R.L. (1997). *Psychology for Language Teachers*. Cambridge: Cambridge University Press.

Willingham, D.T. (2007). Critical thinking. *American Educator*, pp.8-19

Willingham, D.T. (2009). *Why Don't Students Like School? A Cognitive Scientist Answers Questions About How the Mind Works and What it Means for the Classroom*. San Francisco: John Wiley and Sons.

World Bank (2014). *Poor Quality Education Holding Back South Asia, World Bank says*. Press Release. Retrieved from http://www.worldbank.org/en/news/press-release/2014/06/30/poor-quality-education-holding-back-south-asia

World Development Indicators (2016). *Quality Education*. World Bank Group. Green Press Initiative. Retrieved from https://issuu.com/world.bank.publications/docs/9781464806834?e=0/35179276

Wright, L. (2001). Critical Thinking: An Introduction to Analytical Reading and Reasoning. Oxford: Oxford University Press.

Xin, C. (2012). A critique of the community of inquiry framework. *International Journal of E-Learning and Distance Education*, *26*(1). pp.1-10.

Yin, R.K. (2003). Case study research: Design and methods (3rd ed.). Thousand Oaks,: SAGE.

Yin, R.K. (2014). *Case Study Research: Design and Methods 5th Edition*. London: SAGE.

Zafft, C., Kallenbach, S. and Spohn, J. (2006). *Transitioning Adults to College: Adult Basic Education Program Models*. NCSALL Occasional Paper. National Center for the Study of Adult Learning and Literacy (NCSALL). Boston.

Zimmerman, B.J. (1989). A social cognitive view of self-regulated academic learning. *Journal of Educational Psychology*, *81*(3), p.329-339.

Zimmerman, B.J. (2002). Becoming a self-regulated learner: An overview. *Theory into Practice*, *41*(2). Pp.64-70.

Zimmerman, B.J. and Kitsantas, A. (2014). Comparing students' self-discipline and self-regulation measures and their prediction of academic achievement. *Contemporary Educational Psychology*, 39(2), pp.145-155.

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3b) Learning environment mediation analysis

4: Regression simple linear (Experimental group only)

4a) Relationship between students CT skills post-test scores and their perceptions motivation/self-regulation

4b) Relationship between students CT skills post-test scores and their perceptions of classroom Learning Environment

5: Regression multiple linear (Experimental group only)

(Value added approach for questionnaire subscale relationships)

5a) students post-test scores on CT skills test and relationship between their self-reported metacognitive self-regulation and extrinsic-intrinsic goal orientation factor

5b) students post-test scores on CT skills test and relationship between their self-reported metacognitive self-regulation and critical thinking factor

5c) students test gain scores on CT skills and relationship between their self-reported metacognitive self-regulation factor and classroom Learning Environment questionnaire

Appendix G: Qualitative part

1: Interview protocol and unstructured (field notes) protocol

2: Interview questions

3: Structured observation sheets

Appendix A Selected disciplinary definitions, debate on disagreement and major influences for the concept of critical thinking

2.1.1 Detailed discussion of interdisciplinary meaning and definitions of critical thinking

There are similar efforts to simplify the concept in the field of *education, psychology and philosophy* for the application of critical thinking. Some renowned scholarly definitions are discussed form these three fields in the following section.

Educationists such as Dewey (1933), Glaser (1941), and Krathwohl (2002), as well as institutions such as the Manchester Community College (MCC) general education initiative have led efforts to extend the provision of CT in the educational environment. Their definitions provide an instructional view of practising CT skills in teaching/learning situations. This is practical in terms of applicability and deconstructs the complexity of the CT for understanding.

Dewey, an American philosopher and educationist, worked in the early twentieth century to influence the education system and the way that the education process was being conceived. His work in 1910 *How We Think* was directed to teachers and its main assumption was that only reflective thought can improve learning. It would not be wrong to say that Dewey's definition introduced reflection and critical thought to education and formal education institutes. He provided an early definition of CT as

'(a)ctive, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends' (p. 118).

The concept of CT in educationist point of is of an active, engaging process of making judgements about beliefs or any form of knowledge.

CT is a personality trait practised by carefully scrutinizing the evidence, according to Glaser (1941), and is a threefold issue consisting of:

(a)n attitude of being disposed to consider in a thoughtful way the problems and subjects that come within the range of one's experiences, (2) knowledge of the methods of logical inquiry and reasoning, and (3) some skill in applying those methods. CT calls for a persistent effort to examine any belief or supposed form of knowledge in the light of the evidence that supports it and the further conclusions to which it tends. (pp. 5-6)

For Glaser, CT is thus an attitude that is practised when dealing with issues and problems, but logical knowledge supports this attitude rather than emotions and feelings. Glaser also asserted that CT requires persistent effort to examine beliefs and knowledge in the light of evidence. This view seems to portray a merging of psychological and dispositional aspects as functions of CT.

The list of actions and logical knowledge provided in the MCC general education initiatives define CT in its broadest application.

CT includes the ability to respond to material by distinguishing between facts and opinions or personal feelings, judgements and inferences, inductive and deductive arguments, and the objective and subjective. It also includes the ability to generate questions, construct, and recognize the structure of arguments, and adequately support arguments; define, analyse, and devise solutions for problems and issues; sort, organize, classify, correlate, and analyse materials and data; integrate information and see relationships; evaluate information, materials, and data by drawing inferences, arriving at reasonable and informed conclusions, applying understanding and knowledge to new and different problems, developing rational and reasonable interpretations, suspending beliefs and remaining open to new information, methods, cultural systems, values and beliefs and by assimilating information (n.d.).'

In my opinion, this definition includes dimensions and abilities such as distinguishing and using inductive and deductive logic, arguments, seeing relationships and arriving at reasonable conclusions. It can be seen as a concise elaboration of all three disciplinary approaches to CT, and compared to Dewey this definition is detailed about what is involved in the 'active, persistent, careful consideration' of beliefs as well as in the 'grounds that support it' and lead to further conclusions.

In addition, CT is a systematic and organized way of thinking to relate, classify and evaluate information. This organization then leads to informed decisions and judgement about them. This view is more of skills that are exercised from simple to complex. According to Anderson and Krathwohl's (2002) revised version of Bloom's taxonomy (Bloom et al., 1956) this view has a long history of use to promote high-order thinking skills in educational settings. The three levels of cognitive domain of the taxonomy define CT as skills of analysing, synthesizing and creating. These abilities or skills are considered part of CT skills in all disciplines and are especially considered high-order thinking skills in educational situations.

The domain of *psychology* offers some explanations. There are two main fields that discuss and present approaches to CT, the behaviourists' approach and the cognitivists' approach.

Behaviourists define CT skills in the form of the actions that a good critical thinker performs. Cognitivists, however, see CT as the mental processes involved in practising CT skills.

It can be argued that, in general, It is a representation of any new learned concept or problem solved, and these mental processes of CT are visible through people's cognitive processes, strategies and representations (Sternberg, the construct of CT in a way that breaks it down into concrete parts, so that it can be scientifically understood and studied as an object. According to Sternberg (1986),

it is '(t)he mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts' (p.3).

Human cognition has subcategories such as processes, strategies and representations to make the concept more real and imaginable for the reader. One could argue that perhaps the complex nature of the construct has thus been decomposed (in the chemical sense of being broken down into its simpler component elements) by Sternberg, though he did not go so far as to ignore the importance of evidence in reaching decisions. The use of representations might be supported by the use of audio-visual strategies, for instance of pictures, maps, writing, Venn diagrams, discussions or hands-on activities to learn new ideas, solve problems and make decisions.

Halpern (1998) simply defines cognitive skills as those mental skills necessary to increase the chances of achieving or reaching desirable outcomes: '(t)he use of those cognitive skills or strategies that increase the probability of a desirable outcome - in the long run, critical thinkers will have more desirable outcomes than "noncritical" thinkers (where "desirable" is defined by the individual, such as making good career choices or wise financial investments)' (p. 450). This definition is of a cognitivist's view of CT, and her point of view does not provide much detail on the construct and its composition or behavioural strategies or actions to visualize the mental processes. This is described in a more simplistic way of behaviour in Willingham (2007). He considers the importance of adaptability, openness of mind and logical approaches in CT: '(s)eeing both sides of an issue, being open to new evidence that disconfirms your ideas, reasoning dispassionately, demanding that claims be backed by evidence, deducing and inferring conclusions from available facts, solving problems, and so forth (p. 8).' Again, Willingham's point of view essentially matches the need for evidence and calls for making a judgement on issues supported by evidence.

In general, it is thus possible to assert that all definitions of CT offered in the field of psychology, whether by behaviourists or cognitivists, are in essence attempts to deconstruct the complexity of the construct, and to help in developing deeper and more meaningful interpretations of CT as a concept.

The philosophers looked at the concept as an essential human mind dimension that relies on principles of good thinking and mainly sees CT as a judgement and decision-making ability. Ennis (1985), a renowned American scholar in the field of philosophy, defined CT as '(r)eflective and reasonable thinking that is focused on deciding what to believe or do' (p.45). In this definition thinking with an end in mind is promoted when the thinker decides what he/she believes. Ultimately, the decision-making process can be about a belief or an action. This means that thinking should be focused and aligned in such a way (mental processes) to lead to deciding in believing and doing something. According to Bailin et al. (1999), it is '(T)hinking that is goal-directed and purposive, where the thinking itself meets standards of adequacy and accuracy' (p.287). These definitions encompass the same meaning related to thinking that is aimed at judgement, as if one has a goal to achieve or a conclusion to draw. It can also be asserted that adequate and accurate evidence can decide or judge what to believe or not (thinking aimed at forming a judgement).

CT is a purposive judgement that needs criteria or adequate evidence for example; Facione's (1990) definition is similar to Ennis and Bailin et al.'s, that CT is goal oriented/purposeful judgement. He defines CT as '(p)urposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, and inference, as well as explanation of evidential, conceptual, methodological, criteriological, or conceptual considerations upon which that judgement is based' (p.3). However, Facione enlisted the mental process as skills of thinking into elaborated actions such as analysis, evaluation, inference and explanation, that is the criteria on which judgement is based upon. CT is the active application of skills of thinking. According to Fisher and Scriven (1997), skilled, active interpretation and evaluation are the key concepts that denominate the nature of CT: '(CT) is the skilled and active interpretation and evaluation of observations and communications, information and argumentation' (p.21). It is likely that the active application will be based on certain observations and evaluations of situated information. In this regard, consideration of situation, places and the physical realities seems to be of important criteria for judgement.

Lipman (1988) adds the important aspect of context to the definition of CT: '(s)kilful, responsible thinking that facilitates good judgement because (1) it relies on upon criteria, (2) is self-correcting, and (3) is sensitive to context' (Lipman, 1988, p.39). CT is judgement that relies on criteria, but it is adjustable and considers the context. The main purpose of CT again seems to be to reach a good judgement about things and issues, and to be able make decisions in the most reasonable fashion possible so that they lead to good judgement.

All these definitions hint at the idea that CT as a concept has certain processing skills, criteria, characteristics related to context to lead people's thinking towards good judgement. These processes, criteria and contextual considerations are explained comprehensively in the Delphi Report (DR) (1990). This offers a detailed definition and description of the concept of CT, the critical thinker and the advantages of teaching CT skills which is worth quoting in full here:

We understand CT to be purposeful, self-regulatory judgement which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or contextual considerations upon which that judgement is based. CT is essential as a tool of inquiry. As such, CT is a liberating force in education and a powerful resource in one's personal and civic life. While not synonymous with good thinking, CT is a pervasive and self-rectifying human phenomenon. The ideal critical thinker is habitually inquisitive, well informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgements, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit. Thus, educating good critical thinkers means working towards this ideal. It combines developing CT skills with nurturing those dispositions which consistently yield useful insights and which are the basis of a rational and democratic society. (p.2)

This definition is important for its historical shift in educational goals towards the improvement of general education standards in America. It is a comprehensive collection of numerous dimensions and skills related to the concept of CT. This philosophical point of view seems to project an ideal of good thinking in which all relevant criteria and intellectual characteristics are considered before formulating a judgement about the issue of inquiry. For inquiry, one needs tools that are mentioned in this definition as CT skills of interpretation, analysis, evaluation and inference. The good point about DR is that it has academic/disciplinary consensus and takes into account both skills and dispositional aspects. It also presents CT as a self-directed, personal learning and refining one's thinking as the issue of inquiry and circumstances unfold themselves. It makes visible the three dimensional nature - logical, criteriological and pragmatic aspects of CT (Ennis, 1998).

According to Paul (1992),

'(d)isciplined, self-directed thinking that exemplifies the perfections of thinking appropriate to particular mode or domain of thought' (p.9).

Similar to other philosophical viewpoints, Paul also agrees with the idea of CT as disciplined, perfectionist thinking, appropriate to a particular mode or domain. The definition reflects on previous definitions with the added idea of perfectionism - which can be achieved by practice, so one can infer that CT is perfecting thinking, acquired by an individual developing and practising certain skills and dispositions. The education system should strive to promote these in individuals.

Although there are common meanings of CT, the philosophical view is of judgement and decision-making ability based on criteria and personal attributes. But this idea of CT still seems too idealistic, as it does not reflect upon the cognitive processes, individual and context-related practical issues of pursuing for the perfect thinking.

2.1.2 Debate on areas of agreement and disagreement among researchers on critical thinking

Although there seem to be general consensus among researchers on the core concept of CT (includes both skills and dispositions), still there is much that they do not agree on. Researchers have varying opinions on the issues of skills versus dispositions, on domain specificity, on transferability, and on criteria related to the concept and provision of CT.

There is confusion about whether it can be taught, researched without knowing that CT is comprised of skills and dispositions, or preferring one of the two different perspectives: where CT is thought of as an ideal, distinctive ability-emphasizing the development of an environment that might nourish it, or as an attainable academic goal, provided it is exercised in classroom with explicit objectives and tasks and careful design of learning environment.

Preferring CT as 'art' or 'inborn ability', that is, the dispositional and creativity perspective, argues that the characteristics and skills are not taught: they are natural, perhaps nurtured in individuals (Mathews and Lowe, 2011). However, they may be culturally biased (cf. Ennis, 1998) and contextually sensitive (Norris, 1985), so even if taught may not transfer to other situations and cultures (cf. Elder and Paul, 2007; Higher Education Academy, 2014). Therefore, if CT skills cannot be transferred, they may well not be taught. This point of view emphasizes building CT-enhancing environment, general courses and consideration of environmental factors (Mathews and Lowe, 2011). In some researchers' view, CT can hardly ever be taught and quantified due to the complex nature of the concept, as well as the variety of contextual and environmental variables involved (Mathews and Lowe, 2011; Willingham, 2007).

Preferring CT skills over CT traits perspective emphasizes that principles of good thinking are universal, and that dispositions of good character such as truth, honesty, trustworthiness and open mindedness have the same understanding in all cultures, albeit with understandable and delicate variance. Such variance does not mean that instruction is not possible, but that educationally the focus should be on cultivating the basic skills and adjusting to contextual situations from the beginning, progressing from simple to complex problems and scenarios. Therefore, it is completely possible to teach CT skills with instruction (Halpern, 2011; Ennis, 1998; Paul, 1992). CT is not a fixed ability such as intelligence (Higgins, 2015), therefore introducing CT skills is possible at most developmental levels, even at an early age (Lipman, 1991), and at any education level and subject (Abrami et al., 2008; Lewis and Smith, 1993).

Critics may argue that skills approach has oversimplified the process of learning CT skills, and that testing and quantifying/scoring the CT skills of students seems the purpose of teaching CT skills, rather than deploying the attributes of a critical thinker and a critical thinking environment. In my opinion, holding any one of these as entirely true would be not be beneficial to the very nature and definition of CT, as both components are important to cultivate. However, on one hand research evidence is stronger for skills and subject-specific approaches and on the other less convincing for developing dispositional aspects. This is perhaps due to the complexity of the metacognitive and uncontrollable environmental factors involved. Although some research evidence is present (e.g. Facione, 1990a,b; Giancarlo and Facione, 2001) claiming that dispositions of being open minded, fair and truth seeking can be taught to students and have positive association with reasoning skills, self-confidence and student achievement, as pointed out earlier, denying the importance of any of these components would distort the construct. CT comprises both skills and dispositions (Siegel, 1993;1999). Therefore, it might be challenging but CT instruction can be demonstrated, promoted and articulated in classrooms by teachers and thus taught to students (Mulnix, 2012).

Most researchers agree that the CT involves both skills and dispositions (Lai, 2011), but there is significant disagreement about the degree of importance of skills versus dispositions. Some think that critical thinking is founded in moral perspectives and values, therefore it is more important to nurture the dispositional aspects of CT in the educational environment (Martin, 1992). CT is seen as constructive thinking that is necessary value for pluralistic and democratic commitments (Thayer-Bacon, 2001) to be able to have connective criticism-engagement with the world (Alston, 2001). Mathews and Lowe (2011) stress the importance of identifying, discussing and overcoming environmental factors that inhibit the development of a generalizable disposition for critical thought or CT dispositions in a classroom, thus to 'lead to learning environments that support not only the development of CT skills, but also a disposition among students and potentially teachers to think critically' (Mathews and Lowe, 2011, p. 71). By contrast, other researchers, while they agree that dispositions are an important aspect, disagree on their exact role in the definition of CT. They tend to assert that dispositions can be an important aspect in improving or perfecting CT skills and abilities, but that it is unlikely that CT will no longer have a definition if dispositions are separated (APA, 1990; Facione, 1990).

Another area of disagreement to what extent CT skills are domain specific. Some researchers argue that CT skills can only be taught in the context of a specific domain (Lai, 2011); others that it would be unlikely that students could learn to transfer CT skills unless they are provided with sufficient opportunities to practise these skills, meaning that the teaching of CT should not be confined to a single domain (Ennis, 1992). Major arguments in favour of domain specificity come from Willingham (2007), Bailin (2002) and McPeck (1990), and most recently Huber and Kuncel (2015). They all argue that it is easier to learn to think critically within one specific domain, since issues such as what is considered as valid evidence, arguments and standards vary across domains. They also claim that the most useful thinking skills are domain specific (Lai, 2011). By looking at the issue of applicability, it can easily be argued that both conflicting opinions are suitable, depending on the outcomes of CT teaching. Nonetheless, the importance of this issue becomes evident when considering CT instruction. However, looking critically at the whole concept of CT as discussed in the section on definitions above, it seems that learnable CT consists of a whole set of skills which enables a person to improve their CT in general. This is why CT is regarded as a set of skills and dispositions.

My opinion, which informs the discussion in this study, is that once someone has learned these skills and acquires these dispositions, they are applicable to different situations, as human beings naturally tend to make connections with what has been learned previously. For this reason I disagree with the idea of CT as domain specific, because this would negate that dispositions are attached to being a critical thinker, such as those of being open minded and fair-minded. I agree with the issue of domain-specificity to the extent that a single domain might make the first step towards CT easier, including when teaching CT in educational institutions. However, domain-specific CT would limit the whole concept and distort the purpose of preparing students and equipping individuals with skills necessary for contemporary life and teaching, namely CT.

Ennis (1992), Halpern (2001), Lipman (1988) and Van Gelder (2005) provide evidence that CT is general in nature and has great potential when taught in general instruction, and call it paradoxical that CT skills and dispositions should be difficult to transfer to new contexts. Others who agree on both the general and specific elements of CT are Ennis (1989), Facione (1990, 2000) and Paul (1992), who argue that CT skills can be taught both by embedding them in a specific subject and in general CT courses (Lai, 2011).

Yet another area of disagreement among critics is the extent to which CT skills and abilities are transferable to a new context, similar to debate about domain specificity, and again evidence for both positions is available. Willingham (2007) and McPeck (1990), for example, conclude that students fail to transfer learned abilities and skills from one context to the other, therefore CT needs to be regarded as highly domain specific. The counterargument is that concluding CT to be completely domain specific is due to scepticism of students' abilities to transfer the skills from one domain to another (Ennis, 1989, 1992). Research on the issue of a transfer of CT skills certainly shows both successes and failures. Halpern (2001) reported the results of one study in which students successfully transferred the CT skills to an entirely new context several months later; Nickerson (1988), on the other hand, found the evidence of successful transfer to be mixed, and concluded that any transfer method depended on what is being taught and how it is being taught. There is much ambiguity about the degree of transfer in each case and the nearness or distance of domains - in other words, the transfer of CT skills from one domain to the other may depend on context, subject and situation, as well as on what was taught and how well (Bailin, 2002; Ennis, 1989).

The disagreement about the transferability of CT skills depends on the particular meaning assumed for the word 'transfer'. A transfer of learned skills to a similar context is more likely to occur than a transfer to an entirely new context and discipline, and the degree of transfer here also depends on the criteria set for measuring it. It is, however, an advantage to have some criteria for transparent evaluation of student learning and for measuring degrees of transfer from specific to general CT skills and vice versa.

The debate over criteria is mainly an argument between philosophers and psychologists - the philosophical perspective emphasizes the need to use criteria to make judgements or to support decisions, in the form of a standard, laws, norms or ideals. Paul (1992) suggests that criteria are explicit about the intellectual standards used for evaluating students work, and Bailin et al. (1999) and Case (2005) include criteria as one of the five points a student should consider for judging quality of thinking - to think critically. The psychologists, on the other hand, tend to ignore the issue of the qualities of a good thinker and standards, seeing thinking skills as problem solving, and focus more on student dispositions (Reed, 1998) than CT dispositions.

Halpern (1998) warns not to expect dramatic changes or improvements in CT, since this is a skill that develops over time as a result of instructional interventions. Additionally, Paul (1992) argues that traditional instruction does not encourage the development of higher-order thinking skills such as CT. Since for most of the time 'believing', not 'thinking', is considered 'knowing'. Paul (1992) asserts that 'knowledge' is conterminous with 'good thinking', and thus 'CT'. However, the typical school and classroom instruction is designed for content coverage, and one cannot measure the level of transfer and criteria in such a situation - one would need classrooms where teaching is approached with the belief that CT is for every student, and that students of every intellectual level can benefit from it (Kennedy, Fisher and Ennis, 1991; Lewis and Smith, 1993; Lai, 2011).

In the presence of such a wide range of literature and points of views on the educational affordance of critical thinking, it is essential to pick up on the thoughts and works that define the position of teaching/learning of CT skills for this study. The following section reflects on the main thinkers of the field, then the concept of CT is defined and narrowed down for the purpose of research.

Major influences

For this study, the CT concept and the working meaning and definitions are limited to those writers who have had a major influence on my understanding of CT skills and its potential use in teacher education environment in Pakistan.

John Dewey (1859-1952)

In the field of education, what it means to think is perhaps best described in Dewey's philosophy and writings on reflective thinking, learning, school and life, democracy and education. Dewey is acknowledged as a key originator of the concept of reflection in education. Dewey's influence was taken from Plato, Aristotle, Confucius, Lao Tzu, Solomon and Buddha for his conception of reflective thought (Hatton and Smith, 1995). In his writing he discusses more of Bacon's and Locke's work to define belief and addresses the key issues of how we think, how we learn and the experience of learning in his writings. For example the most overt writing about the difference between idle and reflective thinking and thought is in John Dewey's *How We Think,* first published in 1910. Dewey explains the single consistent meaning of thought and thinking. According to Dewey (1910), there are three types of thought that the human mind comes across. First, every single thing that comes to our mind or 'goes through our heads' is a thought and we need only to be conscious of it. Second, the terms thought and thinking comprise things that we do not directly experience with our basic senses of smell, hear, see or taste. The third type of thought is beliefs that rely on some kind of proof or testimony. This third type of thought is, in some cases accepted with little proof, and in other cases proof or testimony is consciously sought. The conscious effort adequately to support a belief that is being examined is called the process of reflective thought (Dewey, 1910).

Reflective thought is a consecutive chain of thoughts, coherent, hanging together on a continuous thread and purposely employed to form a conclusion. Reflective thinking, contrary to imaginative thinking (looking at clouds and finding a human face or other pictures or producing stories), aims at knowledge, at beliefs about facts and truth that are grounded in evidence. For example, Newton had a thought pass by his mind when the apple dropped from the tree. This thought could have been ended just there, but Newton considered to reflect on it and therefore came up with a conclusion or a theory. The discovery or development of gravity laws was hence initiated by the careful consideration of a thought. Now imagine how many times people may have had the thought but did not reflect on it before Newton did. This can be seen as a classic example of reflective thinking. In other words thinking, at its best, considers the basis or and consequences of beliefs; a conscious inquiry into the nature, conditions and its relevance to the conclusion (Dewey, 1910).

In this way, the purpose of reflective thought is pursuing evidence, being sceptical of what seem most certain, looking into the basis for belief, even if the conclusions at which one arrives finally turn out to be wrong. Reflective thinking is a trait as well as a process, described in Dewey's own words as '(a)ctive, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and the further conclusions to which it tends' (Dewey, 1910, p. 6). Reflective thinking or CT, also known as logical thinking or disciplined thinking, has many forms and dimensions attached to it.

Robert H. Ennis (1927–)

Robert Ennis is known for his efforts to infuse CT in instruction. It can rightly be said that his contributions moulded the emerging CT field in the late twentieth century and contributed in building basic knowledge (definition, meaning), clarifying ambiguities and established systems of the field; for instance, curriculum and assessment of CT skills. His works were influenced by Dewey in his conception of CT as a reflective, decision-making process.

Ennis was one of the leading contributors who widely wrote on the topic of CT conceptualizing, assessing and teaching critical thinking. He participated in many projects (e.g. career Illinois Critical Thinking Project), prepared tests for CT assessments (e.g. Cornell CT test), authored books (*Critical Thinking*, 1995) and published many research articles on the topic over a fifty-year academic career. His works appeared in various reviews for CT, its relevance to education, curriculum design and assessment in college education.

His main influences are on the areas of CT definition and its transferability. His earliest works (e.g. Ennis, 1962, 1993, 1996) clarify the conception of CT as a reasonable, reflective thinking that is interdependent on many elements of thought and habits of mind. He considered CT to have three dimensions: logical (judging the relationship between the meaning and statements); criterion (knowledge of the criteria/standard of judging); and pragmatic (impression of the background purpose on judgement). He enlisted 12 aspects of CT (Ennis, 1963), and later elaborated on its conceptualization as abilities and dispositions, including assessment and guidance on development of CT (Ennis, 1993a,b). The three-dimensional aspect of CT can be used for introducing and compelling teaching and learning of CT in mainstream higher education in a compartmentalized yet integrated view of CT that could be inculcated in every discipline.

One of Ennis's many major contributions to the field of CT is the introduction of critical thinking across the curriculum (Ennis, 2011) by using four approaches to integrate that are explicit, implicit, infusion and embedded. In my opinion, this provided the researchers with a range of options in research design and pedagogies to experiment with their respective curricula and context to teach CT. Theoretically speaking, Ennis influenced the selection of taught aspect of CT skills and helped in clarifying the role of tendencies/dispositions of critical thinking.

CT curriculum and its assessment, CT and the relationship of context/culture were understood by merging both skills/abilities and dispositions of a critical thinker. For example, a general opinion drawn on the basis of some small studies is that Asian cultures are biased towards CT because it is a Western idea. Such premises/conclusions should be drawn with care. The critical thinker must respect this position; accounting for all the evidence and reasons presented, but also present reasons for the premise not being true; for instance, Asian learning environments, curricula, and teachers' and students' awareness of constructive pedagogies in classrooms, and the time it took for Western cultures to introduce CT in their respective societies, and so on. In this way, not only is presenting one's argument using CT skills important, but being mindful of personal biases and applying critical thinking dispositions, even when acknowledging fallacies in our own thinking (Ennis, 1998).

Peter A. Facione (1944-)

Another major influence on the conceptualization of CT was Peter A. Facione. His work dated back in late 1980s. His quest was to demonstrate empirically that there can be a consensus on the meaning and understanding of CT, on its core cognitive skills and centrally important dispositions. He coined terms such as elements of thought/thinking to describe core CT skills, and habits of mind to describe the basic dispositions necessary for the cultivation of critical thinking.

Facione took forward the taught/learnable thinking skills and dispositions conception initiated by Robert Ennis. Facione undertook the first empirical study in 1990 to reach a consensus on the working definition of CT for post-16 education. The famous DR on expert consensus on the conceptualization of CT brought a wider understanding to the concept. It also affected liberal education and especially the inclusion of critical thinking in mainstream education curricula in the USA and elsewhere (Facione, 2013). In his influential essay 'Critical Thinking: What It Is and Why It Counts', Facione (2013) also proposed the use of terms such as 'strong critical thinker' vs 'weak critical thinker' when referring to individuals who show good or weak CT. This way he suggested we can reduce the ambiguity around the term critical thinker and the vagueness of what a critical thinker does, by actually listing specific actions and characteristics to support the use of these terms.

The empirical provision of CT in education and the work on testing and measurement of CT skills and dispositions was undoubtedly advanced by Facione. In his article 'the disposition towards critical thinking: its character, measurement, and relationship to thinking skills (Facione, 2000)' examines the relationships between 'consistent internal motivation' and the use of CT skills. Although not all co-relations are evident, strategies for cultivation of good CT dispositions/character are part of effective teaching and this may bring positive results rather than only relying exclusively on cognitive skills (Facione, 2000, p. 61). From the listing of core CT skills and dispositions of a strong critical thinker by Facione and Ennis, the elements of CT and the most educationally relevant habits of mind were selected.

Conclusion

The rigid view of thinking is that it is only for procedural knowledge or relational knowledge. Systematic inquiry with an increased awareness of caring for knowledge and communicating for understanding is what leads to production of trustworthy knowledge. Thayer-Bacon (1993, 1998) presented an alternative approach to CT, in which reflective thinking encompasses the sense of believing as well as of doubting. When one researches a problem, one also suggests possible solutions. The act of inquiry or hypothesis testing involves looking for a potential solution, and after testing one comes to know if it fits or otherwise needs more inquiry. This rather is a fluid concept of knowledge where knowledge is not fixed and has a growing quality (Thayer-Bacon, 1993). Thayer-Bacon viewed CT as constructive thinking and taking a caring and understanding approach in order to gain trustworthy knowledge.

My conceptual understanding of the social-contextual, classroom-curriculum and assessment-criterion aspects related to CT skills was deduced initially from Robert Ennis and Peter Facione and later extended through study of Pintrich (2000), Lipman (2003), Halpern (1997) and Anderson and Krathwohl (2001). Ennis (1993;1998), Facione (2011) and Pauls'(1992) work helped set a path for the definition of CT and its characteristics, and the issues of how to include it in the curriculum (mixed approach) and assessment in an educational setting and therefore to be appropriate for researching teacher education programmes. Implicitly, all definitions point towards a learning environment that nurtures critical thinking. However, further examination of CT skills instruction, implementation and assessment is needed to unravel the mysteries involved in putting this into practice.

Appendix B Intervention design and development

The rationale behind the intervention is the belief that an intervention should not be something ‘off the shelf’ but, on the contrary, based on strong theories about the learning of CT skills and evidence-based practice. In order to ascertain whether an instruction based on theoretical underpinning and research literature, using both explicit instruction of CT skills and instruction embedded in the curriculum, can develop students’ CT skills, designing a tailored intervention seemed the right choice. Therefore, the design of intervention was based on principles derived from the research literature. The details of these principles were outlined in the discussion of the conceptual framework of the study (section 4.2). Figure 1, a blueprint of the intervention design, shows the thought processes on how, step by step from the literature review to conceptual framework, the design of the intervention was achieved. The following section discusses the landscape of CT skills intervention, instructional design, assessment, and the reasons behind these. In particular, it focusses on what lead into determining the ‘must have’ parts of the intervention and the selection of appropriate materials for it (i.e. conceptual framework design criteria).

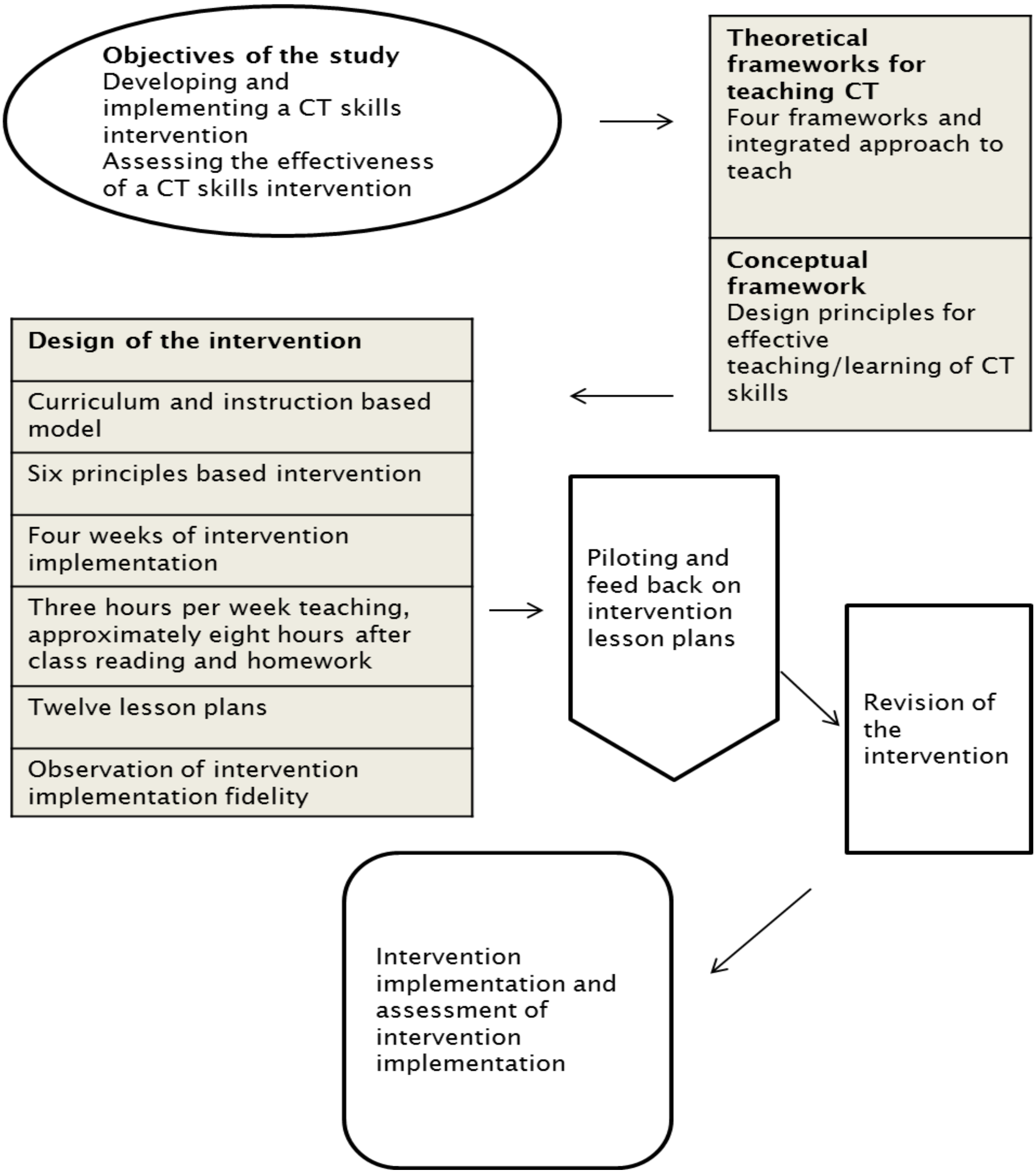

Figure B1: Blueprint of the intervention design.

Description of instructional intervention materials

This research study acknowledges that in educational research, and especially in pedagogic research in CT skills, theory and practice should be tied together. Keeping the challenges of the task and limitations of the context in mind, outlines for lesson plans were developed. The lesson plans were divided into weekly lessons with focus on one or another strategy for developing CT skills. The first two design principles - subject-specific and mixed approach to teach CT - are woven into the theoretical framework of the intervention design. A third design principle is studied as confounding variables in this study, therefore here only principles related to actual teaching/learning of CT skills in the classroom will be mentioned in the description of lesson plans. It is important to remember that the goal of developing CT skills is an iterative, time-consuming process. There are many overlaps and similarities among the frameworks and mental processes involved in learning this skill. As a result drawing a hard line between activities, lesson plans, and their theoretical underpinnings is impossible. This study has attempted to align the lessons according to the frameworks and design principle criteria with the expectation that a carefully designed intervention may increase students' CT skills.

Part one: general approach (explicit teaching of CT)

In the general approach the lesson plans are designed with the objective of teaching CT principles and rules in a direct and explicit way. The duration of lessons in this section was shorter, mainly focused on teaching, instruction and practice of basic CT skills using various materials such as videos, handouts and small group practice in selected CT subskills, namely (1) analysis of elements of an argument, (2) evaluation of argument and (3) extension/inference of an argument. The core purpose of lessons in part one was to make students explicitly aware about the elements of thinking critically.

The total time for teaching of general CT was six (6) hours: one hour a day three times a week. The students were introduced to the CT course video series developed and made freely available by Dwyer (2010), a course originally designed as an e-learning course focused on teaching CT subskills of argument building for adults. These course videos were selected because they firstly cover the selected area of CT skills, and are secondly relevant to the general approach to teach CT. The study expected that the students and class teacher would be able to use this course as an overt way of teaching CT skills. The following section briefly explains the lesson plans and what was taught to students in each of the lessons and affirms what design principles were present in the lesson plans.

Lesson Plan 1: Introduction to CT and dispositions

The first lesson was concerned with making students familiar with the concept, sub-skills and dispositions involved in CT. The students were shown a video from Dwyer's CT course for ten to fifteen minutes in the class. Later, the students were divided into pairs or in some cases into small groups to discuss what they just experienced. The first lesson introduced students to what it is meant by thinking carefully and logically. This lesson involved day-to-day examples that enable students to know and understand that individuals cannot avoid thinking and must acquaint themselves with the art and skill of thinking.

Lesson Plan 2: Analysis and evaluation

The set of videos was about the subskills included in thinking. In Dwyer's CT course the analysis and evaluation of arguments are discussed simultaneously. While analysing a piece of writing individuals usually read and analyse what is said and being communicated in every sentence. At the same time they also process the good, bad, strong, weak, acceptable, and non-acceptable kind of judgements about the pieces of information. The purpose of this lesson was to enhance the concrete understanding of parts of argumentation skills, to provide guidelines to students with examples of analytical skills and how they should use these both in general and while building argument maps in particular. This video session had an example of text about capital punishment and later an evaluation exercise for the analysis of argument skills. A second part of the analysis and evaluation of arguments lesson involved the extension of the previous lesson. It required students to recognise various types of argument, distinguishing as best as they could whether arguments were relevant and logically connected, and looking for ambiguities, omissions and imbalances.

Lesson Plan 3: Inference/extension

This set of videos dealt with teaching students the difference between inference and evaluation as well as syllogism, a conclusion that is drawn from two given or supposed propositions (premises) where a common or central term is present in the two premises but not in the conclusion, which may be unsound (e.g. *all dogs are animals; all dogs have four legs; therefore all animals have four legs*). However, it can also be a valid way of extending an argument, by grouping similar arguments in one place and deriving intermediate conclusions the writer wants the reader to draw.

Lesson Plan 4: Building arguments

This lesson plan included providing students with printed worksheets similar to the interface of the argument mapping software. The students were expected to practise their argument building skills using these worksheets, hoping that they would practise writing good arguments. The students were provided with online resource links to materials. They were encouraged to practise as much as possible to identify, distinguish and infer from various sources of information, e.g. television, talk shows, newspapers and academic writings, and eventually drawing their own argument maps on any selected positions that interest them. Different propositions from the course outline were given which they could use to start with.

Lesson Plan 5: Training to use argument mapping software

The last lesson in the first part of explicit teaching of thinking critically was training in using the argument mapping software selected for this study. The name of the software selected is *Argumentative*. Despite the flexible interface, ease of understanding and ready-to-use argument mapping templates provided by alternative software called *Rationale*, using *Rationale* was not possible, software being costly. Therefore, the freely available software *Argumentative* was selected, which, although it does not provide the same sophistication as *Rationale*, served the purpose of teaching students to use structured boxes, lines and labelling to produce argument maps. The study expected that this would provide students with the minimum of skills necessary to start learning CT in a context where it never existed.

Part Two: Embedded approach (mixed teaching of CT)

In this section the focus of the lessons was to provide students with practice in thought and thinking so that both work in harmony and coherence. To become a critical thinker in thought and thinking means holding information and a point of view on a certain topic or issue, and discussing it with others or pondering it by oneself while applying the principles of how to think consciously. Such was the intention of this section. Two types of main teaching strategies were being used in these lesson plans, the Community of inquiry framework and Halpern's four questions framework for regulating thinking processes. In each lesson plan, there was a discussion section and a practice section.

As per the mixed approach, the second part of instruction contained practice into thinking critically embedded in deep subject matter. The lessons here were longer in duration and utilised the visual representation tools to help students lessen the cognitive load, helping them to think clearly and construct arguments in software designed to facilitate building arguments. Each lesson lasted for two hours in this phase: one hour on theory-based learning strategies (discussions, debates, using evidence to support point of views) and classroom learning tasks, and a second half with thirty (30) minutes of collaborative tasks and 30 minutes of individual tasks for producing argument maps on the same or related topics. This required students to apply the principles of CT skills they had learned infused in subject matter. For the purpose of preparing the second section of the intervention, the curriculum of the subject Educational Psychology was used. A problem that occurred was that the course outline itself is comprised of content topics that covered very basic, factual knowledge about educational psychology (see the course outline attached as Appendix F). It became very challenging to convert factual and rather basic content into a CT skills curriculum, not to mention that any curricular changes made by the researcher might be an issue with the current university authorities.

Therefore, after considerable thought and scrutiny of the course outline, the researcher could not find any other way but expanding the horizon of the course topics, but in a general way. For example, on the topic of hence keeping them inside the recommended curriculum, for example articles related to developmental stages of Piaget were found and given to students for critical analysis of Piaget's theory to go beyond describing the stages.

It should be noted that this difficulty perfectly mirrors the concerns of all who care about CT and quality of teacher education - the lack of potential in curriculum for CT across the disciplines is for example addressed by Ennis (2013) and Chaffee (1992), who both point out that a curriculum without depth can be a hurdle for teaching CT to students, and that therefore first of all revisiting and revising the curriculum is necessary before infusing CT in it. Taking this stance and planning a curriculum change in the current subject would, however, be a completely dimension of educational research and far out of the scope of this study. Similar to other curriculums taught in teacher education programs in Pakistan, the curriculum of the subject Educational Psychology covers only topics related to learning theories and history of psychology. Such a range of topics do not provide extended knowledge, the application of psychology in education, or other modern developments in the field, and therefore there is not much depth to the curriculum content.

For this reason deciding the topics to practice deep learning was also a challenge in this research. The field of educational psychology was examined, and it was attempted to combine the present course outline with some modern development and selected topics that would help in extending the horizon of the educational psychology course in a master's program while remaining within defined areas of the present curriculum. The selected topics relate directly to actual course units, however the lessons presented these topics in a broader, deeper way, teaching critical thought and argument building skills. This study advocates that such intervention study is a first step to test whether the proposed framework for teaching CT skills to students is sufficient and is befitting the curriculum of educational psychology. Its results thus bear important implications for CT educational research.

Lesson Plan 6: Learning theories, psychology, schools of thought and education

The above topic was part of Unit 4 and 5 of the course outline, which included behavioural, cognitive and humanistic learning approaches to teaching. The students were asked to study the topics beforehand. In the class they were provided with excerpts from related texts and were encouraged to inquire into the topic under discussion in a CoI manner. The purpose of this lesson was to enable students to learn how to use information to shape a line of thought and discuss various points of views and develop a personal position based on evidence.

The students learned this in a collaborative environment where each member did not only support the other, but was responsible for their own input in the form of reflection on the topic for the better understanding of the topic under discussion. Once the students had reached the goal of what was asked of them in this lesson, they were directed to the practice session. In the practice session they developed their position further in the form argument maps, using the argument building software. The students were initially asked to think about one reason to support the claim and one reason to object. They added at least one form of evidence for the supporting reasons they gave or objections they found.

Lesson Plan 7: Culture, gender and ability affecting teaching/learning

Mainly units 5 and 6 of the current course were relevant to this topic - the sub topics covered in this section are related to factors that affect learning. The students were asked to study the topics beforehand. In the class, they were provided with excerpts from related texts and were guided to pursue and inquire into the topic under discussion in a CoI discussion form. The purpose of this lesson was how to be open minded and think critically of the effects that culture may have on learning, behaviour, gender and abilities/disabilities, as well as how these factors contribute to individual learning. The students learned this in a collaborative environment where each member did not only support the other, but was required to bring his/her own reflection on the topic for the better understanding of the topic under discussion. Once the students had achieved the objectives of the lesson, they moved on to the practice session. Using the argument building software, in the practice session, they were asked to develop their position on certain premises (provided in the formal lesson plans); they were allowed to choose any premises they liked, but had initially to think about one reason to support their claim and one reason to object. In addition, they had to add at least one form of evidence for the supporting reasons they gave or objections they found.

Lesson Plan 8: Moral development, society and religion

This lesson plan covered Unit 4 of the course, on cognitive and moral development. The theories of Piaget, Kohlberg and Vygotsky were taught to the students. This lesson was again conducted in the same way as the previous two lessons: the student discussed the issue with reference to a given piece of text in the class. They discussed the meaning of morals and how they develop in individuals in a collaborative environment. This brought about an interesting discussion and raised different points of view among students. After this they were guided once again to practice argument building with the help of the software. This time they chose from a varied list of propositions and developed their own arguments. At this stage they were expected to supply more than one supporting reason and objection for a certain premise.

Lesson Plan 9 to Lesson Plan 12: Practice of what has been learned

The third part of the intervention basically consists of more practice; here the students would go through their daily lessons and the class teacher would give them the task to prepare an argument map on a given topic. For this the investigator needed to be present and consult with the teacher about the course units they were planning on teaching next. The teacher would be asked to teach these units in the same manner as in Lessons 6-8 detailed above, the only difference being that the students would independently develop their own premises out of a given text or reading to include in their argument maps. The teacher checked the work of the students and evaluated the quality of the work based on the criteria of strong and weak arguments as discussed by Dwyer (2010), Ennis (1998), and Paul (1999).

Table B1: Intervention lesson plans pre-implementation

Week	Theme/topic of the week	Number of lesson plans	Duration	Design Principle
Week One	*Critical thinking video course*	1+1+1	60 minutes each= 3 hours and roughly two hours home work	Audio-video lessons (ii) mixed approach (Explicit teaching of CT) (iv)collaboration and group work (v) formative Feed-back
Day 1	Lesson Plan 1: Introduction to CT and dispositions	1	15+15minutes of video lesson and 30 minutes class activities	
Day 2	Lesson Plan 2: Analysis and evaluation	1	15+15minutes of video lesson and 30 minutes class activities	
Day 3	Lesson Plan 2: Analysis and evaluation Lesson Plan 3: Inference/ extension	1	15+15 minutes of video lesson and 30 minutes class activities	
Week Two	*Curriculum embedded practice Col discussions and concept maps*	1+1+1	60 minutes each= 3 hours + roughly two hours home work	(i) subject specific (ii) mixed approach (iv) collaboration and group work (v) formative Feed-back (vi) visual Representation
Day 1	Lesson Plan 4: Building arguments	1		
Day 2	Lesson Plan 5: Training to use argument mapping software	1		
Day 3	Lesson Plan 6: Training to use argument mapping software	1		

Table B2: Intervention lesson plans pre-implementation

Week	Theme/topic of the week	Number of lesson plans	Duration	Design Principle
Week Three	*Argument mapping curriculum embedded practice* and activities	1+1+1	60 minutes each= 3 hours + roughly two hours home work	(i) subject specific (ii) mixed approach Course outline topic lessons (iv) collaboration and group work (v) formative Feedback (vi) visual Representation
Day 1	Topic Lesson Plan 7: Learning theories, psychology, schools of thought and education	1		
Day 2	Topic Lesson Plan 8: Culture, gender and ability affecting teaching/ learning	1		
Day 3	Topic Lesson Plan 9: Moral development, society and religion	1		

Week	Theme/topic of the week	Number of lesson plans	Duration	Design Principle
Week Four	Argument mapping and curriculum embedded practice	1+1+1	60 minutes each= 3 hours + roughly two hours home work	(i) subject specific (ii) mixed approach (iv) collaboration and group work (v) formative Feedback (vi) visual Representation
Day 1	Topic: Observation method and Experimental method in Psychology	1	30 minutes discussion 30 minutes argument mapping in each lesson	
Day 2	Topic: Structuralism, Functionalism, Behaviourism	1		
Day 3	Topic: Classical conditioning Operant conditioning	1		
Total	Four weeks	12 lesson plans	12 hours of teaching/ learning adding 8 hours homework total 20 hours of practice	All six principles covered

Fidelity of implementation for CT skills instructional intervention

Educational research that is detached from practice may not account for the influence of the emerging and complex nature of context and outcomes, and may not contribute in the completeness of knowledge about factors that are relevant for prediction (Robinson, 1998). Pedagogic research from diverse contexts is important to complete knowledge about phenomena and factors that interact within them. One way of studying such interactions is by applying specific interventions in educational settings with a certain rationale behind them. Interventions are an interaction between materials, teachers and learners, and therefore claiming success of educational interventions is a complicated business. If success means being certain that an intervention caused learning, then we need to look carefully at the intervention in a particular setting (DBRC, 2003). The findings may not be generalized, but studying them closely in a particular context may be helpful in understanding a similar context and will also help in understanding the how, why and where an intervention works.

Intervention fidelity is an important aspect to be considered while designing and conducting rigorous intervention studies. It helps to increase the external and internal validity of the research undertaken. The instructional intervention for CT in this study is integrated into the curriculum design. A study programme was prepared for CT skills and educational psychology, and the instructional programme was then handed over to the class teacher for delivery. To answer the question as to what extent the intervention was effective or ineffective, it is important to observe how it was implemented or delivered. Research literature on the efficacy or effectiveness of studies has noted that fidelity of intervention is likely to be related with research outcomes (NRC 2004; US Department of Education, 2003). The fidelity of implementation can be a moderator for curriculum effectiveness as well (O'Donnell, Lynch, Lastica, and Merchlinsky, 2007). Most of the work on fidelity of implementation is available from the field of health sciences, and the concept is relatively new for intervention research in general. However, the history of programme evaluation as such goes back three decades (O'Donnell 2008; for a rigorous review of the subject and its literature see O'Donnell, 2007).

The concept of fidelity of intervention is broad and has been well-researched in the field of health sciences, where it is possible to find a number of definitions and measures of fidelity implementation across studies; a number of reviewers suggest defining and establishing a definition of fidelity and criteria prior to measuring fidelity (O'Donnell, 2008). The research literature conceptualizes that fidelity of implementation is important for both efficacy and effectiveness studies, and stresses that there are both overlaps and differences between the term fidelity of implementation and other educational constructs such as curriculum evaluation, curriculum potential, teaching, and adaptation. The fidelity of implementation in curriculum interventions can be this defined as 'the extent to which the project was implemented as proposed' (Loucks, 1983, p.5) and '[t]he extent to which teachers enact innovations in ways that either follow designers' intentions or replicate practices developed elsewhere,' or 'the extent to which the user's current practice matched the developer's "ideal"' (Loucks, 1983, p.4).

Intervention fidelity is close to the construct of intervention integrity as well. Intervention integrity data determines whether a programme was ineffective because it was weak, poorly conceptualised/designed or poorly implemented, if for example the main elements were not implemented as intended (Leff, Hoffman and Gullan, 2009). Thus, systematically monitoring the integrity/fidelity with which interventions are implemented, especially in interventions for teaching complex constructs provides insights into what does not lead to positive effects (Leff, Hofmann and Gullan, 2009). The meaning of fidelity of intervention in this research study is close to that of instructional quality (how the elements of instructional plan are implemented) and received by the teacher from a teaching perspective (the amount of change that occurred in the teacher's practice and student learning after the CT intervention) (O'Donnell, 2008).

In addition, it is argued that the statistical power of a study depends on reliable and valid measures, appropriate design and sampling, and careful assessment of fidelity that decreases as research moves from laboratory toward the field (O'Donnell, 2008). This becomes important when a researcher needs to establish whether poor outcomes are due to structure, complexity, dynamics of the programme, and lack of implementation or misaligned designed intervention with programme theory (Rog, 2012; Summerfelt, 2003).

Implementation fidelity protocol

Vignette-based measures such as classroom observations, surveys and logs are useful for reform-oriented instruction aspects not captured by other methods (Desimone, 2009). The journal notes will be detailed descriptions of each lesson including sketches of the classroom setting, lists of resources, the delivery of the lesson plan, and teacher-student interactions. A description of the overall social, emotional and physical atmosphere of the classroom will also be noted down. The researcher familiarised herself with the participants' pre-intervention to avoid any pressures of a stranger in the class. However, the time an investigator spends with the participants can result in two forms of effect: the participants can start to behave unnaturally both due to an unfamiliarity and to an overfamiliarity with the researcher, resulting in either enthusiastic performance on the one hand, or making no efforts to learn and getting bored on the other. For this study, the researcher intends to keep her interactions neutral when in the class - she will be in the class before the class start time and will leave quietly using the back door. The researcher will also make clear in the introduction the procedures expected and will try to make the participants comfortable with their interaction with the intervention. The duration of the intervention is four weeks consisting of two classes per week for teaching CT. This will involve a total of eighteen hours contact with the students. Due to this limited contact time, there are fewer chances that the participants may become either less motivated or overly enthusiastic.

There can be issues related to researcher’s bias, or disturbing the natural setting. Opting not to react or interfere even when needed is a choice that is made by researchers to eliminate researcher’s bias. Researcher's bias cannot be eliminated entirely since the objectives of qualitative inquiry are to observe the delivery of the instructional intervention, and therefore teacher-students interactions, teacher’s preparation and task delivery, students responsiveness, resources, learning materials and their use will be all need to be observed.

To eliminate or lessen the amount of possible bias the journal notes and observation sheet record will be cross-examined with interviews and quantitative results. The researcher will also record her own emotional, professional stance while observing the lessons. Taking into account the implementation phase is part of understanding the results/study outcome; for this study to assess the quality of delivery and implementation of the instructional programme the intervention fidelity was measured in the form of both quantitative and qualitative observations. The observation themes were determined by the nature of the study; for example it was necessary to understand how the instructional intervention was received both by the teacher and the students in a natural setting, observing how well the intervention is being implemented, and what factors related to teachers and learning environment might be influencing the effectiveness of the intervention. Following O’Donnell (2008), the intervention implementation fidelity was observed in five different aspects, namely adherence, duration, quality of delivery, participants’ responsiveness, and programme differentiation. The consideration of these aspects was included to increase confidence in findings and the internal validity of the effectiveness study (Dumas, Lynch, Laughlin, Smith, and Prinz, 2001). Implementation fidelity is an important aspect of intervention-based research. It can considerably inform how and to what extent research plan and instructional programme were employed, as well as on factors at play that hinder or support the implementation of the intended programme. The investigator can use as many methods as they think are appropriate for determining the intervention fidelity. In this section the fidelity measures adopted and their fitness to research design will be discussed. The five elements of fidelity that were observed in this study are

- Adherence
- Exposure/duration
- Quality of delivery
- Programme specificity
- Student engagement

Ways to measure fidelity

Various tools can be used for the purpose of measuring fidelity, and the relevant literature does not prescribe one or another way to measure fidelity. This study uses:

- Self-report data (interviews)
- Observation (observation sheet)
- Logs, lesson plans, and student work (from the classroom)

Table B3 shows how the fidelity of implementation will be embedded in intervention implementation during data collection phase.

Table B3: Fidelity implementation protocol

What will be observed?	How will be observed?	When will be observed?
Fidelity of implementation (adherence, exposure, quality of delivery, programme specification, student responsiveness)	Classroom observation	Alternate days, once a week
Delivery of lesson plan Teacher–student and learning material interaction	Journal notes/log book	Every day for each lesson
Researcher's presence in class and outside class	Journal notes/logbook	Every day for each lesson

Intervention implementation strategies to enhance fidelity

To ensure smooth implementation of the intervention the following steps were be taken as strategies to ensure timely implementation of the study.

Prior meetings with the teacher

Prior consultation with the class teacher took place at least one week before the intervention implementation. The teacher was familiarised with the content of the interventions. A short training in teaching methods was provided to the teacher along with reading materials to help them understand the objectives of the study and purpose of the instructional intervention. This interaction also informed the researcher about the 'regular' or 'traditional' way the teacher taught which helped to make realistic estimates of the gains from a carefully designed intervention. Incentives for the students

The participants of the experimental group learned strategies to extend their mental abilities. The students were not only able to cover their course materials during the time of intervention implementation, but were also awarded grade points equivalent to twenty percent of the coursework.

Incentives for the teacher

The teacher did not only cover the course outline, but the material used during the intervention would be able to be used for future reference and score students 20% of sessional work. The teacher would also have been able to improve their pedagogy skills, and student performance outcome might increase positively.

Researcher's place and role

The researcher was for most of the time a passive observer who made observations, took notes, and collaborated with the teacher where support and assistance was needed.

Making sure people stay

An active learning and lively environment of the classroom helped participants to remain involved. Likewise, encouragement, feedback, activities, a balanced of use of ICT and constructive teaching strategies and teacher-student interaction rooted in social constructivism also helped in keeping students' interest in the class. A student attendance register also helped to monitor class participation and engagement, though this was warranted as a daily attendance register, not forced by the researcher.

Recording intervention implementation

The researcher has ensured to record data and to observe objectively. Efforts for collecting maximum information on the variables included in the study were made. Observations of class collaboration, teacher–student interaction, and questions asked and answered were recorded along with demographic data, and student portfolios and specimens of homework and assignments were collected.

Intervention risk assessment and prevention strategies

There can be numerous issues in conducting experimental research in educational context, but the most frequently reported are the selection of participants, differences between group abilities and characteristics, the control group getting nothing in the form of instruction and new methods and just there serving the purpose of a control group, and the time duration in which experimental group will be exposed to the intervention ethics. In this section the potential risks related to human participants' during intervention implementation are discussed.

Risk of group's ability of CT

At what stage both groups are with respect to their CT ability before the treatment commences was determined through pre-test data, data on students' scores in their previous degree or exams, and other demographic information. Individual case matching and intact group matching can be used to reduce selection bias in quasi- experimental studies (Cook and Steiner, 2010).

Risk of deviating from the planned curriculum

During the intervention implementation phase there is always a risk of difference between the intended curriculum and the curriculum implemented in the classroom. Moreover, the experimental group and control group interactions on or off campus may also become an obstacle to accurate results on the effect of the intervention on the experimental group. With the help of the participant teachers and students the researcher will endeavour to lessen this risk of information exchange, for example by timetabling the control group classes on different days. There is also the risk that students are not interested in the teaching/learning process.

Risk of teacher's influence

Although the fact that the same teacher was teaching both the control and experimental groups lessened the teacher influence variance in both groups, there is always the threat that the teacher themselves might bring insights from the experimental group to the control group. To deal with this concern, an occasional observation to the control group was also conducted. On the other hand, with the same teacher for both groups the study also runs the risk of the teacher replicating the same teaching habits in the experimental class as in the control class, rather than the new approach.

Pre- existing teaching traditions

Defining what regular/traditional is in one context is important to design and experimental study. This clear differentiation between the established (regular/traditional) and the new helped to distinguish the effect of the treatment, for example in what ways the treatment was different from the business as usual teaching/learning. Only clarifying the existing circumstances can the researcher judge on the effects of a treatment. It is therefore important to know what happens usually in a typical classroom on the site of interest. In this particular case, the traditional lecture method with occasional discussions is used, and as part of course work students are asked to prepare assignments and presentations on topics from the course outline. Most classrooms in Pakistan, particularly in ITE institutions lack in systematic practice of thinking and asking higher order questions, discussion are unplanned and lack structure, and the classroom presentations are usually a way to lessen the teaching load for the teacher and an easy way out to fulfil the teacher's responsibilities and pedagogical skills training, asked to be provided to students by policy. Assessments are based on rote memorization of content and hand-outs are usually provided before the session or after the lecture has been delivered.

In the end, only careful observations in the field can made, since the intention is for the researcher to remain at a distance and not influence the implementation process. However, the researcher might intervene if she observes that after a considerable time, for example two weeks, the intervention does not go as planned, and there are numerous implementation flaws. This is called being apprehensive and prepared - in case, something does happen an alternative plan needs to be prepared. In this case the intention is to sit with the teacher and retrace the implementation program, and help with issues of for example team teaching or feedback to the students in order to bring the intervention implementation back on track.

Table B4: CT intervention risks assessment and prevention strategies.

Risks to intervention Implementation	Strategies to deal with or explain possible risks
Risk of groups ability on CT	Use of pre-test scores and matching cases
Risk of deviating from planned curriculum	Recording intervention implementation, prior meetings with the teacher, Incentives for the teacher
Risk of teacher's influence	Prior meetings with the teacher, sharing what is expected of the teacher
Risk of pre-existing teaching traditions	Observations of both control and experimental group teaching, observations of student responsiveness student interest
Researchers Presence	Gaining approval and familiarity, being aware of the influence

Intervention procedure and schedule

The intervention schedule can be seen in the table below (Figure 7). The lesson plans were distributed weekly, so that the table shows a weekly breakdown displaying the sequence of instruction. It also indicates which particular design principle each section of the intervention addressed. The intervention was scheduled to be implemented on the subject of Educational Psychology; the researcher introduced the purpose and objectives of the study to the teacher and both intervention and non-intervention groups. The level of participation required of them was explained briefly and the initial data on demographics and the pre-test for intervention and non-intervention groups was conducted. Then the intervention implementation phase started. For reasons of space in the table columns, in Figure: 10, each week's lesson plans are grouped together under the general theme according to the purpose of the lesson plans. The table also shows the planned duration and corresponding design principles of these lesson plans. Classroom observations were conducted by the researcher during the implementation phase, both in intervention and non-intervention group. The arrows and blocks on the right-hand side of the table indicate which data collection instruments were used and when the data were collected - for example, pre-test were collected during the first week; data on dispositions was collected in the middle of the second and third week. The post-test was conducted at the end of the fourth week and, in the following week, five qualitative interviews were conducted with participants of the intervention group.

Procedure of the CT skills intervention

The researcher met and greeted the participants and the teacher, briefed them about the purpose of the study, and introduced the concept of CT and the objectives of the current study. At the same time the researcher asked the participants and class teacher to fill in the consent forms, and collected the demographical information from the participants. After the participants had given their consent, the pre-test was conducted. CAPP-CT was administered as a CT measurement instrument at the beginning and at the end of the experiment to both control and experimental groups. Then the intervention, based on the four weekly instructional plans, was executed for experimental group. CT dispositions were measured during the start of third week of instruction. A post-test was conducted at the end of the fourth week of the study. Soon after the post-test, during the remaining week days of the fourth week and the start of the fifth week, the semi- structured interviews were conducted. As discussed in the dispositions section 3.1.1 for design principle iii CT dispositions of motivation and learning environment, the MSLQ and CoI were administered once only to the experimental group to see whether the selected student-related characteristics would have any influence on learning CT skills. The CoI was administered during the middle of the third week to analyse teaching presence, social presence and cognitive presence of students. To provide students with some benefits, course points were awarded to them, and after the evaluation the individual scores of improved CT ability were provided to teacher and students as a token of thanks.

Intervention schedule

Subject: Educational Psychology

Day one Introduction with participants and collection of demographics data

Week	Theme/topic of the week	Number of lesson plans	Duration	Design principle
One	Introduction to CT skills and argument mapping	1+1+1	60 minutes each= 3 hours + roughly two hours home work	Audio-video lessons (i)subject Specific, (ii)mixed Approach (iv)collaboration and group work (v)formative Feedback
Two	Argument mapping content practice and activities	1+1+1	60 minutes each= 3 hours + roughly two hours home work	Audio-video lessons (iv)collaboration and group work (v)formative Feedback (vi) visual Representation
Three	Curriculum embedded practice CoI discussions and concept maps	1+1+1	60 minutes each= 3 hours + roughly two hours home work	(ii)mixed Approach (iv)collaboration and group work (v)formative Feedback (vi) visual representation
Four	Argument mapping and curriculum embedded practice	1+1+1	60 minutes each= 3 hours + roughly two hours home work	(ii)mixed approach (iv)collaboration and group work (v)formative feedback (vi) visual representation
Total	Four weeks	12 lesson plans	12 hours of teaching/learning adding home work	All six principles covered

Pre-test CAAP-CT

Classroom observations (Principles of implementation fidelity)

Data on CT dispositions design principle (iii) MSLQ & CoI

Post-test CAAP-CT

Five interviews with students
Interview of class teacher

Figure B2: Intervention schedule

Appendix C Piloting the intervention and instruments

It is common practice to pre-test the procedure of a study in a replication of the original plan on a small number of people before it is used in earnest. This is called a pilot study. A pilot study was conducted- with a small number (30) online questionnaire and with seven (7) people, a focus group of students- to see the feasibility and appropriateness of the research plan. Three elements of intervention instruments were piloted 6.2-intervention lesson plan design and software testing, 6.3-Communities of Inquiry survey and 6.4 CAAP-critical thinking test.

The prime objective to pilot the study was to familiarize oneself with the feasibility, language difficulty of tests and instruments before using these in the actual study in a specific context (Pakistani university classroom). Equally important to these, piloting sample is similar to the target sample in order to further explore the validity of the instruments.

Sample of the Piloting phase

The main sampling technique for the piloting phase was convenience sampling. For selecting a sample to participate in focus groups, peers having higher education teaching experience were contacted through personal email and Facebook page invitations. A total eleven (11) people were contacted in the first place, out of which seven (7) people reached back, as a second step to finalize time and venue, a doodle poll was used to decide the most agreed day and time for the meeting. The respondents for questionnaires were from diverse backgrounds- mostly students from Pakistani teacher education university background and others from different nationalities, this provided one with a consistent sample for this study.

Comparatively, for the dissemination of questionnaires- that were converted into online surveys for convenient outreach-, a snowball sampling technique with a combination of convenience sampling technique was being adopted. Colleagues and peers in Pakistan teacher education universities and colleagues in universities in the UK were approached to spread the links of the online surveys to the, University of Southampton. Furthermore, social media Pakistani community pages were used to post the surveys, other students were contacted personally, to first fill the survey and later ask others to fill these out. The main reason to select convenience and snowball sampling was (a) specific characteristics of the participants (e.g. Pakistani adults studying at Pakistani universities) (b) the required number of responses i.e. at least thirty.

The feedback questions at the end of each survey, further, helped in estimating the level of difficulty of taking the test in English for the target population; the feedback from for participants in each of the pilot stage is discussed further down in this document. In addition to this, the focus group helped in establishing a feasibility assessment of the intervention plan hence leading to changes in the sequence of delivery of lessons, use of argument mapping software related issues and hurdles and co-ordination of research plan and activities in general. The selected instruments already had established validity and reliability and so were proven with the analysis done by the researcher of this study.

The following table describes the sample size and demographic characteristics of the sample for all tests. The sample of the study takes into account the gender, nationality, education level as demographic information.at the end of the table a total number of samples for each research instrument has been summarized.

Table C1: The sample size and demographic characteristics of the sample

Demographic Category	Critical Thinking test (Part 1)	Critical Thinking test (Part 2)	Communities of Inquiry (CoI)
Gender			
Female	17	20	10
Male	11	12	11
Nationality			
Asian(Pakistani)	18	22	11
African	1	1	1
American/Latin American	2	2	2
Middle Eastern	4	4	3
English	3	3	3
Grade level			
Undergraduate	6	4	6
Master	18	23	14
PhD	4	5	2

Total Sample size	28	32	21

In this study, test are being used in their original form considering that medium of instruction at postgraduate education is English in Pakistan. However, any actions to modify or convert words into similar easy to understand English will be taken when piloted. Based on the feedback, any needed modifications and improvements will be made in the intervention and measurement tools (e.g. CAAP-CT and CoI) observed during the piloting process.

Focus group results for intervention lesson plan design and software testing

Focus group for evaluating Intervention Lesson Plans (ILP)

1 session — October 10, 2014 2:00 pm-4:00pm

Facilitator: Shumaila Mahmood

Personally invited via telephone, email and in person

Total attendees: 5-7

Nature of attendees: A mix of local and international Postgraduate students-professionals and graduate, undergraduate students.

Administration of the focus group

A focus group was conducted with seven people of mixed nationalities (Pakistani and others), experiences and educational background to get qualitative feedback on the design of the study and software being used during the intervention for helping organising critical thinking skills among students.

The room was set for participants to sit in a group with each having access to a laptop.

All the participants had educational experience in the field of teaching, educational planning and use of technology for educational purposes. The researcher explained the design of the study and intervention plan of instruction, the participants were free to ask questions where they felt the need, an introductory lesson was shown to the participants.

The participants were then, given directions to use the software provided on laptops and exercise a task for twenty minutes using the specific software to practice learned critical thinking skills in one of the selected cognitive abilities (e.g. argument building) . All the participants were provided with a copy of the 'help manual' of the program and they were asked to read it before using the software. During the activity, the researcher observed the participants use of the software, addressed the problems and assisted in used of the software where needed.

Most of the participants managed to produce argument maps on given topics within the given time. As the last step of the focus group participation, the members were requested to provide feedback through an online feedback form. The feedback form was kept online to avoid any kind of reluctance on behalf of participants' when providing feedback.

Analysis and results

In order to analyse the focus group data, a coding and theming approach to content analysis was adopted. Total eight questions were asked from the participants' about the research study. The seven of the questions were on Likert scale and the eights question was related to providing open ended comments about the instructional intervention design.

The data for Likert scale questions- from feedback forms- was analysed by simply counting the maximum and minimum responses in favour or against the asked questions. Most of the respondents agreed on about the collective coherence of the study objectives and instructional plan was satisfactory. Maximum of the participants also agreed that the software and its display interface, boxes and arrow symbols, and help menu were supportive in organizing thinking, structuring arguments and building argument maps.

The last question on the feedback form was related to suggesting improvements related to the overall quality of lesson plans and any other suggestion the participants' consider important and relevant. The data from this question was subjective (text) with the specific aim of describing the phenomena, in this case, the opinions and suggestions of the participants about the design and content of an instructional intervention, therefore, of a directed content analysis approach was adopted. Directed content analysis is generally used to validate or extend conceptually a theory, research or focus of research question (Hsieh and Shannon 2005). The codes were defined both before the data collection with a specific focus and during the data analysis, further, the source of codes or key words in this data analysis has been derived from theory and relevant research in the field of critical thinking skills intervention studies (Hsieh and Shannon 2005; Krippendorff 1989; Humble 2009).

Text data were read and naturally appearing codes or key words were categorised into major and minor categories. The main codes were then merged with relevant sub-categories to extend their meanings for the purpose of these focus groups i.e. conceptually extending the design of instructional intervention. The following list of major themes was deducted from participants' feedback and underneath every major category the detail of participants'' provided feedback is discussed underneath.

Content

The participants raised issues about the content of critical thinking course, suggesting that use of culturally specific examples will be more effective to enable students to understand and apply critical thinking skills. Moreover, the lesson plans for the instructional intervention need to be more elaborative in terms of explaining the complex structure of argument while delivering the lessons.

Software technology and training

One major theme that appeared from the data were related to use of technology, need of prior training and specifically the time needed to learn use of the software i.e. prior training for both class teacher and students was raised as an important issue for the successful implementation of the instructional intervention. The participants emphasised on spending more time familiarizing with the software in contrast to twenty minutes in the pilot phase. They also stressed the importance of class teacher's role and expertise in use of technology in order to teach students not only how to develop critical thinking also how to use instructional technology to do so.

Teaching strategies

Another theme appeared frequently form participants feedback was use of specific teaching strategies prior and during the intervention implementation. Participants suggested that before moving into argument building task students may need to practice a controlled example with the teacher one-to-one, so that they can get a concrete idea how to use the software and build the argument map. In addition, it was suggested that students might benefit more from the prior training if they work in pairs or small groups before starting developing argument maps individually and independently.

Conclusion

The analysis of focus group data yielded relevant and beneficial results of the study. The participants' suggestions were useful to take into account some of the foreseen issues that might become a hurdle during the implementation phase. The data gathered from the focus group were relevant and aligned with the objectives of this small pilot testing. The good coding scheme evolving naturally from the data helped to categorize information in most effective and useful manner (Hsieh and Shannon 2005). The feedback was used to refine the content and teaching strategies suggested in the actual lesson plans. Moreover, the software prior training related issues were taken into consideration when applying the intervention. The participants of the focus group brought useful insights to this research study. However, this content analysis is limited to the recorded responses of the participants'; it is also ineffective for gauging causal relationships among the studied phenomena.

Communities of Inquiry (CoI) Survey reliability

Introduction

The communities of inquiry survey was used in this study to determine the presence of external learning environment influences such as teacher presence, social presence and cognitive presence in terms of classrooms as communities of inquiry for the development of critical thinking skills. To use this survey for gauging normal classroom learning environment the researcher modified a few test items (e.g. Item 9 in Social presence). Therefore a pilot of the survey was conducted to check the reliability of the survey.

Administration of the survey

The survey was administered online to a population of interest (i.e. Students) studying in Pakistani universities or general students studying at other universities. The survey was disseminated via Facebook group pages and email lists. Approximately, 50-60 people were reached, out of whom twenty one participants completed the survey. The incomplete responses were ten. The response rate for the survey was approximately 10 percent.

Analysis and Results

The survey data (responses on a Likert scale) were analysed using SPSS, a reliability analysis was conducted on all 34 survey items, and the results are discussed below.

The survey has been developed by total number of attempted surveys was 30, whereas the total number of completed surveys were (27) twenty seven. The Cronbach's Alpha reliability statistics for the Community of inquiry's survey tested for this research study was.906 overall.

The scale holds strong inter item reliability statistics. Diaz, Swan and Ice, (2010) have reported that the three factors together accounted for 61.9% of the total variance in CoI item scores. Cronbach's Alpha results for the internal consistencies equal to 0.96 for Teaching Presence, 0.92

in Social Presence, and 0.95 for Cognitive Presence. Similarly, Arbaugh et al. (2008) Cronbach's Alpha yielded internal consistencies equal to 0.94 for Teaching Presence, 0.91 for Social Presence, and 0.95 for Cognitive Presence.

Most recently, Pollard et al. (2014) reported Cronbach's alpha of.909 for social presence, for Teaching Presence a Cronbach's alpha of.965 and for Learning Environment this scale yielded a Cronbach's alpha of.884. The following table shows the reliability statistics computed for this research study. In this study, the results are consistent with other studies and the Cronbach's Alpha; the following table shows the maximum and minimum factor loading for inter item consistency. In this study the Cronbach's alpha for teaching presence ranges between.912-.898, for social presence ranges between .907-.901 and for cognitive presence ranges between .910-.899.

Table C2: The reliability statistics for CoI survey

Reliability Statistics for COI					
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No. of Items	Reliability statistics for main components (Cronbach's Alpha)		
			Teaching presence	Social presence	Cognitive presence
.906	.908	34	.912-.898	.907-.901	.910-.899

CAAP-Critical Thinking Test reliability

Introduction

The CAAP-CT test was selected to measure the argument analysis, evaluation and extension dimensions of critical thinking skills in this study. The test has been prepared by American Collegiate testing (ACT) for assessing college and university students' critical thinking skills. The reported internal consistency reliabilities of the CAAP-CT range between .81 and .82 (Pascarella et al 2011).

Kuder-Richardson Formula 20 (K-R 20) estimates are quite reliable as they measure the correlation of all items on a test with one another, the reported K-R 20 for CAAP-CT for a sample size of 26,000-43,000 is .85 more over the test length, test completion rate, item difficulty (mean difficulty (.59-.60), SD= .13-.11)) and item discrimination distributions (Mean=.54, SD= .10 to.12) prove that the test holds strong reliability and internal validity (ACT-CAAP Technical Handbook 2008).

The test can be used in parallel forms, test scores can be used to measure change over time in students' academic skills, these changes can be measured after a general or specific teaching program (ACT-CAAP Technical Handbook 2008), thus, is the purpose of this study. However, in order to further explore the validity of the test in a different context, to get familiarised with the test administration, content and scoring- a pilot study was conducted. The detail of test administration and analysis process is detailed below.

Administration of the Survey

The test was distributed in two parts (converted into two online questionnaire forms) - the original test comprises of 32 items and requires 40 minutes to complete- in this study, the researcher kept to guidelines of test administration and no part of the test was changed or moved except dividing it into two parts. The time to complete the test was kept the same (divided into 20 minutes for each part) in the online version. The scoring system recommended in the test handbook was followed and tests were marked as a whole for each participant. Both parts of the test were disseminated to the target sample using social media and email lists, approximately fifty to sixty (50-60) people were contacted for each part, out of which twenty eight (28) responses were received on critical thinking part one whereas thirty two (32) responses were received on critical thinking part two.

Analysis and results

The tests were scored individually and data were analysed to get mean scores on the test. The correct answers were given one as a mark and zero for a wrong answer, no negative marking was done in scoring the tests. The total scores for each participant were than analysed as cumulative score on critical thinking test through SPSS. The mean scores of the total sample for both test was 5.8 with a SD of 2.9 suggesting that that the participants of the survey scored very low on the test. The highest score on the test was 12 on 32 items. Considering the diverse sample and various grade levels, this finding shows a general lack of critical thinking skills in individuals at undergraduate, graduate, and postgraduate level; especially skills of argument analysis, evaluation and extension are low among students in this sample.

Conclusions

The critical thinking skills test results helped in getting familiar with test language, time required for completion of test, and test scoring. It further extended on test content validity, many participants opined that test is cognitively challenging, interesting and they required thinking before answering, however thinking and practice both in test analysis and skill of argument analysis, extension and evaluation is a must, hence is the purpose of this study. The low scores of the participants comply with the thesis of this study indicating that critical thinking skills (argumentation) are not common; furthermore lower scores indicate the need of teaching before we measure. This reflects on the purpose of this study and the need to test this field.

At the end of each questionnaire the respondents were asked to provide comments and information on the language, item difficulty and time of the test. There was no language difficulties reported in participants' feedback therefore the test will be kept in its original form and format, only it will be administered in two halves as a parallel test form at the beginning and the end of the study to compare mean scores of students.

The results of the pilot study were useful for not only to confirm the suitability of the research instruments, checking the language related issues that are going to be used in this study, but also helped in reflecting on the process of intervention implementation, use of software and points to take into account while working with technology and students e.g. familiarity with the software, clarity of commands and clarity of instruction to use the software.

Appendix D Questionnaires

Critical Thinking Part One

Page 1

Hello,
I am a PhD student. My research study topic is "Effectiveness of a critical thinking skills intervention on developing CT skills of initial teacher education students (in Pakistan)". This test has been designed to measure three aspects of critical thinking skills that are analysing, evaluating and extending arguments.

I would like to request your cooperation in filling in the following survey. Your participation is voluntary and you have the right to withdraw from participation any time you like. However your kind contribution will help bringing out practical findings for the improvement of teacher education in Pakistan in general and in public universities in specific. Moreover it will be fun to know at what level your critical thinking skills are.

Time required: 20-30 minutes (also depend on your personal pace)

You will see a text paragraph, please read it carefully. Later you will be asked questions related to the text you read before, please select your answers using your argument skills for given situations/questions/choices. Please note that there is no right or wrong answers just use your skills.

Please note that by continuing you are consenting to participate in this research and use of data for research purposes.
It will be ensured that your participation data is used for research purposes only and your identity remain protected.
Thank you for your kind cooperation and effort to make this research happen.
Many Thanks!
Shumaila Mahmood
email: shumailam8@gmail.com

Page 2

Passage I

Keepit, Givit, and Wait are discussing whether to make regular voluntary donations to charitable organizations.

Keepit: I ought not to contribute to charities. What good would it do? My contribution would never be noticed as part of a million-dollar budget. But that same amount of money would be very noticeable if kept in my own family budget; that's where it makes the biggest difference, and hence does the most substantial good. In any case, our first moral obligation is always to the well-being of our own families. My family would rightly resent my favouring strangers over them. Given my level of income, any money of mine that is not needed for their present well-being should be saved for their future.

Givit: People have a right to have therefore most basic needs satisfied. Rights entail obligation s. So anyone who has more than enough money to satisfy his or her own basic needs has a constant moral obligation to help meet the most basic needs of others. Hence we are each morally obliged to contribute to charities, and to refuse is blameworthy.

Wait: I haven't decided what to do yet. I agree that it is good to contribute; still, it is not morally obligatory for us. Our money comes from wages we earn by our own labour, utilizing our own abilities. And so long as people don't use the money to harm others, they are morally entitled to put earned wages to whatever use they choose. People who contribute hard-earned money to charities deserve praise. But no one should be blamed for not contributing such money.

Givit: Some people are not as lucky as you: their abilities are fewer, or their legitimate needs are greater. For example, some people are born with serious physical or mental disabilities; others require expensive medical treatments. Why should they suffer for such accidents of fate? When our economic system provides you with luxuries while failing to meet their most basic needs, you are getting more than your fair share. I'm not saying that money should be taken from you by force, but I am saying that you have a constant moral obligation to help right such wrongs.

Wait: Your principles go too far. Suppose we do have a constant moral obligation of the kind you describe. Then even if people act morally, they will find themselves with a continuing obligation to keep giving until they can just barely satisfy their own most basic needs. Be honest. We are all planning to buy season football tickets, which are not basic needs. Do you think we are obliged to forgo the tickets and give the money to charity instead?

Keepit: The economic system may treat some people unfairly, but that does not mean that I am obliged to help them at the expense of my own family. The wealthiest 5 percent own 35 percent of the country's wealth, so obviously they have more money than they can use for their own families. And if they would contribute just a tenth of that wealth, charities would have all the money they need. Thus, there is no need for ordinary people like us to contribute, and hence no obligation.

1. Keepit' s stated principles entail that:

- ☐ A. people who have no families have no moral obligations.
- ☐ B. Keepit is not morally obligated to contribute earned wages to charities.
- ☐ C. every action is either praiseworthy or blameworthy.
- ☐ D. it is fair to pay people on the basis of their abilities as well as their labour.

2. Wait states that so long as people don't use the money to harm others, they are morally entitled to put earned wages to whatever use they choose. In making this statement, Wait is:

- ☐ F. trying to establish that Wait, Keepit, and Givit are not morally obligated to contribute to charities.
- ☐ G. trying to establish that it is good to contribute to charities.
- ☐ H. trying to establish that charities should receive money from sources other than earned wages.
- ☐ J. contradicting Wait 's own claim that those who contribute hard-earned money to charities deserve praise.

3. Givit's argument assumes, although it does not explicitly state, that:
I. Keepit, Givit, and Wait each have more than enough money to satisfy their most basic needs.
II. contributing to charities is a way to help some people satisfy their most basic needs.
III. if people refuse to contribute to charities voluntarily, governments should force them to contribute.

- ☐ A. I only
- ☐ B. II only
- ☐ C. III only
- ☐ D. I and II only

4. Keepit states that the truly wealthy have more money than they can use for their own families. Which of the following is NOT true of Keepit's statement?

☐ F. It is part of Keepit's attempt to establish that there is no need for ordinary people to contribute to charity.

☐ G. It is consistent with Keepit 's claim that charities would have all the money they need if the truly wealthy would contribute one-tenth of their wealth.

☐ H, It supports Givit's claim that we each have a moral obligation to contribute to charities.

☐ J. It is part of Keepit's attempt to refute Givit.

5. Which of the following, if true, would most substantially weaken Keepit's argument for not contributing?

☐ A. Keepit does not really want to contribute.

☐ B. If Keepit were to contribute, the contribution would go entirely to a needy family who otherwise would not have received assistance.

☐ C. Rights entail responsibilities.

☐ D. The wealthiest 5% own much more than 35% of the country's wealth.

6. Keepit's argument for the conclusion that there is no need for ordinary people to contribute to charity is subject to a reasonable objection on the grounds that:

☐ F.the wealthy must spend some of their money on their own families.

☐ G.It may not be possible to induce the wealthiest 5% to contribute one-tenth of their wealth to charity.

☐ H. Keepit assumes that the wealthy have not earned their wealth.

☐ J. the conclusion is not relevant to Keepit's main point.

7. Which of the following best explains why Walt's reference to the season football tickets is relevant to a logical evaluation of Givit's argument?

☐ A. It implies that Givit is a hypocrite.

☐ B. It illustrates a possible consequence of Givit's position concerning the extent of the obligation to help those in need.

☐ C. It demonstrates an inconsistency in Givit's position concerning one's obligations to one's family.

☐ D. It indicates that Givit overestimates the willingness of others to join with him in rendering substantial charitable aid.

8. Keepit and Walt clearly agree, while Givit clearly denies, that:

☐ F. Keepit should not be blamed for refusing to contribute.

☐ G. contributing to charities is an ineffective way to help those in need.

☐ H. the first moral obligation is to one's own family.

☐ J. the present economic system is fair.

Page 3

Passage II

The college at which Professor Burke teaches regularly asks students to evaluate faculty teaching performance. The announced purpose of these evaluations is to give information to faculty about their strengths and weaknesses as teachers, and to allow those who make decisions about salary increases and promotions to reward the better teachers. Professor Burke, who never does very well on those evaluations, recently wrote the following letter of objection to the college president:

"It has become common practice in many colleges and universities for students to write formal evaluations of their professors and submit these to those who make salary and promotion decisions. Of course we do that here as well. This practice is supposed to provide valuable evidence both to faculty members and to decision makers regarding how well the faculty are teaching their courses. Despite all that, I believe this practice has so many undesirable consequences that it ought to be abandoned. I grant that those who advocate the use of student opinion surveys as a way of evaluating teaching have laudable goals. However, they have overlooked the disastrous effects which inevitably flow from this practice.

In order for students to learn effectively, two requirements must be met: Students must be informed when they are in error, and they must be challenged to stretch their minds as far as possible. But this requires faculty members to be frank in criticizing student work. It also requires faculty members to set high standards so as to challenge all students to develop fully. Should a faculty member come to fear that being critical toward student work will result in loss of salary raises and denial of promotions, that faculty member is not likely to make critical comments when they are needed. Should a faculty member come to fear that maintaining high academic standards will also result in loss of raises and denial of promotions, that faculty member is not likely to set high standards? These things are exactly what happens when student evaluations are used by colleges to help make salary and promotion decisions. These things are happening here.

It doesn't take long for a faculty member to discover that many students react negatively to criticism, and that most students feel quite put upon when they are expected really to strive in a course outside of their major fields. True, some students do respond positively to a challenge, and many take criticism well, but what about those who don't? By not being critical and by having low standards, a faculty member can keep every student happy. By being critical and setting high standards, a faculty member runs the risk of making only a few students happy. There is no pay-off for the faculty member in alienating a significant number of those who will be filling out the course evaluation form at the end of the term, when the results of those forms will be considered in future decisions about the faculty member's career advancement. Several of my colleagues have deliberately lowered their standards in order to curry student favour on these evaluations, and I note they have done far better than I in getting raises in recent years.

Because of these factors, student evaluation of college faculty represents an important pressure to lower academic standards. Such erosion in standards of achievement tends, of course, to promote a general climate of mediocrity in which no one expects of any student anything more than average performance. Students who have the ability to do better than average lose out from this process by not being encouraged to become all they can be. And society simply cannot afford to continue to allow this weakening of our educational system when the crying need is for ever larger numbers of well-trained, well-educated citizens.

Thus, for the benefit of students and society alike, we must stop using student opinion surveys to evaluate college faculty performance for salary and promotion decisions. It would be far better to ask certain selected faculty members to write evaluations of the teaching performance of other faculty members, based on classroom visits. This would avoid the difficulties described above and give us expert, objective opinions about teaching performance, which could be used as evidence for making salary and promotion decisions.

I urge you to take whatever action is necessary to bring about these changes on our campus."

9. Which of the following is a conclusion which Professor Burke argues for in this passage?

☐ A.There is a crying need for large numbers of well-trained, well-educated citizens in our society.

☐ B. Some of Burke's fellow faculty members lowered their standards in order to get better student evaluations of their teaching.

☐ C. The practice of using student evaluations of teaching performance as evidence for faculty salary decisions has very undesirable consequences.

☐ D. If a faculty member fears that maintaining high standards will result in loss of salary raises, that faculty member will not be likely to maintain high standards.

10. From what is said in this passage, we can see Professor Burke explicitly assumes without argument that:

- ☐ F. students today are less academically ambitious and more critical of their instructors than students used to be.
- ☐ G. effective student learning requires that students be told of their mistakes.
- ☐ H. administrators believe all the negative comments made by students about faculty teaching.
- ☐ J. students lack the background necessary for making accurate judgements regarding faculty knowledge of course subject matter.

11. Burke claims that a faculty member can keep every student happy by not being critical and by having low standards, while that faculty member can make only a few good students happy by being critical and having high standards. What's the immediate point of these remarks?

- ☐ A. When a faculty member is critical and has high standards, that benefits only a few good students.
- ☐ B. Unfortunately, there are more weak than good students attending the college where Burke teaches.
- ☐ C. Using student evaluations for making salary and promotion decisions leads to desirable results.
- ☐ D. There is no reward for the critical faculty member with. high standards in a school that uses student evaluations in salary and promotion decisions.

12. Burke mentions some colleagues who lowered their standards and subsequently received higher raises than Burke.In order to make the overall argument as logical as possible, what does Burke need to establish with respect to these cases?

- ☐ F. That these teachers are not as good at teaching as Burke
- ☐ G. That the higher raises were due in part to the lowering of academic standards mentioned
- ☐ H. That the higher raises were not merely some sort of accidental quirk in the salary system
- ☐ J. That the standards maintained by these faculty before they lowered their standards were unreasonably high

13. Although the passage does not explicitly say so, Burke is apparently assuming that:

- ☐ A. students generally feel that faculty criticism of their work is unfairly harsh.
- ☐ B. students who react negatively to criticism and challenge will not give a favourable rating to the teaching of demanding instructors.
- ☐ C. most faculty members at Burke's college have lowered their standards in response to pressures created by student evaluation of instruction.
- ☐ D. being willing to criticize student work when needed and maintaining high academic standards are the two most important aspects of good teaching .

14. Given what Burke says in the passage, which of the following statements would Burke most likely agree with?

- ☐ F. Student evaluations of faculty performance provide useful information for decision making about faculty salaries and promotions.
- ☐ G. All students desire their college courses to be less demanding than reasonable faculty members do.
- ☐ H. There are disadvantages associated with the use of student evaluations as evidence in salary and promotion decisions.
- ☐ J. There is a real danger that students will deliberately use evaluations of faculty performance to lower academic standards.

15. Which one of the following, if known to be true, would do the most to undermine Burke's argument in favor of having faculty, rather than students, evaluate teaching performance?

- ☐ A. Faculty are generally reluctant to have other faculty members visit their classrooms.
- ☐ B. Most faculty members who would do the evaluating believe in upholding reasonably high academic standards.
- ☐ C. Most faculty members who would do the evaluating believe that it is possible to be too highly critical of student work.
- ☐ D. Because of personal relationships between faculty members, those who would do the evaluating could not be good judges of teaching performance.

16. In a school that uses student evaluation of instruction as evidence in salary and promotion decision s, according to Burke, the following three items are related to one another:
I. Faculty members fear that being critical of student work will have bad career consequences for the faculty member.
II. Faculty members experience negative student reaction to criticism of student work.
III. Undesirable educational practices are promoted at the institution.
Which of the following represents the most satisfactory summary of the logical relations between I, II, and ID as Burke sees them?

- ☐ F. I and II cause III.
- ☐ G. I promotes II, and II causes III.
- ☐ H. II causes I which then results in III.
- ☐ J. III causes II which in turn results in I.

Please provide your demographic details in the boxes below. The details will only be used for research purposes.

Full Name:	
Age (in years):	
Gender (Male/Female/Unspecified):	
Education Level (e.g. graduate/undergraduate/Masters):	

You have reached at the end of the test. Thank you very much for your time and patience. IF

YOU FINISH BEFORE TIME IS CALLED, YOU MAY GO BACK AND CHECK YOUR WORK.

Critical Thinking Part Two

Page 1

Hello,
I am a PhD student. My research study topic is "Effectiveness of a critical thinking skills intervention on developing CT skills of initial teacher education students (in Pakistan)". This questionnaire has been designed to measure three aspects of critical thinking skills that are analysing, evaluating and extending arguments.

I would like to request your cooperation in filling the following survey. Your participation is voluntary and you have the right to withdraw from participation any time you like. However your kind contribution will help bringing out practical findings for the improvement of teacher education in Pakistan in general and in public universities in specific. Moreover it will be fun to know at what level your critical thinking skills are.
Time required: 20-30 minutes (also depend on your personal pace)

You will see a text paragraph, please read it carefully. Later you will be asked questions related to the text you read before, please select your answers using your argument skills for given situations/questions/choices. Please note that there is no right or wrong answers just use your skills.

Please note that by continuing you are consenting to participate and use of data for research purposes.
It will be ensured that your participation data is used for research purposes only and your identity remain protected.
Thank you for your kind cooperation and effort to make this research happen.
Many Thanks!
Shumaila Mahmood
email: shumailam8@gmail.com

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Passage III

Silver is an attorney specializing in criminal defense. In a conversation with her friends Brown, Green, and Gray, she mentioned that she has recently become utterly convinced of the guilt of one of her clients, a client who has not yet gone to trial but insists on pleading not guilty. Brown, Green, and Gray are discussing Silver's moral obligations in such a case.

Brown: If I were Silver, I would withdraw from the case. If she continued to serve as the client's attorney, she would have a moral obligation to her client, based on the implicit promise involved in the attorney/client relationship , to do her best to win an acquittal. But that obligation would conflict with an absolute moral obligation she has to her fellow citizens and shares with them: the obligation not to hinder the conviction of persons one strongly believe s to be guilty. She cannot cancel that obligation to her fellow citizens, but she can cancel the obligation to her client by withdrawing from the case. Moreover, to defend her client; she would have to argue contrary to her beliefs, which is dishonest. But dishonesty is always wrong. So it is her duty to withdraw.

Green: And what good will that do? Any defendant can always easily get another attorney who will keep the case and fight for an acquittal. Suppose the new attorney wins an acquittal, and Silver's client then goes on to commit more crimes. Part of the responsibility for those crimes would rest with Silver, since she can prevent them by keeping the case and seeing to it that her client is convicted and punished, as all criminals should be.

For example, she could subtly highlight inconsistencies in her client's story, and refrain from introducing misleading evidence of innocence. She could intentionally be less aggressive than usual in cross-examination, and give less than her best effort in her closing arguments to the jury. After all, no one can ever have an obligation to protect criminals from the just consequences of their actions. Her highest obligation is to the public good, the general welfare of people.

It is not enough for Silver to wash her hands of the case and thereby make it someone else's problem. In order to fully protect the general welfare, she must see to it that her client is convicted.

Brown: But that would be dishonest perhaps even more dishonest than defending a client whom she knows to be guilty. If Silver did what you suggest, she would have to mislead both her client and the judge about her true aims in the case. For if she admitted to her client what she was trying to do, the client would fire her for self-interest; and if she admitted to the judge what she was trying to do, the judge would be legally bound to remove her from the case.

Green: Don't you sometimes pay compliments that are insincere? Wouldn't you lie to an enemy in order to protect the lives of your friends? But I am not even advising Silver to tell a lie just to keep the truth about her intentions to herself.

Gray: I agree with Green that Silver should not withdraw. After all, the vast majority of criminal defendants in this country are guilty if they weren't, there would have to be something very wrong with our police or prosecutors. If defense attorneys withdrew every time they became convinced of their clients' guilt, the legal system would become a shambles. And many defendants wouldn't even be able to find attorneys willing to keep their cases.

But I also agree with Brown that Silver has a duty to give her client her best effort to win acquittal if she remains. That is because human history shows by direct examination that, of the various systems tried, the best criminal justice system is one that works as a true adversary system, where each side strives skillfully to present a persuasive and successful case. Such a system tends ultimately to produce correct decisions more consistently than any other, and hence, best serves the general welfare; that is why we adopted an adversary system in the first place. When one side does less than its very best, the criminal justice system does not work as effectively; and so, in the long run, justice is not served as often.

The guilt or innocence of the accused is for the jury to decide-it is not even for the judge to decide, let alone for the competing attorneys. An attorney's job is to formulate the strongest case available for whichever side the attorney is given to represent. If the attorney does that, then his or her whole duty in the case has been fulfilled, and he or she is blameless. Silver should keep her client and do her best to win an acquittal.

17. Gray disagrees with Brown 's claim that:

- ☐ A. short-term benefits usually outweigh long-term benefit s.
- ☐ B. Silver's decisive moral obligation is to the public welfare.
- ☐ C. It is Silver's duty to withdraw from the case.
- ☐ D. Silver should allow her own judgement of her client's guilt or innocence to guide her actions.

18. If human history shows by direct examination, as Gray claims, that of the various systems tried , a true adversary system makes more consistently correct decisions than any other kind of criminal justice system, which of the following must be true?
I. The present criminal justice system was never intended to be a true adversary system .
II. Human history contains examples of criminal justice systems that are not true adversary systems.
III. There is a way of evaluating how consistently a criminal justice system makes correct decisions.

- ☐ F. II only
- ☐ G. III only
- ☐ H. II and III only
- ☐ J. I, II, and III

19. By using a parallel argument adapted to the case of judges, Green could argue equally well from his stated principles that judges should:
I. not disqualify themselves from cases in which they have a financial interest.
II. not disqualify themselves from cases in which they have a personal relationship with the victim.
III. try to influence juries to convict defendants whom the judges know to be guilty.

- ☐ A. II only
- ☐ B. III only
- ☐ C. I and II only
- ☐ D. I, II, and III

20. Brown and Green evidently disagree about which of the following principles?

- ☐ F. If attorneys accept cases, then they should do their best to win them.
- ☐ G. Attorneys should always act ethically.
- ☐ H. Our legal system, as presently constituted, is a true adversary system.
- ☐ J. People generally act from self-interest.

21. Gray's remark (last paragraph; lines..) that "the vast majority of criminal defendants in this country are guilty" is relevant to his argument because it:
I. expresses a lack of confidence in police and prosecutors.
II. suggests that defense attorneys will frequently become convinced of their clients' guilt.
III. supports the claim that our present legal system was intentionally adopted as a true adversary system.

- ☐ A. I only
- ☐ B. II only
- ☐ C. III only
- ☐ D. I, II, and III

22. Which of the following, if true, would do the most to strengthen Gray's overall argument and weaken Green's argument?

- ☐ F. Some innocent clients have an attorney who believes that the client is guilty.
- ☐ G. Attorneys very often judge a client to be innocent when in fact the client is guilty.
- ☐ H. Police and prosecutors do their jobs effectively on the whole.
- ☐ J. Most attorneys would concur with Gray's advice.

23. Which of the following claims does Brown make without offering supporting argumentation?

- ☐ A. Silver has a duty to withdraw from the case.
- ☐ B. Silver would have to act dishonestly if she were to follow Green's advice.
- ☐ C. Silver wants to behave honestly.
- ☐ D. A judge would be legally bound to remove Silver from the case if she admitted to the judge that she was not trying her best to acquit her client.

Green's two questions, about insincere compliments and lying to one's enemies (second last paragraph; lines 53-55), are relevant to establishing the correctness of Green's conclusions to the extent that the questions:

- ☐ F. suggest that Brown is a hypocrite.
- ☐ G. indicate that lying is only one kind of dishonesty.
- ☐ H. show that Brown's argument contradicts itself.
- ☐ J. imply that dishonesty may sometimes be morally permissible when its consequences are beneficial.

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Passage IV

Senator Support proposed a bill in the Senate that would forbid TV stations from broadcasting commercials directed at children under thirteen years of age. In support of the bill, Support argued: I feel that advertising aimed at young children takes unfair advantage of their undeveloped reasoning abilities and encourages bad thinking. Commercials aimed at young children should be banned. My bill would do that.

Research has shown that young children are often unable to discriminate good argument s from subtly bad ones. The arguments in TV commercials are, of course, predominantly bad, the main argument being, in essence, "Look at this image. If you like the image, buy this product." Children like my young son aren't sophisticated enough to know that this is a bad argument. Advertisers are taking advantage of children's ignorance, and that is utterly despicable.

Furthermore, TV ads encourage bad thinking habits. As you know, young children are impressionable, but we are showing them bad arguments like those in TV commercials. So they are bound to start thinking badly. A cereal commercial, for instance, will direct children to look at the characters and images associated with the cereal rather than at the ingredients. More generally, commercials encourage children to evaluate a product on the basis of images associated with the product rather than on the basis of the product's ingredients and utility.

I am sure that Senator Oppose will object to this bill, but I hope you will find her arguments unconvincing.

After Senator Support's speech, Senator Oppose stood to defend an opposing position: I can't approve of Senator Support's attempt to shield young children from advertising. His bill is vague, poorly supported, and unrealistic.

It is vague because it provides no clear and explicit criteria for distinguishing ads aimed at young children from ads aimed at teenagers. Without any specific criteria, regulators won't be able to decide what to forbid. Consequently, the bill would be unenforceable.

As if this were not enough, the bill is also poorly supported by evidence and argument. On the one hand, there is no scientific evidence to support the contention that ads encourage bad thinking. Indeed there are no studies which show that commercials have any harmful effects on children. On the other hand, none of Senator Support's arguments are satisfactory. First, commercials don't take unfair advantage of children since children can, to a large extent; distinguish good arguments from poor ones.

Second, commercials don't encourage bad thinking because they rarely involve bad arguments. There's nothing wrong, for example, with, "Here's an image. If you like the image, buy this product. "I suspect that man y senators have acted on the basis of such arguments. So Senator Support's arguments are not just inconclusive, they're wrong.

To conclude, I would like to point out some of the implications of the bill that make it politically unrealistic. First, of course, child advertising would stop. But then so would child programming, since commercial stations would have no child based income. Children would then not know what to do with their time, so parents would become angry with us. For economic reasons, manufacturers and retailers would also be upset with us. Considering that the bill is also vague and poorly supported by evidence or argument, I don't think it's worth enduring the anger of so many interests.

25. In his speech, Senator Support's main conclusion is that:

- ☐ A. commercials aimed at young children should be banned .
- ☐ B. It is unfair to aim commercials at people who can 't reason well.
- ☐ C. commercials with bad arguments encourage children to think badly .
- ☐ D. the bill is politically, socially, and economically unrealistic.

26. When Senator Support says (......lines 17-19) that taking advantage of ignorance "is utterly despicable," he is probably:

- ☐ F. condemning ignorance .
- ☐ G. concluding that his son is ignorant.
- ☐ H. concluding that all children are ignorant.
- ☐ J. appealing to the emotions of the audience.

27. Suppose Senator Support's reasons for his belief that advertising has a detrimental effect on children are wrong. Would that show that advertising has no detrimental effects on children ?

- ☐ A. Yes, because bad reasons often yield incorrect conclusions.
- ☐ B. Yes, because advertising ha s not been proven to have a detrimental effect on children .
- ☐ C. No, because good reasons may support contrasting conclusions.
- ☐ D. No, because reasons can be wrong when the conclusion is correct.

28. What would Senator Support probably need to assume in order to apply his arguments to the proposal that all commercials should be banned ?

- ☐ F. If all commercials are banned , then bad arguments will not appear on TV.
- ☐ G. Commercials often encourage people to buy luxuries rather than necessities.
- ☐ H. Commercials are irritating interruptions in viewing, and they irritate everyone, not just children.
- ☐ J. People of all age groups are impressionable and unable to discriminate good arguments from subtly bad ones.

29. According to the passage, which of the following is the main reason why Senator Oppose thinks that the bill would be unenforceable?

- ☐ A. The bill is too vague.
- ☐ B. Powerful interest groups would be upset.
- ☐ C. The bill would, in effect, ban child advertising.
- ☐ D. Commercials contain relatively few bad arguments.

30. Senator Oppose says that without child programming, children would not know what to do with their time. Which of the arguments below would probably be the most effective reply to this statement?

- ☐ F. At any point in time, every child is doing something, be it eating, sleeping, thinking , or something else. So children would always be doing something with their time, even without TV.
- ☐ G. If Senator Oppose is considering teenagers as children, she is wrong. If Oppose is excluding teenagers, she is contradicting herself.
- ☐ H. You are assuming that children do not value their time. Based on my experience with children, I know that assumption is false.
- ☐ J. In many parts of the world, children still have no television but find things to do with their time. So children can find things to do with their time.

31. In mentioning that no studies show that commercials damage children (..........lines 49-51), Senator Oppose seems to assume, but does not say, that:

- ☐ A. commercials are valuable for purposes of entertainment.
- ☐ B. If commercials have known harmful effect s, they should be banned.
- ☐ C. If commercials have no known harmful effects, they should not be banned.
- ☐ D. If commercials are not banned, then they have no known harmful effects.

32. What conclusion follows necessarily from these two premises?
I. If the bill passes, child advertising will stop.
II. Once child advertising stops, commercial stations won't be able to make a profit from child programming .

- ○ F. If the bill passes, commercial station s will not show child programming.
- ○ G. If child advertising stops, it will be because the bill passed.
- ○ H. Passing the bill would be a disaster for child programming.
- ○ J. If the bill passes, then child programming would be unprofitable for commercial stations.

Please provide your demographic details in the below box. The details will only be used for research purposes.

Full Name:	
Age (in years):	
Gender(Male/Female/Unspecified):	
Education Level(e.g. graduate/undergraduate/Masters):	

You have reached at the end of the survey. Thank you very much for your time and patience.

IF YOU FINISH BEFORE TIME IS CALLED, YOU MAY GO BACK AND CHECK YOUR WORK.

Motivated Strategies for Learning Questionnaire Manual

Part A. Motivation

The following questions ask about your motivation for and attitudes about this class. **Remember there are no right or wrong answers, just answer as accurately as possible.** Use the scale below to answer the questions. If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

1	2	3	4	5	6	7
not at all true of me						very true of me

1.	In a class like this, I prefer course material that really challenges me so I can learn new things.	1	2	3	4	5	6	7
2.	If I study in appropriate ways, then I will be able to learn the material in this course.	1	2	3	4	5	6	7
3.	When I take a test I think about how poorly I am doing compared with other students.	1	2	3	4	5	6	7
4.	I think I will be able to use what I learn in this course in other courses.	1	2	3	4	5	6	7
5.	I believe I will receive an excellent grade in this class.	1	2	3	4	5	6	7
6.	I'm certain I can understand the most difficult material presented in the readings for this course.	1	2	3	4	5	6	7
7.	Getting a good grade in this class is the most satisfying thing for me right now.	1	2	3	4	5	6	7
8.	When I take a test I think about items on other parts of the test I can't answer.	1	2	3	4	5	6	7

Motivated Strategies for Learning Questionnaire Manual

		not at all true of me						very true of me
9.	It is my own fault if I don't learn the material in this course.	1	2	3	4	5	6	7
10.	It is important for me to learn the course material in this class.	1	2	3	4	5	6	7
11.	The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	1	2	3	4	5	6	7
12.	I'm confident I can learn the basic concepts taught in this course.	1	2	3	4	5	6	7
13.	If I can, I want to get better grades in this class than most of the other students.	1	2	3	4	5	6	7
14.	When I take tests I think of the consequences of failing.	1	2	3	4	5	6	7
15.	I'm confident I can understand the most complex material presented by the instructor in this course.	1	2	3	4	5	6	7
16.	In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	1	2	3	4	5	6	7
17.	I am very interested in the content area of this course.	1	2	3	4	5	6	7
18.	If I try hard enough, then I will understand the course material.	1	2	3	4	5	6	7
19.	I have an uneasy, upset feeling when I take an exam.	1	2	3	4	5	6	7

		not at all true of me						very true of me
20.	I'm confident I can do an excellent job on the assignments and tests in this course.	1	2	3	4	5	6	7
21.	I expect to do well in this class.	1	2	3	4	5	6	7
22.	The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	1	2	3	4	5	6	7
23.	I think the course material in this class is useful for me to learn.	1	2	3	4	5	6	7
24.	When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	1	2	3	4	5	6	7
25.	If I don't understand the course material, it is because I didn't try hard enough.	1	2	3	4	5	6	7
26.	I like the subject matter of this course.	1	2	3	4	5	6	7
27.	Understanding the subject matter of this course is very important to me.	1	2	3	4	5	6	7
28.	I feel my heart beating fast when I take an exam.	1	2	3	4	5	6	7
29.	I'm certain I can master the skills being taught in this class.	1	2	3	4	5	6	7
30.	I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	1	2	3	4	5	6	7
31.	Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	1	2	3	4	5	6	7

Part B. Learning Strategies

The following questions ask about your learning strategies and study skills for this class. **Again, there are no right or wrong answers. Answer the questions about how you study in this class as accurately as possible.** Use the same scale to answer the remaining questions. If you think the statement is very true of you, circle 7; if a statement is not at all true of you, circle 1. If the statement is more or less true of you, find the number between 1 and 7 that best describes you.

1	2	3	4	5	6	7
not at all true of me						very true of me

32.	When I study the readings for this course, I outline the material to help me organize my thoughts.	1	2	3	4	5	6	7
33.	During class time I often miss important points because I'm thinking of other things.	1	2	3	4	5	6	7
34.	When studying for this course, I often try to explain the material to a classmate or friend.	1	2	3	4	5	6	7
35.	I usually study in a place where I can concentrate on my course work.	1	2	3	4	5	6	7
36.	When reading for this course, I make up questions to help focus my reading.	1	2	3	4	5	6	7
37.	I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	1	2	3	4	5	6	7
38.	I often find myself questioning things I hear or read in this course to decide if I find them convincing.	1	2	3	4	5	6	7
39.	When I study for this class, I practice saying the material to myself over and over.	1	2	3	4	5	6	7

		not at all true of me						very true of me
40.	Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.	1	2	3	4	5	6	7
41.	When I become confused about something I'm reading for this class, I go back and try to figure it out.	1	2	3	4	5	6	7
42.	When I study for this course, I go through the readings and my class notes and try to find the most important ideas.	1	2	3	4	5	6	7
43.	I make good use of my study time for this course.	1	2	3	4	5	6	7
44.	If course readings are difficult to understand, I change the way I read the material.	1	2	3	4	5	6	7
45.	I try to work with other students from this class to complete the course assignments.	1	2	3	4	5	6	7
46.	When studying for this course, I read my class notes and the course readings over and over again.	1	2	3	4	5	6	7
47.	When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.	1	2	3	4	5	6	7
48.	I work hard to do well in this class even if I don't like what we are doing.	1	2	3	4	5	6	7
49.	I make simple charts, diagrams, or tables to help me organize course material.	1	2	3	4	5	6	7

		not at all true of me						very true of me
50.	When studying for this course, I often set aside time to discuss course material with a group of students from the class.	1	2	3	4	5	6	7
51.	I treat the course material as a starting point and try to develop my own ideas about it.	1	2	3	4	5	6	7
52.	I find it hard to stick to a study schedule.	1	2	3	4	5	6	7
53.	When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.	1	2	3	4	5	6	7
54.	Before I study new course material thoroughly, I often skim it to see how it is organized.	1	2	3	4	5	6	7
55.	I ask myself questions to make sure I understand the material I have been studying in this class.	1	2	3	4	5	6	7
56.	I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	1	2	3	4	5	6	7
57.	I often find that I have been reading for this class but don't know what it was all about.	1	2	3	4	5	6	7
58.	I ask the instructor to clarify concepts I don't understand well.	1	2	3	4	5	6	7
59.	I memorize key words to remind me of important concepts in this class.	1	2	3	4	5	6	7
60.	When course work is difficult, I either give up or only study the easy parts.	1	2	3	4	5	6	7

Motivated Strategies for Learning Questionnaire Manual

		not at all true of me						very true of me
61.	I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying for this course.	1	2	3	4	5	6	7
62.	I try to relate ideas in this subject to those in other courses whenever possible.	1	2	3	4	5	6	7
63.	When I study for this course, I go over my class notes and make an outline of important concepts.	1	2	3	4	5	6	7
64.	When reading for this class, I try to relate the material to what I already know.	1	2	3	4	5	6	7
65.	I have a regular place set aside for studying.	1	2	3	4	5	6	7
66.	I try to play around with ideas of my own related to what I am learning in this course.	1	2	3	4	5	6	7
67.	When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.	1	2	3	4	5	6	7
68.	When I can't understand the material in this course, I ask another student in this class for help.	1	2	3	4	5	6	7
69.	I try to understand the material in this class by making connections between the readings and the concepts from the lectures.	1	2	3	4	5	6	7
70.	I make sure that I keep up with the weekly readings and assignments for this course.	1	2	3	4	5	6	7
71.	Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.	1	2	3	4	5	6	7

Motivated Strategies for Learning Questionnaire Manual

	not at all true of me						very true of me
72. I make lists of important items for this course and memorize the lists.	1	2	3	4	5	6	7
73. I attend this class regularly.	1	2	3	4	5	6	7
74. Even when course materials are dull and uninteresting, I manage to keep working until I finish.	1	2	3	4	5	6	7
75. I try to identify students in this class whom I can ask for help if necessary.	1	2	3	4	5	6	7
76. When studying for this course I try to determine which concepts I don't understand well.	1	2	3	4	5	6	7
77. I often find that I don't spend very much time on this course because of other activities.	1	2	3	4	5	6	7
78. When I study for this class, I set goals for myself in order to direct my activities in each study period.	1	2	3	4	5	6	7
79. If I get confused taking notes in class, I make sure I sort it out afterwards.	1	2	3	4	5	6	7
80. I rarely find time to review my notes or readings before an exam.	1	2	3	4	5	6	7
81. I try to apply ideas from course readings in other class activities such as lecture and discussion.	1	2	3	4	5	6	7

Community of Inquiry questionnaire
(assessing classroom teaching and learning)

Page 1

Hello,
I am a PhD student. My research study's topic is "Effectiveness of a critical thinking skills intervention for developing CT skills of initial teacher education students (in Pakistan)". This questionnaire has been designed to measure aspects on classroom teaching and learning environment and is titled as Community of Inquiry Survey.

I would like to request your cooperation in filling the following survey. Your participation is voluntary and you have the right to withdraw from participation any time you like. However your kind contribution will help to bring out useful findings for the betterment of teacher education in Pakistan.

Please read carefully and select the response that best fit your opinion.

Please note that by continuing you are consenting to participate in this data collection.
It will be ensured that your participation data is used only for research purposes and your identity remains protected.

Many Thanks!
Shumaila Mahmood
email: shumailam8@gmail.com

Thank you for your kind cooperation and effort to make this happen.

Teaching Presence

The instructor clearly communicated important course topics.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor clearly communicated important course goals.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor provided clear instructions on how to participate in course learning activities.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor clearly communicated important due dates/time frames for learning activities

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor helped to keep course participants engaged and participating in productive dialogue.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor helped keep the course participants on task in a way that helped me to learn.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

The instructor encouraged course participants to explore new concepts in this course.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

Instructor actions reinforced the development of a sense of community among course participants

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

The instructor helped to focus discussion on relevant issues in a way that helped me to learn.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

The instructor provided feedback that helped me understand my strengths and weaknesses.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

The instructor provided feedback in a timely fashion.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Social presence

Getting to know other course participants gave me a sense of belonging in the course.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I was able to form distinct impressions of some course participants.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Classroom discussion in form of discussion in groups is an excellent medium for social interaction

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I felt comfortable conversing through the mapping software medium.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I felt comfortable participating in the course discussions.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I felt comfortable interacting with other course participants.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I felt that my point of view was acknowledged by other course participants.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Classroom discussions help me to develop a sense of collaboration

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Cognitive presence

Problems posed increased my interest in course issues.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Course activities piqued my curiosity.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I felt motivated to explore content related questions.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

I utilized a variety of information sources to explore problems posed in this course.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Brainstorming and finding relevant information helped me resolve content related questions.

- strongly disagree
- disagree
- neutral
- agree
- strongly agree

Classroom discussions were valuable in helping me appreciate different perspectives

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

Combining new information helped me answer questions raised in course activities.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

Learning activities helped me construct explanations/solutions.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

Reflection on course content and discussions helped me understand fundamental concepts in this class.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

I can describe ways to test and apply the knowledge created in this course.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

I have developed solutions to course problems that can be applied in practice.

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

I can apply the knowledge created in this course to my work or other non-class related activities

- ○ strongly disagree
- ○ disagree
- ○ neutral
- ○ agree
- ○ strongly agree

Please provide your demographic details in the boxes below. The details will be used for research purposes only.

Full Name:	
Age (in years):	
Gender (Male/Female/Unspecified):	
Education Level (e.g. graduate/undergraduate/Masters):	

You have reached at the end of the questionnaire. Thank you very much for your time and patience.

Appendix E Participants' consent forms and Information sheets

UNIVERSITY OF Southampton

CONSENT FORM (Intervention group)

Study title: Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan.

Researcher: Miss Shumaila Mahmood **Ethics number**: **12135**

Please initial the box (es) if you agree with the statement(s):

I have read and understood the information sheet [21-11-2014-Version3.doc] that requires me to

1. Participate in an *intervention group* for testing the effectiveness of a critical thinking skills intervention
2. To undertake the pre-test and post-test to measure my improvement/non improvement on learning critical thinking skills (20-25 minutes each)
3. To undertake MSLQ (20-30 minutes) to evaluate motivation, collaboration and self-regulation and COI (20 minutes) to evaluate the learning environment of the classroom during this period

I agree to take part in this research project and agree for my data to be recorded and used for the purpose of this study

I understand that my responses will be anonymised in reports of the research

I understand my participation is voluntary and I may withdraw at any time without my legal rights being affected and no other penalty will be applied what so ever.

Data Protection

I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study.

Name of participant (print name)..

Signature of participant..

Date..

If you would like to receive the results of the study, please leave your email below:-

....

UNIVERSITY OF Southampton

Participant Information Sheet (Intervention group)

Study Title: Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan.

Researcher: Miss Shumaila Mahmood **Ethics number:** 12135

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

I am a student currently researching as a PhD student at the University of Southampton, UK. This research study is part of an academic qualification. I teach at a teacher education university in Pakistan (place of study) my passion is to improve teacher education programs taught in universities with specific emphasis on improving critical thinking skills (an essential requirement for teachers professional standards) and the intellectual well-being of students . To start with, I have chosen the above mentioned topic. The main question I am interested in is whether critical thinking skills (argument building) can be taught to students through a carefully designed instructional intervention model. This will enable to establish research based outcomes on which classroom based instructional model for teaching critical thinking can be developed.

Why have I been chosen?

You are approached as future teachers who require building their critical thinking skills as part of National Professional Standards for Teachers in Pakistan. You are selected because you are enrolled in a teacher training programme at University of Education. The researcher is interested in your participation experience and how much critical thinking skills you will improve at the end of a four week instructional intervention.

What will happen to me if I take part?

If you decide to participate in the research, you will be required to attend the module classes as normally as you would, however you will take part in activities during the classes and complete tasks and homework given in any of the classes during four weeks. The intervention will be delivered to you in the form of lesson plans explicitly teaching critical thinking skills through audio-video lectures and embedded practice in argument building activities in the classroom. You will also have hands on experience with argument building software to practice your learning during the class. You will be provided with constructive feedback on your work so that you can improve your overall critical thinking skills. You may be asked to participate in individual interviews and a focus group at the end of the four weeks of study programme. You will also be observed a couple of times during classes and while working with the class teacher on activities. You are highly advised to not share any of the classroom information outside the class until the study is finished. Overall, this involves a) pre and post critical thinking skills test b) critical thinking skills intervention c) two more test for assessing motivation, self-regulation, collaboration and learning environment.

Are there any benefits in my taking part?

Your participation may not bring financial or other material benefits. However, this will be highly appreciable for non-material benefits. This is an opportunity to develop your critical thinking skills, gain diverse insights, and provide feedback based on your expertise. You will help in adding the knowledge of the field and bring improvement in a highly valuable manner, not only in your personal learning but also in institutional teaching-learning standards. In any other way this will be an intellectually triggering opportunity for you and for the researcher both. You will be provided with 20% course points as acknowledgement of your full participation in the study, your work will be counted as

[Date 21-11-14 Version number 3]

20% of your sessional work. Twenty percent sessional work is described in your course outline for participation in classroom activities and assignments during the whole semester. Your participation in this intervention study related activities will be counted for as this sessional work. The reason for giving these extra marks to you is not to burden the class teacher and participants with extra work load, but to merge the intervention into the existing teaching learning schedule. For those who do not wish to participate will attend classes as regular but will not be required to participate in research related activities, a different sessional work will be assigned to you by the class teacher.

Are there any risks involved?

There are no foreseen risks involved in the design and participation requirements of the study. It will be assured that the physical environment is welcoming and comfortable for you. The only risk involved is that you might feel tired or fatigued because of participation in discussion and activities.

Will my participation be confidential?

This research study is being conducted in compliance with the Data protection Act/ University of Southampton Policy. All necessary efforts to protect your data will be taken care of. Although, in the case of focus group and interviews at the end of the study, complete anonymity cannot be granted, but data will be shared only with research related bodies using pseudo names or no names, where required. Mostly 'participant' as a subject noun will be used.

Other data will be coded and kept under a password protected computer and other cloud data saving points. However, no data will be reachable without the permission of the researcher and the research team involved. After the completion of the research, the data will be kept locked for three years later it will be destroyed permanently as per data protection policy if required.

What happens if I change my mind?

Please note that you if at any point for any reason whatsoever find yourself unable to participate, you have the right to withdraw your participation without any penalty applied. No points will be deducted from your course points and you will be provided different sessional work for the 20% of semester work. However, your full participation will be highly valued.

What happens if something goes wrong?

If you would like to complain or put forward any of your concern about this research. You may use the following contact.

Head of Research Governance

(02380 595058)

(rgoinfo@soton.ac.uk).

Where can I get more information?

If you have any more question or would like more information about any research related issues, please contact me on the following email and I will respond to you as soonest as possible.

Shumaila Mahmood: sm1c11@soton.ac.uk

[Date 21-11-14 Version number 3]

UNIVERSITY OF Southampton

CONSENT FORM (Non-intervention group)

Study title: Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan.

Researcher: Miss Shumaila Mahmood **Ethics number:** 12135

Please initial the box (es) if you agree with the statement(s):

I have read and understood the information sheet [21-11-2014-Version3.doc] that requires me to

Participate in a *non-intervention group* for testing the effectiveness of a critical thinking skills intervention

To undertake the pre-test and post-test to measure on learning in critical thinking skills (20-25 minutes each)

To undertake MSLQ (20-30 mints) to evaluate motivation, collaboration and self-regulation and COI (20 minutes) to evaluate the learning environment of the classroom during this period

I agree to take part in this research project and agree for my data to be recorded and used for the purpose of this study

I understand that my responses will be anonymised in reports of the research

I understand my participation is voluntary and I may withdraw at any time without my legal rights being affected and no other penalty will be applied what so ever.

Data Protection

I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study.

Name of participant (print name)..

Signature of participant..

Date..

If you would like to receive the results of the study, please leave your email below:-

....

UNIVERSITY OF Southampton

Participant Information Sheet (Non-intervention group)

Study Title: Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan.

Researcher: Miss Shumaila Mahmood **Ethics number:** 12135

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

I am a student currently researching as a PhD student at the University of Southampton, UK. This research study is part of an academic qualification. I teach at a teacher education university in Pakistan (place of study) my passion is to improve teacher education programs taught in universities with specific emphasis on improving critical thinking skills (an essential requirement for teachers professional standards) and the intellectual wellbeing of students. To start with, I have chosen the above mentioned topic. The main question I am interested in is whether critical thinking skills (argument building) can be taught to students through a carefully designed instructional intervention model. This will enable to establish research based outcomes on which classroom based instructional model for teaching critical thinking skills can be developed.

Why have I been chosen?

You are approached as future teachers who require building their critical thinking skills as part of National Professional Standards for Teachers in Pakistan. You have been selected because you are enrolled in a teacher training program at University of Education. The researcher is interested in your participation as a control group in an instructional intervention.

What will happen to me if I take part?

If you decide to participate in the research, you will be required to attend the module classes as normally as you would, however you will take part in filling in four questionnaires at different times, for this research study. You will also be observed a couple of times during classes and while working with the class teacher. You are highly advised to not share any of the classroom information outside the class until the study is finished. Overall, this involves a) pre and post critical thinking skills test b) critical thinking skills intervention c) two more test for assessing motivation, self-regulation, collaboration and learning environment. Please note these tests will be spread on various days and times during next four weeks.

Are there any benefits in my taking part?

Your participation may not bring financial or other individual benefits. However, this will be highly appreciable for non-material benefits and provide feedback based on your expertise. You will surely help in adding to the knowledge of the field of education and bring improvement in a highly valuable manner not only in your personal learning but in institutional teaching-learning standards. In any other way this will be an intellectually triggering opportunity for you and the researcher both. For those who do not wish to participate will attend classes as regular but will not be required to participate in research no data will be recorded or used in this research study and there is no penalty applied.

[Date 21-11-14 Version number 3]

UNIVERSITY OF Southampton

Are there any risks involved?

There are no foreseen risks involved in the design and participation requirements of the study. It will be assured that the physical environment is welcoming and comfortable for you. The only risk involved is that you might feel tired or fatigued because of participation in filling out tests.

Will my participation be confidential?

This research study is being conducted in compliance with the Data protection Act/ University of Southampton Policy. All necessary efforts to protect your data will be taken care of. Although complete anonymity cannot be granted in the case of focus group and interviews at the end of the study, but data will be shared with only research related bodies using pseudo names or no names were required. Mostly 'participant' as a subject noun will be used.

Other data will be coded and kept under a password protected computer and other cloud data saving points. However, no data will be reachable without the permission of the researcher and her supervisors involved. After the research the data will be kept locked for three years and then it will be destroyed permanently as per data protection policy, if required.

What happens if I change my mind?

Please note that you if at any point for any reason whatsoever find yourself unable to participate, you have the right to withdraw your participation without any penalty applied. However, your full participation will be highly valued.

What happens if something goes wrong?

If you would like to complain or put forward any of your concern about this research. You may use the following contact.

Head of Research Governance

(02380 595058)

(rgoinfo@soton.ac.uk).

Where can I get more information?

If you have any more questions or would like more information about any research related issues, please contact me on the following email and I will respond to you as soonest as possible.

Shumaila Mahmood: smlc11@soton.ac.uk

[Date 21-11-14 Version number 3]

UNIVERSITY OF Southampton

CONSENT FORM (Teacher)

Study title: Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan.

Researcher: Miss Shumaila Mahmood **Ethics number**: 12135

Please initial the box (es) if you agree with the statement(s):

I have read and understood the information sheet [21-11-2014-Version3.doc] that requires me to

Participate in a *quasi-experimental research study* for testing the effectiveness of a critical thinking skills intervention

To undertake the teaching programme on critical thinking skills (4 weeks)

To participate in an interview after the intervention testing period has finished

To undertake that the researcher can observe the learning environment of the classroom during this period

I agree to take part in this research project and agree for my data to be recorded and used for the purpose of this study

I understand that my responses will be anonymised in reports of the research

I understand my participation is voluntary and I may withdraw at any time without my legal rights being affected and no other penalty will be applied what so ever.

Data Protection

I understand that information collected about me during my participation in this study will be stored on a password protected computer and that this information will only be used for the purpose of this study.

Name of participant (print name)..

Signature of participant..

Date..

If you would like to receive the results of the study, please leave your email below:-

....

UNIVERSITY OF Southampton

Participant Information Sheet (Teacher)

Study Title: Testing the effectiveness of a critical thinking skills intervention for initial teacher education students in Pakistan.

Researcher: Miss Shumaila Mahmood **Ethics number**: 12135

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to sign a consent form.

What is the research about?

I am a student currently researching as a PhD student at University of Southampton, UK. This research study is part of an academic qualification. I teach at a teacher education university in Pakistan (place of study) my passion is to improve teacher education programs taught in universities with specific emphasis on improving critical thinking skills (an essential requirement for teachers professional standards) and the intellectual well-being of students . To start with, I have chosen the above mentioned topic. The main question I am interested in is whether critical thinking skills (argument building) can be taught to students through a carefully designed instructional intervention model. This will enable to establish research based outcomes on which classroom based instructional model for teaching critical thinking can be developed.

Why have I been chosen?

You are approached as a partner in the research implementation process. Your teaching expertise and cooperation are required to teach critical thinking skills as part of National Professional Standards for Teachers in Pakistan to the intervention group. You are selected because you are a teacher at University of Education. The researcher is interested in your participation as an implementer of an instructional intervention.

What will happen to me if I take part?

If you decide to participate in the research, you will be required to teach the module to the non-intervention group as normally as you would; however you will execute the teaching plan prepared by the researcher to the intervention group. In this research study you will also be observed a couple of times during classes and while working with the students both in intervention and non-intervention groups. You are highly advised to not share any of the classroom information outside the intervention group until the study is finished. Overall, you will be approached for an interview at the end of the intervention and your insights are important for explaining the results of the study. Please note this intervention study will be spread on next four weeks along with a one day of interviews and focus group with participants.

Are there any benefits in my taking part?

Your participation may not bring financial or other individual benefits. However, this will be highly appreciable for non-material benefits and provide feedback based on your expertise. You will surely help in adding to the knowledge of the field of education and bring improvement in a highly valuable manner not only in your pedagogical learning but in institutional teaching-learning standards. You can, if you want to, use this four week intervention as part of your assigned sessional work for the intervention group. In any other way this will be an intellectually triggering opportunity for you and the researcher both. It will be very useful to promote your goodwill and your academic profile within the institution.

[Date 21-11-14 Version number 3]

Are there any risks involved?

There are no foreseen risks involved in the design and participation requirements of the study. It will be assured that the physical environment is welcoming and comfortable for you. The only risk involved is that you might feel tired or fatigued because of implementing and arranging activities for your students.

Will my participation be confidential?

This research study is being conducted in compliance with the Data protection Act/ University of Southampton Policy. All necessary efforts to protect your data will be taken care of. Although complete anonymity cannot be granted in the case of focus group and interviews at the end of the study, but data will be shared with only research related bodies using pseudo names or no name, where required. Mostly 'participant' as a subject noun will be used.

Other data will be coded and kept under a password protected computer and other cloud data saving points. However, no data will be reachable without the permission of the researcher and her supervisors involved. After the research the data will be kept locked for three years and then it will be destroyed permanently as per data protection policy, if required.

What happens if I change my mind?

Please note that you if at any point for any reason whatsoever find yourself unable to participate, you have the right to withdraw your participation without any penalty applied. However, your full participation will be highly valued.

What happens if something goes wrong?

If you would like to complain or put forward any of your concern about this research. You may use the following contact.

Head of Research Governance

(02380 595058)

(rgoinfo@soton.ac.uk).

Where can I get more information?

If you have any more questions or would like more information about any research related issues, please contact me on the following email and I will respond to you as soonest as possible.

Shumaila Mahmood: sm1c11@soton.ac.uk

[Date 21-11-14 Version number 3]

Appendix F Quantitative part

Descriptive analysis
E.1 Descriptive analysis of Experimental (Intervention) group data

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Scores_Intrvnpretest	27	100.0%	0	0.0%	27	100.0%
Scores_Intrvnposttest	27	100.0%	0	0.0%	27	100.0%

Descriptives

			Statistic	Std. Error
Scores_Intrvnpretest	Mean		4.5556	.35136
	95% Confidence Interval for Mean	Lower Bound	3.8333	
		Upper Bound	5.2778	
	5% Trimmed Mean		4.4239	
	Median		4.0000	
	Variance		3.333	
	Std. Deviation		1.82574	
	Minimum		2.00	
	Maximum		10.00	
	Range		8.00	
	Interquartile Range		2.00	
	Skewness		1.214	.448
	Kurtosis		1.926	.872
Scores_Intrvnposttest	Mean		3.6667	.40999
	95% Confidence Interval for Mean	Lower Bound	2.8239	
		Upper Bound	4.5094	
	5% Trimmed Mean		3.5062	
	Median		3.0000	
	Variance		4.538	
	Std. Deviation		2.13037	
	Minimum		1.00	
	Maximum		10.00	
	Range		9.00	
	Interquartile Range		3.00	
	Skewness		1.014	.448
	Kurtosis		1.384	.872

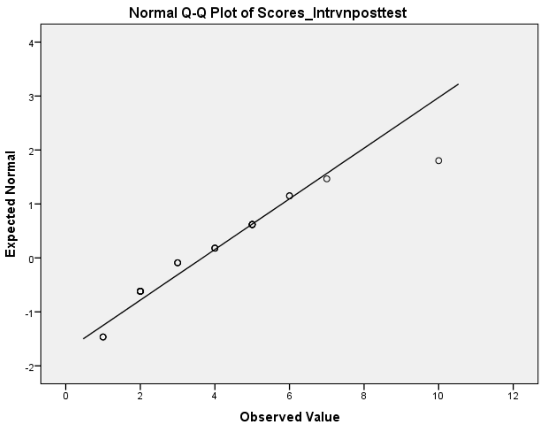
Appendix

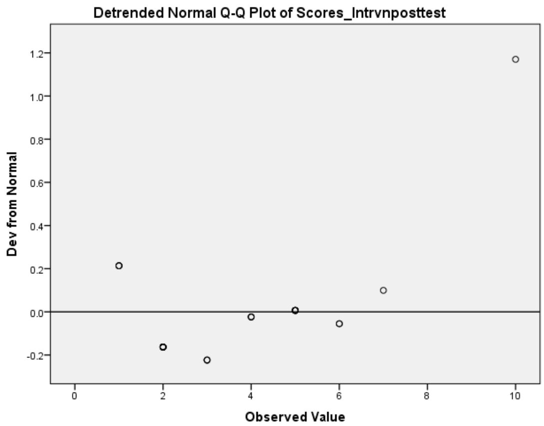
Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Scores_Intrvnpretest	.219	27	.002	.892	27	.009
Scores_Intrvnposttest	.190	27	.013	.897	27	.012

a. Lilliefors Significance Correction

Scores_Intrvnpretest, Scores_Intrvnposttest





Frequencies
Gender

Statistics

Gender

N	Valid	27
	Missing	0

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	25	92.6	92.6	92.6
	Male	2	7.4	7.4	100.0
	Total	27	100.0	100.0	

Age

Statistics

age

N	Valid	26
	Missing	1

age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30 years	26	96.3	100.0	100.0
Missing	System	1	3.7		
Total		27	100.0		

Marital. status

Statistics

M.status

N	Valid	26
	Missing	1

M.status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	26	96.3	100.0	100.0
Missing	System	1	3.7		
Total		27	100.0		

Ethnicity

Statistics

Ethnicity

N	Valid	26
	Missing	1

Ethnicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pakistani	25	92.6	96.2	96.2
	Urban	1	3.7	3.8	100.0
	Total	26	96.3	100.0	
Missing	System	1	3.7		
Total		27	100.0		

Religion

Statistics

Religion

N	Valid	26
	Missing	1

Religion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Islam	26	96.3	100.0	100.0
Missing	System	1	3.7		
Total		27	100.0		

ParentsEducation

Statistics

ParentsEducation

N	Valid	26
	Missing	1

ParentsEducation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No formal education	7	25.9	26.9	26.9
	matriculation	8	29.6	30.8	57.7
	bachelors	11	40.7	42.3	100.0
	Total	26	96.3	100.0	
Missing	System	1	3.7		
Total		27	100.0		

PreviousScores_grades

Statistics

PreviousScores_grades

N	Valid	24
	Missing	3

PreviousScores_grades

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	2	7.4	8.3	8.3
	50.00	11	40.7	45.8	54.2
	51.00	1	3.7	4.2	58.3
	55.50	2	7.4	8.3	66.7
	56.00	1	3.7	4.2	70.8
	56.20	1	3.7	4.2	75.0
	58.00	1	3.7	4.2	79.2
	61.00	1	3.7	4.2	83.3
	70.00	3	11.1	12.5	95.8
	86.00	1	3.7	4.2	100.0
	Total	24	88.9	100.0	
Missing	System	3	11.1		
Total		27	100.0		

Appendix

I rate my English language ability as

Statistics

I rate my english language ability as

N	Valid	26
	Missing	1

I rate my english language ability as

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Poor	1	3.7	3.8	3.8
	Average	22	81.5	84.6	88.5
	Fluent	3	11.1	11.5	100.0
	Total	26	96.3	100.0	
Missing	System	1	3.7		
Total		27	100.0		

I am able to read. speak and understand academic English, course work, notes and non-formal daily conversation in English.

Statistics

I am able to read. speak and understand academic english, course work, notes and non-formal daily conversation in English.

N	Valid	26
	Missing	1

I am able to read. speak and understand academic english, course work, notes and non-formal daily conversation in English.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	14	51.9	53.8	53.8
	No	2	7.4	7.7	61.5
	To some extent	9	33.3	34.6	96.2
	Fairly	1	3.7	3.8	100.0
	Total	26	96.3	100.0	
Missing	System	1	3.7		
Total		27	100.0		

I am able to read, understand, summarize and paraphrase my thoughts about any given topic in English language

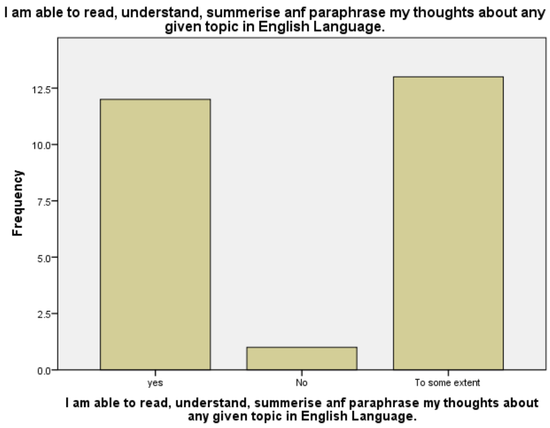
Statistics

I am able to read, understand, summarize and paraphrase my thoughts about any given topic in English Language.

N	Valid	26
	Missing	1

I am able to read, understand, summarize and paraphrase my thoughts about any given topic in English Language.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	12	44.4	46.2	46.2
	No	1	3.7	3.8	50.0
	To some extent	13	48.1	50.0	100.0
	Total	26	96.3	100.0	
Missing	System	1	3.7		
Total		27	100.0		



E.2 Descriptive Analysis of Control (No-intervention) Group data

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Scores_pretest_NonIntervention	26	81.3%	6	18.8%	32	100.0%
Scores_posttest_NonIntervention	26	81.3%	6	18.8%	32	100.0%

Descriptives

			Statistic	Std. Error
Scores_pretest_NonIntervention	Mean		4.6923	.28158
	95% Confidence Interval for Mean	Lower Bound	4.1124	
		Upper Bound	5.2722	
	5% Trimmed Mean		4.6581	
	Median		5.0000	
	Variance		2.062	
	Std. Deviation		1.43581	
	Minimum		2.00	
	Maximum		8.00	
	Range		6.00	
	Interquartile Range		1.50	
	Skewness		.327	.456
	Kurtosis		-.046	.887
Scores_posttest_NonIntervention	Mean		4.9231	.45378
	95% Confidence Interval for Mean	Lower Bound	3.9885	
		Upper Bound	5.8577	
	5% Trimmed Mean		4.8034	
	Median		5.0000	
	Variance		5.354	
	Std. Deviation		2.31384	
	Minimum		2.00	
	Maximum		10.00	
	Range		8.00	
	Interquartile Range		3.25	
	Skewness		.647	.456
	Kurtosis		-.127	.887

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Scores_pretest_NonIntervention	.184	26	.023	.946	26	.187
Scores_posttest_NonIntervention	.143	26	.181	.925	26	.058

a. Lilliefors Significance Correction

Scores_pretest_NonIntervention

Scores_pretest_NonIntervention Stem-and-Leaf Plot

```
 Frequency    Stem and  Leaf
    1.00 Extremes    (=<2.0)
    5.00        3 .  00000
     .00        3.
    5.00        4.  00000
     .00        4.
    9.00        5.  000000000
     .00        5.
    3.00        6.  000
    3.00 Extremes    (>=7.0)

 Stem width:      1.00
 Each leaf:       1 case(s)
```

Scores_posttest_NonIntervention

Scores_posttest_NonIntervention Stem-and-Leaf Plot

```
 Frequency    Stem and Leaf

    4.00        2.  0000
    5.00        3.  00000
    3.00        4.  000
    4.00        5.  0000
    4.00        6.  0000
    3.00        7.  000
    1.00        8.  0
     .00        9.
    2.00       10.  00

 Stem width:      1.00
 Each leaf:       1 case(s)
```

Appendix

Frequencies

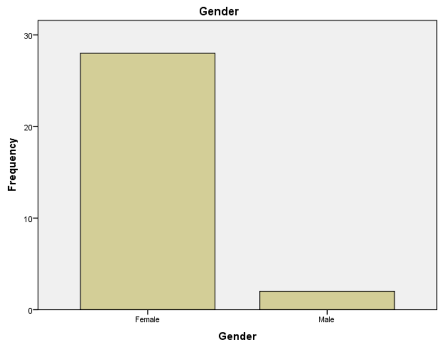
Statistics

		Gender	Age	M.status	Ethnicity	Religion	ParentsEducation	PreviousScores_grades	I rate my english language ability as	I am able to read. speak and understand academic english, course work, notes and non-formal daily conversation in English.	I am able to read, understand, summarize and paraphrase my thoughts about any given topic in English Language.
N	Valid	30	29	29	29	29	27	26	29	29	29
	Missing	2	3	3	3	3	5	6	3	3	3

Frequency Table

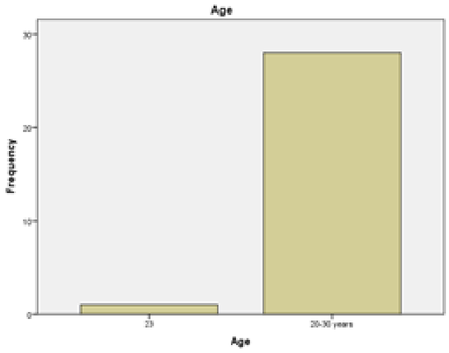
Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	28	87.5	93.3	93.3
	Male	2	6.3	6.7	100.0
	Total	30	93.8	100.0	
Missing	System	2	6.3		
Total		32	100.0		

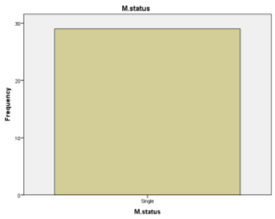


Age

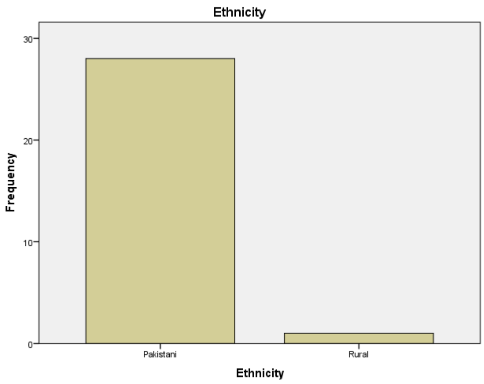
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	23	1	3.1	3.4	3.4
	20-30 years	28	87.5	96.6	100.0
	Total	29	90.6	100.0	
Missing	System	3	9.4		
Total		32	100.0		



M.status		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	29	90.6	100.0	100.0
Missing	System	3	9.4		
Total		32	100.0		



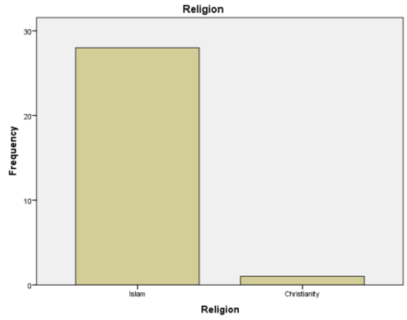
Ethnicity		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Pakistani	28	87.5	96.6	96.6
	Rural	1	3.1	3.4	100.0
	Total	29	90.6	100.0	
Missing	System	3	9.4		
Total		32	100.0		



Appendix

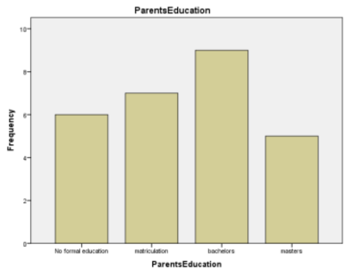
Religion

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Islam	28	87.5	96.6	96.6
	Christianity	1	3.1	3.4	100.0
	Total	29	90.6	100.0	
Missing	System	3	9.4		
Total		32	100.0		



ParentsEducation

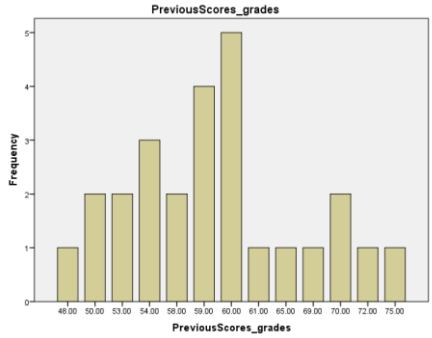
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No formal education	6	18.8	22.2	22.2
	matriculation	7	21.9	25.9	48.1
	bachelors	9	28.1	33.3	81.5
	masters	5	15.6	18.5	100.0
	Total	27	84.4	100.0	
Missing	System	5	15.6		
Total		32	100.0		



PreviousScores_grades

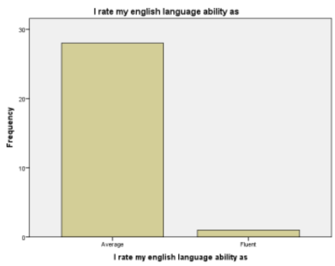
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	48.00	1	3.1	3.8	3.8
	50.00	2	6.3	7.7	11.5
	53.00	2	6.3	7.7	19.2
	54.00	3	9.4	11.5	30.8
	58.00	2	6.3	7.7	38.5
	59.00	4	12.5	15.4	53.8
	60.00	5	15.6	19.2	73.1

	61.00	1	3.1	3.8	76.9
	65.00	1	3.1	3.8	80.8
	69.00	1	3.1	3.8	84.6
	70.00	2	6.3	7.7	92.3
	72.00	1	3.1	3.8	96.2
	75.00	1	3.1	3.8	100.0
	Total	26	81.3	100.0	
Missing	System	6	18.8		
Total		32	100.0		



I rate my English language ability as

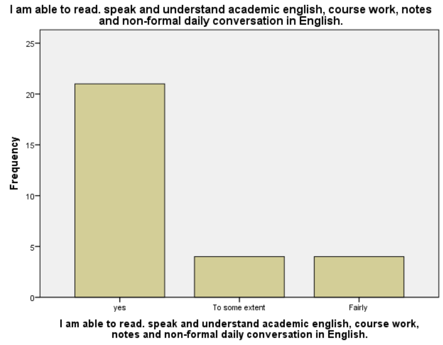
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Average	28	87.5	96.6	96.6
	Fluent	1	3.1	3.4	100.0
	Total	29	90.6	100.0	
Missing	System	3	9.4		
Total		32	100.0		



Appendix

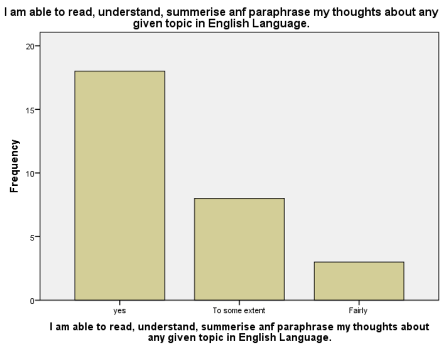
I am able to read. speak and understand academic english, course work, notes and non-formal daily conversation in English.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	21	65.6	72.4	72.4
	To some extent	4	12.5	13.8	86.2
	Fairly	4	12.5	13.8	100.0
	Total	29	90.6	100.0	
Missing	System	3	9.4		
Total		32	100.0		



I am able to read, understand, summarize and paraphrase my thoughts about any given topic in English Language.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	18	56.3	62.1	62.1
	To some extent	8	25.0	27.6	89.7
	Fairly	3	9.4	10.3	100.0
	Total	29	90.6	100.0	
Missing	System	3	9.4		
Total		32	100.0		



E.3 Case Processing Summary of Descriptive analysis of each item in motivation/self-regulation questionnaire

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
In a class like this, I prefer course material that really challenges me so I can learn new things.	17	63.0%	10	37.0%	27	100.0%
If I study in appropriate ways, then I will be able to learn the material in this course.	17	63.0%	10	37.0%	27	100.0%
When I take a test I think about how poorly I am doing compared with other students.	17	63.0%	10	37.0%	27	100.0%
I think I will be able to use what I learn in this course in other courses.	17	63.0%	10	37.0%	27	100.0%
I believe I will receive an excellent grade in this class.	17	63.0%	10	37.0%	27	100.0%
I'm certain I can understand the most difficult material presented in the readings for this course.	17	63.0%	10	37.0%	27	100.0%
Getting a good grade in this class is the most satisfying thing for me right now.	17	63.0%	10	37.0%	27	100.0%
When I take a test I think about items on other parts of the test I can't answer.	17	63.0%	10	37.0%	27	100.0%
It is my own fault if I don't learn the material in this course.	17	63.0%	10	37.0%	27	100.0%
It is important for me to learn the course material in this class.	17	63.0%	10	37.0%	27	100.0%
The most important thing for m2 right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	17	63.0%	10	37.0%	27	100.0%
I'm confident 1 can learn the basic concepts taught in this course.	17	63.0%	10	37.0%	27	100.0%

If I can, I want to get better grades in this class than most of the other students.	17	63.0%	10	37.0%	27	100.0%
When I take tests I think of the consequences of failing.	17	63.0%	10	37.0%	27	100.0%
I'm confident I can understand the most complex material presented by the instructor in this course.	17	63.0%	10	37.0%	27	100.0%
In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	17	63.0%	10	37.0%	27	100.0%
I am very interested in the content area of this course.	17	63.0%	10	37.0%	27	100.0%
If I try hard enough, then I will understand the course material.	17	63.0%	10	37.0%	27	100.0%
I have an uneasy, upset feeling when I take an exam.	17	63.0%	10	37.0%	27	100.0%
I'm confident I can do an excellent job on the assignments and tests in this course.	17	63.0%	10	37.0%	27	100.0%
I expect to do well in this class.	17	63.0%	10	37.0%	27	100.0%
The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.	17	63.0%	10	37.0%	27	100.0%
I think the course material in this class is useful for me to learn.	17	63.0%	10	37.0%	27	100.0%
When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	17	63.0%	10	37.0%	27	100.0%
If I don't understand the course material, it is because I didn't try hard enough.	17	63.0%	10	37.0%	27	100.0%
I like the subject matter of this course.	17	63.0%	10	37.0%	27	100.0%
Understanding the subject matter of this course is very important to me.	17	63.0%	10	37.0%	27	100.0%

I feel my heart beating fast when I take an exam.	17	63.0%	10	37.0%	27	100.0%
I'm certain I can master the skills beling taught in this class.	17	63.0%	10	37.0%	27	100.0%
I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	17	63.0%	10	37.0%	27	100.0%
Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	17	63.0%	10	37.0%	27	100.0%
When I study the readings for this course, I outline the material to help me organize my thoughts.	17	63.0%	10	37.0%	27	100.0%
During class time I often miss important points because I'm thinking of other things.	17	63.0%	10	37.0%	27	100.0%
When studying for this course, l often try to explain the material to a classmate or friend.	17	63.0%	10	37.0%	27	100.0%
I usually study in a place where I can concentrate on my course work.	17	63.0%	10	37.0%	27	100.0%
When reading for this course, I make up questions to help focus my reading.	17	63.0%	10	37.0%	27	100.0%
I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	17	63.0%	10	37.0%	27	100.0%
I often find myself questioning things I hear or read in this course to decide if I find them convincing.	17	63.0%	10	37.0%	27	100.0%
When I study for this class, I practice saying the material to myself over and over.	17	63.0%	10	37.0%	27	100.0%
Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.	17	63.0%	10	37.0%	27	100.0%

When I become confused about something I'm reading for this class, I go back and try to figure it out.	17	63.0%	10	37.0%	27	100.0%
When I study for this course, I go through the readings and my class notes and try to find the most important ideas.	17	63.0%	10	37.0%	27	100.0%
I make good use of my study time for this course.	17	63.0%	10	37.0%	27	100.0%
If course readings are difficult to understand, I change the way I read the material.	17	63.0%	10	37.0%	27	100.0%
I try to work with other students from this class to complete the course assignments.	17	63.0%	10	37.0%	27	100.0%
When studying for this course, I read my class notes and the course readings over and over again.	17	63.0%	10	37.0%	27	100.0%
When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if there is good supporting evidence.	17	63.0%	10	37.0%	27	100.0%
I work hard to do well in this class even if I don't like what we are doing.	17	63.0%	10	37.0%	27	100.0%
I make simple charts, diagrams, or tables to help me organize course material.	17	63.0%	10	37.0%	27	100.0%
When studying for this course, I often set aside time to discuss course material with a group of students from the class	17	63.0%	10	37.0%	27	100.0%
I treat the course material as a starting point and try to develop my own ideas about it.	17	63.0%	10	37.0%	27	100.0%
I find it hard to stick to a study schedule.	17	63.0%	10	37.0%	27	100.0%

When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.	17	63.0%	10	37.0%	27	100.0%
Before I study new course material thoroughly, I often skim it to see how it is organized.	17	63.0%	10	37.0%	27	100.0%
I ask myself questions to make sure I understand the material I have been studying in this class.	17	63.0%	10	37.0%	27	100.0%
I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	17	63.0%	10	37.0%	27	100.0%
I often find that I have been reading for this class but don't know what it was all about.	17	63.0%	10	37.0%	27	100.0%
I ask the instructor to clarify concepts I don’t understand well.	17	63.0%	10	37.0%	27	100.0%
I memorize key words to remind me of important concepts in this class.	17	63.0%	10	37.0%	27	100.0%
When course work is difficult, I either give up or only study the easy parts.	17	63.0%	10	37.0%	27	100.0%
I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying - for this course.	17	63.0%	10	37.0%	27	100.0%
I try to relate ideas in this subject to those in other courses whenever possible.	17	63.0%	10	37.0%	27	100.0%
When I study for this course, I go over my class notes and make an outline of important concepts.	17	63.0%	10	37.0%	27	100.0%
When reading for this class, I try to relate the material to what I already know.	17	63.0%	10	37.0%	27	100.0%
I have a regular place set aside for studying.	17	63.0%	10	37.0%	27	100.0%

I try to play around with ideas of my own related to what I am learning in this course.	17	63.0%	10	37.0%	27	100.0%
When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.	17	63.0%	10	37.0%	27	100.0%
When I can't understand the material in this course, I ask another student in this class for help.	17	63.0%	10	37.0%	27	100.0%
I try to understand the material in this class by making connections between the readings and the concepts from the lectures.	17	63.0%	10	37.0%	27	100.0%
I make sure that I keep up with the weekly readings and assignments for this course.	17	63.0%	10	37.0%	27	100.0%
Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.	17	63.0%	10	37.0%	27	100.0%
I make lists of important items for this course and memorize the lists.	17	63.0%	10	37.0%	27	100.0%
I attend this class regularly.	17	63.0%	10	37.0%	27	100.0%
Even when course materials are dull and uninteresting, I manage to keep working until I finish.	17	63.0%	10	37.0%	27	100.0%
I try to identify students in this class	17	63.0%	10	37.0%	27	100.0%
When studying for this course I try to determine which concepts I don't understand well.	17	63.0%	10	37.0%	27	100.0%
I often find that I don't spend very much time on this course because of other activities.	17	63.0%	10	37.0%	27	100.0%
When I study for this class, set goals for myself in order to direct my activities in each study period.	17	63.0%	10	37.0%	27	100.0%

If I get confused taking notes in class, I make sure I sort it out afterwards.	17	63.0%	10	37.0%	27	100.0%
I rarely find time to review my notes or readings before an exam.	17	63.0%	10	37.0%	27	100.0%
I try to apply ideas from course readings in other class activities such as lecture and discussion.	17	63.0%	10	37.0%	27	100.0%

E.4 Descriptive analysis of each item in motivation/self-regulation questionnaire

			Statistic	Std. Error
In a class like this, I prefer course material that really challenges me so I can learn new things.	Mean		5.5882	.39350
	95% Confidence Interval for Mean	Lower Bound	4.7540	
		Upper Bound	6.4224	
	5% Trimmed Mean		5.6536	
	Median		6.0000	
	Variance		2.632	
	Std. Deviation		1.62245	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		3.00	
	Skewness		-.627	.550
	Kurtosis		-1.299	1.063
If I study in appropriate ways, then I will be able to learn the material in this course.	Mean		6.0588	.26389
	95% Confidence Interval for Mean	Lower Bound	5.4994	
		Upper Bound	6.6182	
	5% Trimmed Mean		6.1209	
	Median		7.0000	
	Variance		1.184	
	Std. Deviation		1.08804	
	Minimum		4.00	
	Maximum		7.00	
	Range		3.00	
	Interquartile Range		2.00	
	Skewness		-.459	.550
	Kurtosis		-1.541	1.063
When I take a test I think about how poorly I am doing compared	Mean		4.9412	.47334
	95% Confidence Interval for Mean	Lower Bound	3.9377	

with other students.		Upper Bound	5.9446	
	5% Trimmed Mean		4.9902	
	Median		5.0000	
	Variance		3.809	
	Std. Deviation		1.95162	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		4.00	
	Skewness		-.364	.550
	Kurtosis		-1.380	1.063
I think I will be able to use what I learn in this course in other courses.	Mean		5.4706	.31057
	95% Confidence Interval for Mean	Lower Bound	4.8122	
		Upper Bound	6.1290	
	5% Trimmed Mean		5.5229	
	Median		6.0000	
	Variance		1.640	
	Std. Deviation		1.28051	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		1.50	
	Skewness		-.837	.550
	Kurtosis		-.236	1.063
I believe I will receive an excellent grade in this class.	Mean		4.6471	.40166
	95% Confidence Interval for Mean	Lower Bound	3.7956	
		Upper Bound	5.4985	
	5% Trimmed Mean		4.6634	
	Median		5.0000	
	Variance		2.743	
	Std. Deviation		1.65609	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		3.00	
	Skewness		.081	.550
	Kurtosis		-1.377	1.063
I'm certain I can understand the most difficult material presented in the readings for this course.	Mean		3.8824	.34173
	95% Confidence Interval for Mean	Lower Bound	3.1579	
		Upper Bound	4.6068	
	5% Trimmed Mean		3.9248	

	Median		4.0000	
	Variance		1.985	
	Std. Deviation		1.40900	
	Minimum		1.00	
	Maximum		6.00	
	Range		5.00	
	Interquartile Range		2.00	
	Skewness		-.374	.550
	Kurtosis		-.367	1.063
Getting a good grade in this class is the most satisfying thing for me right now.	Mean		5.1765	.35599
	95% Confidence Interval for Mean	Lower Bound	4.4218	
		Upper Bound	5.9311	
	5% Trimmed Mean		5.1961	
	Median		6.0000	
	Variance		2.154	
	Std. Deviation		1.46779	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		2.50	
	Skewness		-.478	.550
	Kurtosis		-1.153	1.063
When I take a test I think about items on other parts of the test I can't answer.	Mean		4.5294	.52242
	95% Confidence Interval for Mean	Lower Bound	3.4219	
		Upper Bound	5.6369	
	5% Trimmed Mean		4.5882	
	Median		4.0000	
	Variance		4.640	
	Std. Deviation		2.15400	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.237	.550
	Kurtosis		-1.273	1.063
It is my own fault if I don't learn the material in this course.	Mean		5.2941	.45183
	95% Confidence Interval for Mean	Lower Bound	4.3363	
		Upper Bound	6.2520	
	5% Trimmed Mean		5.4379	
	Median		6.0000	
	Variance		3.471	

	Std. Deviation		1.86295	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-1.078	.550
	Kurtosis		.425	1.063
It is important for me to learn the course material in this class.	Mean		5.9412	.37837
	95% Confidence Interval for Mean	Lower Bound	5.1391	
		Upper Bound	6.7433	
	5% Trimmed Mean		6.0458	
	Median		7.0000	
	Variance		2.434	
	Std. Deviation		1.56007	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		2.00	
	Skewness		-1.234	.550
	Kurtosis		.012	1.063
The most important thing for m2 right now is improving my overall grade point average, so my main concern in this class is getting a good grade.	Mean		6.0588	.36853
	95% Confidence Interval for Mean	Lower Bound	5.2776	
		Upper Bound	6.8401	
	5% Trimmed Mean		6.2876	
	Median		7.0000	
	Variance		2.309	
	Std. Deviation		1.51948	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		1.50	
	Skewness		-2.534	.550
	Kurtosis		7.717	1.063
I'm confident 1 can learn the basic concepts taught in this course.	Mean		5.4118	.35416
	95% Confidence Interval for Mean	Lower Bound	4.6610	
		Upper Bound	6.1626	
	5% Trimmed Mean		5.4575	
	Median		6.0000	
	Variance		2.132	
	Std. Deviation		1.46026	
	Minimum		3.00	

	Maximum		7.00	
	Range		4.00	
	Interquartile Range		3.00	
	Skewness		-.144	.550
	Kurtosis		-1.730	1.063
If I can, I want to get better grades in this class than most of the other students.	Mean		5.4706	.37493
	95% Confidence Interval for Mean	Lower Bound	4.6758	
		Upper Bound	6.2654	
	5% Trimmed Mean		5.6340	
	Median		6.0000	
	Variance		2.390	
	Std. Deviation		1.54587	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.00	
	Skewness		-1.491	.550
	Kurtosis		3.307	1.063
When I take tests I think of the consequences of failing.	Mean		3.1176	.54153
	95% Confidence Interval for Mean	Lower Bound	1.9697	
		Upper Bound	4.2656	
	5% Trimmed Mean		3.0196	
	Median		4.0000	
	Variance		4.985	
	Std. Deviation		2.23278	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		.368	.550
	Kurtosis		-1.465	1.063
I'm confident I can understand the most complex material presented by the instructor in this course.	Mean		4.6471	.39240
	95% Confidence Interval for Mean	Lower Bound	3.8152	
		Upper Bound	5.4789	
	5% Trimmed Mean		4.7190	
	Median		5.0000	
	Variance		2.618	
	Std. Deviation		1.61791	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	

	Interquartile Range		2.00	
	Skewness		-1.253	.550
	Kurtosis		1.642	1.063
In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.	Mean		5.4706	.32219
	95% Confidence Interval for Mean	Lower Bound	4.7876	
		Upper Bound	6.1536	
	5% Trimmed Mean		5.5229	
	Median		5.0000	
	Variance		1.765	
	Std. Deviation		1.32842	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		2.50	
	Skewness		-.110	.550
	Kurtosis		-1.186	1.063
I am very interested in the content area of this course.	Mean		5.0588	.40648
	95% Confidence Interval for Mean	Lower Bound	4.1971	
		Upper Bound	5.9205	
	5% Trimmed Mean		5.1209	
	Median		5.0000	
	Variance		2.809	
	Std. Deviation		1.67595	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		2.50	
	Skewness		-.556	.550
	Kurtosis		-.693	1.063
If I try hard enough, then I will understand the course material.	Mean		5.2941	.46782
	95% Confidence Interval for Mean	Lower Bound	4.3024	
		Upper Bound	6.2859	
	5% Trimmed Mean		5.4379	
	Median		6.0000	
	Variance		3.721	
	Std. Deviation		1.92888	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.947	.550

	Kurtosis		-.033	1.063
I have an uneasy, upset feeling when I take an exam.	Mean		4.5294	.54985
	95% Confidence Interval for Mean	Lower Bound	3.3638	
		Upper Bound	5.6950	
	5% Trimmed Mean		4.5882	
	Median		5.0000	
	Variance		5.140	
	Std. Deviation		2.26709	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.645	.550
	Kurtosis		-.954	1.063
I'm confident I can do an excellent job on the assignments and tests in this course.	Mean		4.4118	.47788
	95% Confidence Interval for Mean	Lower Bound	3.3987	
		Upper Bound	5.4248	
	5% Trimmed Mean		4.4575	
	Median		4.0000	
	Variance		3.882	
	Std. Deviation		1.97037	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.101	.550
	Kurtosis		-1.365	1.063
I expect to do well in this class.	Mean		5.9412	.26389
	95% Confidence Interval for Mean	Lower Bound	5.3818	
		Upper Bound	6.5006	
	5% Trimmed Mean		5.9902	
	Median		6.0000	
	Variance		1.184	
	Std. Deviation		1.08804	
	Minimum		4.00	
	Maximum		7.00	
	Range		3.00	
	Interquartile Range		1.50	
	Skewness		-.861	.550
	Kurtosis		-.348	1.063
The most satisfying thing for me	Mean		5.8235	.36617

in this course is trying to understand the content as thoroughly as possible.	95% Confidence Interval for Mean	Lower Bound	5.0473	
		Upper Bound	6.5998	
	5% Trimmed Mean		5.9706	
	Median		6.0000	
	Variance		2.279	
	Std. Deviation		1.50977	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		2.00	
	Skewness		-1.391	.550
	Kurtosis		1.504	1.063
I think the course material in this class is useful for me to learn.	Mean		6.0588	.32619
	95% Confidence Interval for Mean	Lower Bound	5.3673	
		Upper Bound	6.7503	
	5% Trimmed Mean		6.1765	
	Median		7.0000	
	Variance		1.809	
	Std. Deviation		1.34493	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		2.00	
	Skewness		-1.168	.550
	Kurtosis		.068	1.063
When I have the opportunity in this class, I choose course assignments that I can learn from even if they don't guarantee a good grade.	Mean		4.8824	.41905
	95% Confidence Interval for Mean	Lower Bound	3.9940	
		Upper Bound	5.7707	
	5% Trimmed Mean		4.9804	
	Median		5.0000	
	Variance		2.985	
	Std. Deviation		1.72780	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-.455	.550
	Kurtosis		-.178	1.063
If I don't understand the course material, it is because I didn't try hard enough.	Mean		5.2941	.43525
	95% Confidence Interval for Mean	Lower Bound	4.3714	
		Upper Bound	6.2168	

	5% Trimmed Mean		5.4379	
	Median		6.0000	
	Variance		3.221	
	Std. Deviation		1.79460	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.00	
	Skewness		-1.237	.550
	Kurtosis		.986	1.063
I like the subject matter of this course.	Mean		4.9412	.46551
	95% Confidence Interval for Mean	Lower Bound	3.9543	
		Upper Bound	5.9280	
	5% Trimmed Mean		5.0458	
	Median		6.0000	
	Variance		3.684	
	Std. Deviation		1.91933	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-1.048	.550
	Kurtosis		.189	1.063
Understanding the subject matter of this course is very important to me.	Mean		5.4706	.43823
	95% Confidence Interval for Mean	Lower Bound	4.5416	
		Upper Bound	6.3996	
	5% Trimmed Mean		5.6340	
	Median		6.0000	
	Variance		3.265	
	Std. Deviation		1.80685	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-1.099	.550
	Kurtosis		.564	1.063
I feel my heart beating fast when I take an exam.	Mean		5.4118	.52900
	95% Confidence Interval for Mean	Lower Bound	4.2903	
		Upper Bound	6.5332	
	5% Trimmed Mean		5.5686	
	Median		7.0000	

	Variance		4.757	
	Std. Deviation		2.18114	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-1.217	.550
	Kurtosis		.184	1.063
I'm certain I can master the skills b (ling taught in this class.	Mean		4.8235	.37608
	95% Confidence Interval for Mean	Lower Bound	4.0263	
		Upper Bound	5.6208	
	5% Trimmed Mean		4.8595	
	Median		5.0000	
	Variance		2.404	
	Std. Deviation		1.55062	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		2.50	
	Skewness		-.694	.550
	Kurtosis		-.727	1.063
I want to do well in this class because it is important to show my ability to my family, friends, employer, or others.	Mean		6.0588	.31472
	95% Confidence Interval for Mean	Lower Bound	5.3916	
		Upper Bound	6.7260	
	5% Trimmed Mean		6.1765	
	Median		7.0000	
	Variance		1.684	
	Std. Deviation		1.29762	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		1.50	
	Skewness		-1.289	.550
	Kurtosis		.576	1.063
Considering the difficulty of this course, the teacher, and my skills, I think I will do well in this class.	Mean		5.5294	.37493
	95% Confidence Interval for Mean	Lower Bound	4.7346	
		Upper Bound	6.3242	
	5% Trimmed Mean		5.6993	
	Median		6.0000	
	Variance		2.390	
	Std. Deviation		1.54587	

	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.00	
	Skewness		-1.615	.550
	Kurtosis		3.611	1.063
When I study the readings for this course, I outline the material to help me organize my thoughts.	Mean		4.5882	.45422
	95% Confidence Interval for Mean	Lower Bound	3.6253	
		Upper Bound	5.5511	
	5% Trimmed Mean		4.6536	
	Median		5.0000	
	Variance		3.507	
	Std. Deviation		1.87279	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.674	.550
	Kurtosis		-.411	1.063
During class time I often miss important points because I'm thinking of other things.	Mean		4.4706	.54312
	95% Confidence Interval for Mean	Lower Bound	3.3192	
		Upper Bound	5.6220	
	5% Trimmed Mean		4.5229	
	Median		5.0000	
	Variance		5.015	
	Std. Deviation		2.23935	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.50	
	Skewness		-.524	.550
	Kurtosis		-1.177	1.063
When studying for this course, I often try to explain the material to a classmate or friend.	Mean		5.0588	.48104
	95% Confidence Interval for Mean	Lower Bound	4.0391	
		Upper Bound	6.0786	
	5% Trimmed Mean		5.1765	
	Median		6.0000	
	Variance		3.934	
	Std. Deviation		1.98339	
	Minimum		1.00	
	Maximum		7.00	

	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.963	.550
	Kurtosis		.101	1.063
I usually study in a place where I can concentrate on my course work.	Mean		5.7647	.42469
	95% Confidence Interval for Mean	Lower Bound	4.8644	
		Upper Bound	6.6650	
	5% Trimmed Mean		5.9608	
	Median		7.0000	
	Variance		3.066	
	Std. Deviation		1.75105	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.00	
	Skewness		-1.572	.550
	Kurtosis		2.208	1.063
When reading for this course, I make up questions to help focus my reading.	Mean		5.0000	.41124
	95% Confidence Interval for Mean	Lower Bound	4.1282	
		Upper Bound	5.8718	
	5% Trimmed Mean		5.0556	
	Median		5.0000	
	Variance		2.875	
	Std. Deviation		1.69558	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		3.00	
	Skewness		-.523	.550
	Kurtosis		-.770	1.063
I often feel so lazy or bored when I study for this class that I quit before I finish what I planned to do.	Mean		3.6471	.53510
	95% Confidence Interval for Mean	Lower Bound	2.5127	
		Upper Bound	4.7814	
	5% Trimmed Mean		3.6078	
	Median		4.0000	
	Variance		4.868	
	Std. Deviation		2.20627	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.50	

	Skewness		.074	.550
	Kurtosis		-1.438	1.063
I often find myself questioning things I hear or read in this course to decide if I find them convincing.	Mean		4.6471	.38292
	95% Confidence Interval for Mean	Lower Bound	3.8353	
		Upper Bound	5.4588	
	5% Trimmed Mean		4.7190	
	Median		4.0000	
	Variance		2.493	
	Std. Deviation		1.57881	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.00	
	Skewness		-.198	.550
	Kurtosis		.511	1.063
When I study for this class, I practice saying the material to myself over and over.	Mean		4.4118	.52201
	95% Confidence Interval for Mean	Lower Bound	3.3052	
		Upper Bound	5.5184	
	5% Trimmed Mean		4.4575	
	Median		4.0000	
	Variance		4.632	
	Std. Deviation		2.15229	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.226	.550
	Kurtosis		-1.342	1.063
Even if I have trouble learning the material in this class, I try to do the work on my own, without help from anyone.	Mean		3.8235	.45565
	95% Confidence Interval for Mean	Lower Bound	2.8576	
		Upper Bound	4.7895	
	5% Trimmed Mean		3.8595	
	Median		4.0000	
	Variance		3.529	
	Std. Deviation		1.87867	
	Minimum		1.00	
	Maximum		6.00	
	Range		5.00	
	Interquartile Range		3.50	
	Skewness		-.353	.550
	Kurtosis		-1.382	1.063

When I become confused about something I'm reading for this class, I go back and try to figure it out.	Mean		4.0000	.52859
	95% Confidence Interval for Mean	Lower Bound	2.8794	
		Upper Bound	5.1206	
	5% Trimmed Mean		4.0000	
	Median		4.0000	
	Variance		4.750	
	Std. Deviation		2.17945	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.50	
	Skewness		-.205	.550
	Kurtosis		-1.364	1.063
When I study for this course, I go through the readings and my class notes and try to find the most important ideas.	Mean		5.2353	.52531
	95% Confidence Interval for Mean	Lower Bound	4.1217	
		Upper Bound	6.3489	
	5% Trimmed Mean		5.3725	
	Median		6.0000	
	Variance		4.691	
	Std. Deviation		2.16591	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.929	.550
	Kurtosis		-.444	1.063
I make good use of my study time for this course.	Mean		4.5294	.50815
	95% Confidence Interval for Mean	Lower Bound	3.4522	
		Upper Bound	5.6066	
	5% Trimmed Mean		4.5882	
	Median		4.0000	
	Variance		4.390	
	Std. Deviation		2.09516	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.162	.550
	Kurtosis		-1.161	1.063
If course readings are difficult to	Mean		5.3529	.41957

understand, I change the way I read the material.	95% Confidence Interval for Mean	Lower Bound	4.4635	
		Upper Bound	6.2424	
	5% Trimmed Mean		5.5033	
	Median		6.0000	
	Variance		2.993	
	Std. Deviation		1.72993	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-1.196	.550
	Kurtosis		1.035	1.063
I try to work with other students from this class to complete the course assignments.	Mean		5.5882	.50773
	95% Confidence Interval for Mean	Lower Bound	4.5119	
		Upper Bound	6.6646	
	5% Trimmed Mean		5.7647	
	Median		7.0000	
	Variance		4.382	
	Std. Deviation		2.09341	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-1.461	.550
	Kurtosis		.960	1.063
When studying for this course, I read my class notes and the course readings over and over again.	Mean		4.4706	.50086
	95% Confidence Interval for Mean	Lower Bound	3.4088	
		Upper Bound	5.5324	
	5% Trimmed Mean		4.5229	
	Median		5.0000	
	Variance		4.265	
	Std. Deviation		2.06512	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.676	.550
	Kurtosis		-.619	1.063
When a theory, interpretation, or conclusion is presented in class or in the readings, I try to decide if	Mean		4.4706	.37493
	95% Confidence Interval for Mean	Lower Bound	3.6758	
		Upper Bound	5.2654	

there is good supporting evidence.	5% Trimmed Mean		4.4673	
	Median		4.0000	
	Variance		2.390	
	Std. Deviation		1.54587	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		1.50	
	Skewness		.235	.550
	Kurtosis		-.351	1.063
I work hard to do well in this class even if I don't like what we are doing.	Mean		5.4706	.42111
	95% Confidence Interval for Mean	Lower Bound	4.5779	
		Upper Bound	6.3633	
	5% Trimmed Mean		5.5784	
	Median		6.0000	
	Variance		3.015	
	Std. Deviation		1.73629	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		3.00	
	Skewness		-.675	.550
	Kurtosis		-.922	1.063
I make simple charts, diagrams, or tables to help me organize course material.	Mean		2.7647	.49653
	95% Confidence Interval for Mean	Lower Bound	1.7121	
		Upper Bound	3.8173	
	5% Trimmed Mean		2.6275	
	Median		2.0000	
	Variance		4.191	
	Std. Deviation		2.04724	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		1.053	.550
	Kurtosis		.188	1.063
When studying for this course, I often set aside time to discuss course material with a group of students from the class	Mean		4.4118	.52900
	95% Confidence Interval for Mean	Lower Bound	3.2903	
		Upper Bound	5.5332	
	5% Trimmed Mean		4.4575	
	Median		5.0000	

	Variance		4.757	
	Std. Deviation		2.18114	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.397	.550
	Kurtosis		-1.094	1.063
I treat the course material as a starting point and try to develop my own ideas about it.	Mean		4.7647	.37894
	95% Confidence Interval for Mean	Lower Bound	3.9614	
		Upper Bound	5.5680	
	5% Trimmed Mean		4.7941	
	Median		4.0000	
	Variance		2.441	
	Std. Deviation		1.56243	
	Minimum		2.00	
	Maximum		7.00	
	Range		5.00	
	Interquartile Range		2.50	
	Skewness		.219	.550
	Kurtosis		-.875	1.063
I find it hard to stick to a study schedule.	Mean		4.7059	.49083
	95% Confidence Interval for Mean	Lower Bound	3.6654	
		Upper Bound	5.7464	
	5% Trimmed Mean		4.7843	
	Median		5.0000	
	Variance		4.096	
	Std. Deviation		2.02376	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.622	.550
	Kurtosis		-.621	1.063
When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions.	Mean		5.1176	.51365
	95% Confidence Interval for Mean	Lower Bound	4.0287	
		Upper Bound	6.2065	
	5% Trimmed Mean		5.2418	
	Median		6.0000	
	Variance		4.485	
	Std. Deviation		2.11785	

	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.935	.550
	Kurtosis		-.429	1.063
Before I study new course material thoroughly, I often skim it to see how it is organized.	Mean		4.4118	.54272
	95% Confidence Interval for Mean	Lower Bound	3.2612	
		Upper Bound	5.5623	
	5% Trimmed Mean		4.4575	
	Median		5.0000	
	Variance		5.007	
	Std. Deviation		2.23771	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.513	.550
	Kurtosis		-.989	1.063
I ask myself questions to make sure I understand the material I have been studying in this class.	Mean		4.7059	.56727
	95% Confidence Interval for Mean	Lower Bound	3.5033	
		Upper Bound	5.9084	
	5% Trimmed Mean		4.7843	
	Median		6.0000	
	Variance		5.471	
	Std. Deviation		2.33893	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.495	.550
	Kurtosis		-1.325	1.063
I try to change the way I study in order to fit the course requirements and the instructor's teaching style.	Mean		4.0588	.42418
	95% Confidence Interval for Mean	Lower Bound	3.1596	
		Upper Bound	4.9581	
	5% Trimmed Mean		4.0654	
	Median		4.0000	
	Variance		3.059	
	Std. Deviation		1.74895	
	Minimum		1.00	
	Maximum		7.00	

	Range		6.00	
	Interquartile Range		2.50	
	Skewness		.217	.550
	Kurtosis		-.658	1.063
I often find that I have been reading for this class but don't know what it was all about.	Mean		4.4118	.50043
	95% Confidence Interval for Mean	Lower Bound	3.3509	
		Upper Bound	5.4726	
	5% Trimmed Mean		4.4575	
	Median		5.0000	
	Variance		4.257	
	Std. Deviation		2.06334	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.680	.550
	Kurtosis		-.843	1.063
I ask the instructor to clarify concepts I don't understand well.	Mean		5.0588	.54551
	95% Confidence Interval for Mean	Lower Bound	3.9024	
		Upper Bound	6.2152	
	5% Trimmed Mean		5.1765	
	Median		6.0000	
	Variance		5.059	
	Std. Deviation		2.24918	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.718	.550
	Kurtosis		-.930	1.063
I memorize key words to remind me of important concepts in this class.	Mean		5.6471	.44508
	95% Confidence Interval for Mean	Lower Bound	4.7035	
		Upper Bound	6.5906	
	5% Trimmed Mean		5.8301	
	Median		6.0000	
	Variance		3.368	
	Std. Deviation		1.83511	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	

	Skewness		-1.401	.550
	Kurtosis		1.153	1.063
When course work is difficult, I either give up or only study the easy parts.	Mean		4.1765	.50900
	95% Confidence Interval for Mean	Lower Bound	3.0974	
		Upper Bound	5.2555	
	5% Trimmed Mean		4.1961	
	Median		4.0000	
	Variance		4.404	
	Std. Deviation		2.09867	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.218	.550
	Kurtosis		-1.094	1.063
I try to think through a topic and decide what I am supposed to learn from it rather than just reading it over when studying - for this course.	Mean		4.8824	.49913
	95% Confidence Interval for Mean	Lower Bound	3.8242	
		Upper Bound	5.9405	
	5% Trimmed Mean		4.9804	
	Median		5.0000	
	Variance		4.235	
	Std. Deviation		2.05798	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.602	.550
	Kurtosis		-.593	1.063
I try to relate ideas in this subject to those in other courses whenever possible.	Mean		3.8235	.52325
	95% Confidence Interval for Mean	Lower Bound	2.7143	
		Upper Bound	4.9328	
	5% Trimmed Mean		3.8039	
	Median		4.0000	
	Variance		4.654	
	Std. Deviation		2.15741	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		.088	.550
	Kurtosis		-1.144	1.063

When I study for this course, I go over my class notes and make an outline of important concepts.	Mean		3.5882	.57560
	95% Confidence Interval for Mean	Lower Bound	2.3680	
		Upper Bound	4.8085	
	5% Trimmed Mean		3.5425	
	Median		4.0000	
	Variance		5.632	
	Std. Deviation		2.37326	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		5.00	
	Skewness		.146	.550
	Kurtosis		-1.699	1.063
When reading for this class, I try to relate the material to what I already know.	Mean		4.1176	.43625
	95% Confidence Interval for Mean	Lower Bound	3.1928	
		Upper Bound	5.0424	
	5% Trimmed Mean		4.1863	
	Median		4.0000	
	Variance		3.235	
	Std. Deviation		1.79869	
	Minimum		1.00	
	Maximum		6.00	
	Range		5.00	
	Interquartile Range		3.00	
	Skewness		-.417	.550
	Kurtosis		-1.118	1.063
I have a regular place set aside for studying.	Mean		4.7647	.51827
	95% Confidence Interval for Mean	Lower Bound	3.6660	
		Upper Bound	5.8634	
	5% Trimmed Mean		4.8497	
	Median		5.0000	
	Variance		4.566	
	Std. Deviation		2.13686	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.568	.550
	Kurtosis		-.984	1.063
I try to play around with ideas of	Mean		4.7059	.48328

my own related to what I am learning in this course.	95% Confidence Interval for Mean	Lower Bound	3.6814	
		Upper Bound	5.7304	
	5% Trimmed Mean		4.7843	
	Median		5.0000	
	Variance		3.971	
	Std. Deviation		1.99263	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.560	.550
	Kurtosis		-.640	1.063
When I study for this course, I write brief summaries of the main ideas from the readings and my class notes.	Mean		4.8235	.50173
	95% Confidence Interval for Mean	Lower Bound	3.7599	
		Upper Bound	5.8871	
	5% Trimmed Mean		4.9150	
	Median		5.0000	
	Variance		4.279	
	Std. Deviation		2.06867	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.597	.550
	Kurtosis		-.775	1.063
When I can't understand the material in this course, I ask another student in this class for help.	Mean		5.0588	.57183
	95% Confidence Interval for Mean	Lower Bound	3.8466	
		Upper Bound	6.2710	
	5% Trimmed Mean		5.1765	
	Median		6.0000	
	Variance		5.559	
	Std. Deviation		2.35772	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.50	
	Skewness		-.760	.550
	Kurtosis		-1.145	1.063
I try to understand the material in this class by making connections between the readings	Mean		5.5294	.32219
	95% Confidence Interval for Mean	Lower Bound	4.8464	
		Upper Bound	6.2124	

and the concepts from the lectures.	5% Trimmed Mean		5.5882	
	Median		6.0000	
	Variance		1.765	
	Std. Deviation		1.32842	
	Minimum		3.00	
	Maximum		7.00	
	Range		4.00	
	Interquartile Range		2.00	
	Skewness		-.797	.550
	Kurtosis		-.381	1.063
I make sure that I keep up with the weekly readings and assignments for this course.	Mean		5.0588	.50345
	95% Confidence Interval for Mean	Lower Bound	3.9916	
		Upper Bound	6.1261	
	5% Trimmed Mean		5.1765	
	Median		6.0000	
	Variance		4.309	
	Std. Deviation		2.07577	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.849	.550
	Kurtosis		-.377	1.063
Whenever I read or hear an assertion or conclusion in this class, I think about possible alternatives.	Mean		5.2941	.43525
	95% Confidence Interval for Mean	Lower Bound	4.3714	
		Upper Bound	6.2168	
	5% Trimmed Mean		5.4379	
	Median		6.0000	
	Variance		3.221	
	Std. Deviation		1.79460	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-1.163	.550
	Kurtosis		.819	1.063
I make lists of important items for this course and memorize the lists.	Mean		4.0588	.53186
	95% Confidence Interval for Mean	Lower Bound	2.9313	
		Upper Bound	5.1863	
	5% Trimmed Mean		4.0654	
	Median		4.0000	

	Variance		4.809	
	Std. Deviation		2.19290	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.50	
	Skewness		.036	.550
	Kurtosis		-1.239	1.063
I attend this class regularly.	Mean		5.1765	.55727
	95% Confidence Interval for Mean	Lower Bound	3.9951	
		Upper Bound	6.3578	
	5% Trimmed Mean		5.3072	
	Median		7.0000	
	Variance		5.279	
	Std. Deviation		2.29770	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.805	.550
	Kurtosis		-.917	1.063
Even when course materials are dull and uninteresting, I manage to keep working until I finish.	Mean		5.2353	.45801
	95% Confidence Interval for Mean	Lower Bound	4.2644	
		Upper Bound	6.2062	
	5% Trimmed Mean		5.3725	
	Median		6.0000	
	Variance		3.566	
	Std. Deviation		1.88843	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.699	.550
	Kurtosis		-.438	1.063
I try to identify students in this class	Mean		4.5294	.57598
	95% Confidence Interval for Mean	Lower Bound	3.3084	
		Upper Bound	5.7504	
	5% Trimmed Mean		4.5882	
	Median		6.0000	
	Variance		5.640	
	Std. Deviation		2.37481	

	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.50	
	Skewness		-.565	.550
	Kurtosis		-1.355	1.063
When studying for this course I try to determine which concepts I don't understand well.	Mean		4.8824	.43625
	95% Confidence Interval for Mean	Lower Bound	3.9576	
		Upper Bound	5.8072	
	5% Trimmed Mean		4.9804	
	Median		6.0000	
	Variance		3.235	
	Std. Deviation		1.79869	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.605	.550
	Kurtosis		-.627	1.063
I often find that I don't spend very much time on this course because of other activities.	Mean		4.2353	.55921
	95% Confidence Interval for Mean	Lower Bound	3.0498	
		Upper Bound	5.4208	
	5% Trimmed Mean		4.2614	
	Median		4.0000	
	Variance		5.316	
	Std. Deviation		2.30568	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		4.00	
	Skewness		-.256	.550
	Kurtosis		-1.636	1.063
When I study for this class, set goals for myself in order to direct my activities in each study period.	Mean		4.1765	.50173
	95% Confidence Interval for Mean	Lower Bound	3.1129	
		Upper Bound	5.2401	
	5% Trimmed Mean		4.1961	
	Median		5.0000	
	Variance		4.279	
	Std. Deviation		2.06867	
	Minimum		1.00	
	Maximum		7.00	

	Range		6.00	
	Interquartile Range		3.00	
	Skewness		-.267	.550
	Kurtosis		-.993	1.063
If I get confused taking notes in class, I make sure I sort it out afterwards.	Mean		4.3529	.52118
	95% Confidence Interval for Mean	Lower Bound	3.2481	
		Upper Bound	5.4578	
	5% Trimmed Mean		4.3922	
	Median		4.0000	
	Variance		4.618	
	Std. Deviation		2.14887	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		3.50	
	Skewness		-.392	.550
	Kurtosis		-1.137	1.063
I rarely find time to review my notes or readings before an exam.	Mean		5.2353	.47379
	95% Confidence Interval for Mean	Lower Bound	4.2309	
		Upper Bound	6.2397	
	5% Trimmed Mean		5.3725	
	Median		6.0000	
	Variance		3.816	
	Std. Deviation		1.95350	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	
	Interquartile Range		2.50	
	Skewness		-1.058	.550
	Kurtosis		.110	1.063
I try to apply ideas from course readings in other class activities such as lecture and discussion.	Mean		4.8235	.53712
	95% Confidence Interval for Mean	Lower Bound	3.6849	
		Upper Bound	5.9622	
	5% Trimmed Mean		4.9150	
	Median		5.0000	
	Variance		4.904	
	Std. Deviation		2.21459	
	Minimum		1.00	
	Maximum		7.00	
	Range		6.00	

	Interquartile Range	4.00	
	Skewness	-.805	.550
	Kurtosis	-.699	1.063

E.5 Case Processing Summary Descriptive analysis of each item in classroom learning environment questionnaire

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
The instructor clearly communicated important course topics.	24	88.9%	3	11.1%	27	100.0%
The instructor clearly communicated important course goals.	24	88.9%	3	11.1%	27	100.0%
The instructor provided clear instructions on how to participate in course learning activities.	24	88.9%	3	11.1%	27	100.0%
The instructor clearly communicated important due dates/time frames for learning activities.	24	88.9%	3	11.1%	27	100.0%
The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	24	88.9%	3	11.1%	27	100.0%
The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	24	88.9%	3	11.1%	27	100.0%
The instructor helped to keep course participants engaged and participating in productive dialogue.	24	88.9%	3	11.1%	27	100.0%
The instructor helped keep the course participants on task in a way that helped me to learn.	24	88.9%	3	11.1%	27	100.0%
The instructor encouraged course participants to explore new concepts in this course.	24	88.9%	3	11.1%	27	100.0%

Instructor actions reinforced the development of a sense of community among course participants	24	88.9%	3	11.1%	27	100.0%
The instructor helped to focus discussion on relevant issues in a way that helped me to learn.	24	88.9%	3	11.1%	27	100.0%
The instructor provided feedback that helped me understand my strengths and weaknesses.	24	88.9%	3	11.1%	27	100.0%
The instructor provided feedback in a timely fashion.	24	88.9%	3	11.1%	27	100.0%
Getting to know other course participants gave me a sense of belonging in the course.	24	88.9%	3	11.1%	27	100.0%
I was able to form distinct impressions of some course participants.	24	88.9%	3	11.1%	27	100.0%
Classroom discussion in form of discussion in groups is an excellent medium for social interaction	24	88.9%	3	11.1%	27	100.0%
I felt comfortable conversing through the mapping software medium.	24	88.9%	3	11.1%	27	100.0%
Felt comfortable participating in the course discussions.	24	88.9%	3	11.1%	27	100.0%
I felt comfortable interacting with other course participants.	24	88.9%	3	11.1%	27	100.0%
I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	24	88.9%	3	11.1%	27	100.0%
I felt that my point of view was acknowledged by other course participants.	24	88.9%	3	11.1%	27	100.0%
Classroom discussions help me to develop a sense of collaboration	24	88.9%	3	11.1%	27	100.0%
Problems posed increased my interest in course issues.	24	88.9%	3	11.1%	27	100.0%
Course activities piqued my curiosity.	24	88.9%	3	11.1%	27	100.0%

I felt motivated to explore content related questions.	24	88.9%	3	11.1%	27	100.0%
I utilized a variety of information sources to explore problems posed in this course.	24	88.9%	3	11.1%	27	100.0%
Brainstorming and finding relevant information helped me resolve content related questions.	24	88.9%	3	11.1%	27	100.0%
Classroom discussions were valuable in helping me appreciate different perspectives	24	88.9%	3	11.1%	27	100.0%
Combining new information helped me answer questions raised in course activities.	24	88.9%	3	11.1%	27	100.0%
Learning activities helped me construct explanations/solutions.	24	88.9%	3	11.1%	27	100.0%
Reflection on course content and discussions helped me understand fundamental concepts in this class.	24	88.9%	3	11.1%	27	100.0%
I can describe ways to test and apply the knowledge created in this course.	24	88.9%	3	11.1%	27	100.0%
I have developed solutions to course problems that can be applied in practice.	24	88.9%	3	11.1%	27	100.0%
I can apply the knowledge created in this course to my work or other non-class related activities.	24	88.9%	3	11.1%	27	100.0%

E.6 Descriptive analysis of each item in classroom learning environment questionnaire

			Statistic	Std. Error
The instructor clearly communicated important course topics.	Mean		3.9583	.15322
	95% Confidence Interval for Mean	Lower Bound	3.6414	
		Upper Bound	4.2753	
	5% Trimmed Mean		4.0000	
	Median		4.0000	
	Variance		.563	
	Std. Deviation		.75060	
	Minimum		2.00	
	Maximum		5.00	

	Range		3.00	
	Interquartile Range		.00	
	Skewness		-.603	.472
	Kurtosis		.829	.918
The instructor clearly communicated important course goals.	Mean		4.1667	.09829
	95% Confidence Interval for Mean	Lower Bound	3.9633	
		Upper Bound	4.3700	
	5% Trimmed Mean		4.1759	
	Median		4.0000	
	Variance		.232	
	Std. Deviation		.48154	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		.00	
	Skewness		.519	.472
	Kurtosis		1.057	.918
The instructor provided clear instructions on how to participate in course learning activities.	Mean		4.0417	.16462
	95% Confidence Interval for Mean	Lower Bound	3.7011	
		Upper Bound	4.3822	
	5% Trimmed Mean		4.0463	
	Median		4.0000	
	Variance		.650	
	Std. Deviation		.80645	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		2.00	
	Skewness		-.079	.472
	Kurtosis		-1.434	.918
The instructor clearly communicated important due dates/time frames for learning activities.	Mean		3.9167	.14641
	95% Confidence Interval for Mean	Lower Bound	3.6138	
		Upper Bound	4.2195	
	5% Trimmed Mean		3.9074	
	Median		4.0000	
	Variance		.514	
	Std. Deviation		.71728	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		1.00	

	Skewness		.125	.472
	Kurtosis		-.912	.918
The instructor was helpful in identifying areas of agreement and disagreement on course topics that helped me to learn.	Mean		4.0000	.15926
	95% Confidence Interval for Mean	Lower Bound	3.6706	
		Upper Bound	4.3294	
	5% Trimmed Mean		4.0463	
	Median		4.0000	
	Variance		.609	
	Std. Deviation		.78019	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		.75	
	Skewness		-.599	.472
	Kurtosis		.527	.918
The instructor was helpful in guiding the class towards understanding course topics in a way that helped me clarify my thinking.	Mean		3.9583	.15322
	95% Confidence Interval for Mean	Lower Bound	3.6414	
		Upper Bound	4.2753	
	5% Trimmed Mean		3.9537	
	Median		4.0000	
	Variance		.563	
	Std. Deviation		.75060	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		1.75	
	Skewness		.070	.472
	Kurtosis		-1.128	.918
The instructor helped to keep course participants engaged and participating in productive dialogue.	Mean		3.9167	.16936
	95% Confidence Interval for Mean	Lower Bound	3.5663	
		Upper Bound	4.2670	
	5% Trimmed Mean		3.9630	
	Median		4.0000	
	Variance		.688	
	Std. Deviation		.82970	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		.00	
	Skewness		-.833	.472
	Kurtosis		.854	.918

The instructor helped keep the course participants on task in a way that helped me to learn.	Mean		4.1667	.15542
	95% Confidence Interval for Mean	Lower Bound	3.8452	
		Upper Bound	4.4882	
	5% Trimmed Mean		4.1852	
	Median		4.0000	
	Variance		.580	
	Std. Deviation		.76139	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		1.00	
	Skewness		-.298	.472
	Kurtosis		-1.148	.918
The instructor encouraged course participants to explore new concepts in this course.	Mean		3.9583	.15322
	95% Confidence Interval for Mean	Lower Bound	3.6414	
		Upper Bound	4.2753	
	5% Trimmed Mean		3.9537	
	Median		4.0000	
	Variance		.563	
	Std. Deviation		.75060	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		1.75	
	Skewness		.070	.472
	Kurtosis		-1.128	.918
Instructor actions reinforced the development of a sense of community among course participants	Mean		3.7500	.19271
	95% Confidence Interval for Mean	Lower Bound	3.3513	
		Upper Bound	4.1487	
	5% Trimmed Mean		3.7778	
	Median		4.0000	
	Variance		.891	
	Std. Deviation		.94409	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.75	
	Skewness		-.127	.472
	Kurtosis		-.879	.918
The instructor helped to focus	Mean		4.0417	.15322

discussion on relevant issues in a way that helped me to learn.	95% Confidence Interval for Mean	Lower Bound	3.7247	
		Upper Bound	4.3586	
	5% Trimmed Mean		4.0463	
	Median		4.0000	
	Variance		.563	
	Std. Deviation		.75060	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		1.75	
	Skewness		-.070	.472
	Kurtosis		-1.128	.918
The instructor provided feedback that helped me understand my strengths and weaknesses.	Mean		3.9167	.15830
	95% Confidence Interval for Mean	Lower Bound	3.5892	
		Upper Bound	4.2441	
	5% Trimmed Mean		3.9537	
	Median		4.0000	
	Variance		.601	
	Std. Deviation		.77553	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		.75	
	Skewness		-.460	.472
	Kurtosis		.298	.918
The instructor provided feedback in a timely fashion.	Mean		3.5000	.17025
	95% Confidence Interval for Mean	Lower Bound	3.1478	
		Upper Bound	3.8522	
	5% Trimmed Mean		3.5000	
	Median		3.0000	
	Variance		.696	
	Std. Deviation		.83406	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		.245	.472
	Kurtosis		-.343	.918
Getting to know other course participants gave me a sense of belonging in the course.	Mean		3.4167	.17974
	95% Confidence Interval for Mean	Lower Bound	3.0448	
		Upper Bound	3.7885	

	5% Trimmed Mean		3.4074	
	Median		3.5000	
	Variance		.775	
	Std. Deviation		.88055	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.141	.472
	Kurtosis		-.610	.918
I was able to form distinct impressions of some course participants.	Mean		3.4167	.14641
	95% Confidence Interval for Mean	Lower Bound	3.1138	
		Upper Bound	3.7195	
	5% Trimmed Mean		3.4167	
	Median		3.0000	
	Variance		.514	
	Std. Deviation		.71728	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.068	.472
	Kurtosis		-.058	.918
Classroom discussion in form of discussion in groups is an excellent medium for social interaction	Mean		4.0417	.16462
	95% Confidence Interval for Mean	Lower Bound	3.7011	
		Upper Bound	4.3822	
	5% Trimmed Mean		4.0463	
	Median		4.0000	
	Variance		.650	
	Std. Deviation		.80645	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		2.00	
	Skewness		-.079	.472
	Kurtosis		-1.434	.918
I felt comfortable conversing through the mapping software medium.	Mean		3.3750	.17869
	95% Confidence Interval for Mean	Lower Bound	3.0054	
		Upper Bound	3.7446	
	5% Trimmed Mean		3.4074	
	Median		3.0000	

	Variance		.766	
	Std. Deviation		.87539	
	Minimum		1.00	
	Maximum		5.00	
	Range		4.00	
	Interquartile Range		1.00	
	Skewness		-.431	.472
	Kurtosis		1.449	.918
Felt comfortable participating in the course discussions.	Mean		3.7083	.17528
	95% Confidence Interval for Mean	Lower Bound	3.3457	
		Upper Bound	4.0709	
	5% Trimmed Mean		3.7315	
	Median		4.0000	
	Variance		.737	
	Std. Deviation		.85867	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.267	.472
	Kurtosis		-.318	.918
I felt comfortable interacting with other course participants.	Mean		3.6250	.15711
	95% Confidence Interval for Mean	Lower Bound	3.3000	
		Upper Bound	3.9500	
	5% Trimmed Mean		3.6389	
	Median		4.0000	
	Variance		.592	
	Std. Deviation		.76967	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.458	.472
	Kurtosis		.172	.918
I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	Mean		3.4583	.14719
	95% Confidence Interval for Mean	Lower Bound	3.1539	
		Upper Bound	3.7628	
	5% Trimmed Mean		3.4630	
	Median		3.5000	
	Variance		.520	
	Std. Deviation		.72106	

	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.222	.472
	Kurtosis		-.076	.918
I felt that my point of view was acknowledged by other course participants.	Mean		3.5833	.14641
	95% Confidence Interval for Mean	Lower Bound	3.2805	
		Upper Bound	3.8862	
	5% Trimmed Mean		3.6019	
	Median		4.0000	
	Variance		.514	
	Std. Deviation		.71728	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.703	.472
	Kurtosis		.368	.918
Classroom discussions help me to develop a sense of collaboration	Mean		3.9167	.16936
	95% Confidence Interval for Mean	Lower Bound	3.5663	
		Upper Bound	4.2670	
	5% Trimmed Mean		3.9074	
	Median		4.0000	
	Variance		.688	
	Std. Deviation		.82970	
	Minimum		3.00	
	Maximum		5.00	
	Range		2.00	
	Interquartile Range		2.00	
	Skewness		.164	.472
	Kurtosis		-1.529	.918
Problems posed increased my interest in course issues.	Mean		3.7917	.15902
	95% Confidence Interval for Mean	Lower Bound	3.4627	
		Upper Bound	4.1206	
	5% Trimmed Mean		3.8241	
	Median		4.0000	
	Variance		.607	
	Std. Deviation		.77903	
	Minimum		2.00	
	Maximum		5.00	

	Range		3.00	
	Interquartile Range		.75	
	Skewness		-.809	.472
	Kurtosis		.950	.918
Course activities piqued my curiosity.	Mean		3.3333	.14329
	95% Confidence Interval for Mean	Lower Bound	3.0369	
		Upper Bound	3.6297	
	5% Trimmed Mean		3.3241	
	Median		3.0000	
	Variance		.493	
	Std. Deviation		.70196	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		.244	.472
	Kurtosis		.234	.918
I felt motivated to explore content related questions.	Mean		3.4583	.15902
	95% Confidence Interval for Mean	Lower Bound	3.1294	
		Upper Bound	3.7873	
	5% Trimmed Mean		3.4630	
	Median		4.0000	
	Variance		.607	
	Std. Deviation		.77903	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.452	.472
	Kurtosis		-.276	.918
I utilized a variety of information sources to explore problems posed in this course.	Mean		3.5000	.17025
	95% Confidence Interval for Mean	Lower Bound	3.1478	
		Upper Bound	3.8522	
	5% Trimmed Mean		3.5093	
	Median		4.0000	
	Variance		.696	
	Std. Deviation		.83406	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	

	Skewness		-.736	.472
	Kurtosis		-.343	.918
Brainstorming and finding relevant information helped me resolve content related questions.	Mean		3.7500	.13792
	95% Confidence Interval for Mean	Lower Bound	3.4647	
		Upper Bound	4.0353	
	5% Trimmed Mean		3.7685	
	Median		4.0000	
	Variance		.457	
	Std. Deviation		.67566	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.577	.472
	Kurtosis		.959	.918
Classroom discussions were valuable in helping me appreciate different perspectives	Mean		3.8333	.15542
	95% Confidence Interval for Mean	Lower Bound	3.5118	
		Upper Bound	4.1548	
	5% Trimmed Mean		3.8704	
	Median		4.0000	
	Variance		.580	
	Std. Deviation		.76139	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		.00	
	Skewness		-.991	.472
	Kurtosis		1.540	.918
Combining new information helped me answer questions raised in course activities.	Mean		3.7500	.21068
	95% Confidence Interval for Mean	Lower Bound	3.3142	
		Upper Bound	4.1858	
	5% Trimmed Mean		3.8241	
	Median		4.0000	
	Variance		1.065	
	Std. Deviation		1.03209	
	Minimum		1.00	
	Maximum		5.00	
	Range		4.00	
	Interquartile Range		1.00	
	Skewness		-1.003	.472
	Kurtosis		1.017	.918

Learning activities helped me construct explanations/solutions.	Mean		3.8750	.18369
	95% Confidence Interval for Mean	Lower Bound	3.4950	
		Upper Bound	4.2550	
	5% Trimmed Mean		3.9537	
	Median		4.0000	
	Variance		.810	
	Std. Deviation		.89988	
	Minimum		1.00	
	Maximum		5.00	
	Range		4.00	
	Interquartile Range		.75	
	Skewness		-1.300	.472
	Kurtosis		3.390	.918
Reflection on course content and discussions helped me understand fundamental concepts in this class.	Mean		3.7917	.19015
	95% Confidence Interval for Mean	Lower Bound	3.3983	
		Upper Bound	4.1850	
	5% Trimmed Mean		3.8704	
	Median		4.0000	
	Variance		.868	
	Std. Deviation		.93153	
	Minimum		1.00	
	Maximum		5.00	
	Range		4.00	
	Interquartile Range		.75	
	Skewness		-1.309	.472
	Kurtosis		2.651	.918
I can describe ways to test and apply the knowledge created in this course.	Mean		3.5417	.14719
	95% Confidence Interval for Mean	Lower Bound	3.2372	
		Upper Bound	3.8461	
	5% Trimmed Mean		3.5370	
	Median		3.5000	
	Variance		.520	
	Std. Deviation		.72106	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		.222	.472
	Kurtosis		-.076	.918
I have developed solutions to	Mean		3.4583	.14719

course problems that can be applied in practice.	95% Confidence Interval for Mean	Lower Bound	3.1539	
		Upper Bound	3.7628	
	5% Trimmed Mean		3.4630	
	Median		3.5000	
	Variance		.520	
	Std. Deviation		.72106	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		-.222	.472
	Kurtosis		-.076	.918
I can apply the knowledge created in this course to my work or other non-class related activities.	Mean		3.7083	.16462
	95% Confidence Interval for Mean	Lower Bound	3.3678	
		Upper Bound	4.0489	
	5% Trimmed Mean		3.7222	
	Median		4.0000	
	Variance		.650	
	Std. Deviation		.80645	
	Minimum		2.00	
	Maximum		5.00	
	Range		3.00	
	Interquartile Range		1.00	
	Skewness		.062	.472
	Kurtosis		-.500	.918

T-tests (Experimental and control group)

```
GET
  FILE='\\soton.ac.uk\ude\PersonalFiles\Users\sm1c11\mydocuments\PhD RESEARCH\DataentryAnalysis\Datafiles\Datafile42groups_2015Working.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
T-TEST GROUPS=Inter_nonIntervn(0 1)
  /MISSING=ANALYSIS
  /VARIABLES=Scores_pretest_  /CRITERIA=CI(.95).
```

T-Test

Group Statistics

	0 for studentIDNon, 1 forstudentIDintervention	N	Mean	Std. Deviation	Std. Error Mean
Scores_pretest_	NonIntervention	32	3.97	2.040	.361
	Intervention	27	4.44	2.006	.386

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Scores_pretest_	Equal variances assumed	.186	.668	-.899	57	.372	-.476	.529	-1.535	.584
	Equal variances not assumed			-.900	55.634	.372	-.476	.528	-1.534	.583

T-Test

Group Statistics

	0 for studentIDNon, 1 forstudentIDintervention	N	Mean	Std. Deviation	Std. Error Mean
Scores_posttest_	NonIntervention	32	4.00	2.851	.504
	Intervention	27	3.48	2.225	.428

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Scores_posttest_	Equal variances assumed	1.827	.182	.768	57	.446	.519	.675	-.834	1.871
	Equal variances not assumed			.784	56.689	.436	.519	.661	-.806	1.843

Group	N	Mean	SD	T	df	p
Pre-test				-.899	57	.37
Intervention	27	4.44	2.00			
No-intervention	32	3.97	2.04			
Post-test				.768	57	.45
Intervention	27	3.48	2.22			
No-intervention	32	4.00	2.85			

Mediation analysis (Experimental group only)

E.8a Mediation analysis of motivation/self-regulation questionnaire

Run MATRIX procedure:

```
************* PROCESS Procedure for SPSS Release 2.16.3 *****************

      Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
   Documentation available in Hayes (2013). www.guilford.com/p/hayes3

**************************************************************************
Model = 4
   Y = S_I_post
   X = Score_LE
   M = MSLQM

Sample size
       27

**************************************************************************
Outcome: MSLQM
```

```
Model Summary
      R     R-sq      MSE       F      df1      df2       p
    .2194    .0481    .5278    1.2641    1.0000   25.0000    .2716

Model
          coeff       se        t       p
constant    3.5131    1.2658    2.7754     .0103
Score_LE     .3684     .3277    1.1243     .2716

**************************************************************************
Outcome: S_I_post

Model Summary
      R     R-sq      MSE       F      df1      df2       p
    .2085    .0435    4.7030     .5452    2.0000   24.0000    .5867

Model
          coeff       se        t       p
constant    6.3179    4.3217    1.4619     .1567
MSLQM      -.6188     .5970   -1.0365     .3103
Score_LE     .1036    1.0026     .1034     .9185

************************** TOTAL EFFECT MODEL ****************************
Outcome: S_I_post

Model Summary
      R     R-sq      MSE       F      df1      df2       p
    .0254    .0006    4.7170     .0161    1.0000   25.0000    .9000

Model
          coeff       se        t       p
constant    4.1440    3.7843    1.0951     .2839
Score_LE    -.1243     .9796    -.1269     .9000
***************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
   Effect       SE        t       p
   -.1243     .9796    -.1269     .9000

Direct effect of X on Y
   Effect       SE        t       p
    .1036    1.0026     .1034     .9185

Indirect effect of X on Y
        Effect   Boot SE   BootLLCI   BootULCI
MSLQM    -.2280     .3313   -1.2948     .1769

Partially standardized indirect effect of X on Y
        Effect   Boot SE   BootLLCI   BootULCI
MSLQM    -.1070     .1637    -.6079     .1010

Completely standardized indirect effect of X on Y
        Effect   Boot SE   BootLLCI   BootULCI
MSLQM    -.0465     .0651    -.2434     .0360

Ratio of indirect to total effect of X on Y
        Effect   Boot SE   BootLLCI   BootULCI
MSLQM    1.8337 3.745E+012     .6984 4.804E+014

Ratio of indirect to direct effect of X on Y
        Effect   Boot SE   BootLLCI   BootULCI
MSLQM   -2.1995   189.8856 -34975.188   -1.0169

R-squared mediation effect size (R-sq_med)
        Effect   Boot SE   BootLLCI   BootULCI
MSLQM     .0002     .0230    -.0343     .0617

Normal theory tests for indirect effect
   Effect       se        Z       p
   -.2280     .3574    -.6378     .5236

******************* ANALYSIS NOTES AND WARNINGS *************************
```

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
  50000

WARNING: Bootstrap CI endpoints below not trustworthy. Decrease confidence or increase bootstraps
 -34975.188

Level of confidence for all confidence intervals in output:
  95.00

NOTE: Kappa-squared is disabled from output as of version 2.16.

------ END MATRIX -----

E.8b Mediation analysis of learning environment questionnaire

```
Run MATRIX procedure:

************* PROCESS Procedure for SPSS Release 2.16.3 *****************

          Written by Andrew F. Hayes, Ph.D.       www.afhayes.com
    Documentation available in Hayes (2013). www.guilford.com/p/hayes3
**************************************************************************
Model = 4
    Y = S_I_post
    X = MSLQM
    M = Score_LE

Sample size
       27
**************************************************************************
Outcome: Score_LE

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2194      .0481      .1872     1.2641     1.0000    25.0000      .2716

Model
              coeff         se          t          p
constant     3.1957      .5786     5.5232      .0000
MSLQM         .1306      .1162     1.1243      .2716

**************************************************************************
Outcome: S_I_post

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2085      .0435     4.7030      .5452     2.0000    24.0000      .5867

Model
              coeff         se          t          p
constant     6.3179     4.3217     1.4619      .1567
Score_LE      .1036     1.0026      .1034      .9185
MSLQM        -.6188      .5970    -1.0365      .3103

************************** TOTAL EFFECT MODEL ****************************
Outcome: S_I_post

Model Summary
          R       R-sq        MSE          F        df1        df2          p
      .2074      .0430     4.5169     1.1242     1.0000    25.0000      .2992

Model
              coeff         se          t          p
constant     6.6491     2.8425     2.3392      .0276
MSLQM        -.6052      .5708    -1.0603      .2992

***************** TOTAL, DIRECT, AND INDIRECT EFFECTS ********************

Total effect of X on Y
     Effect         SE          t          p
     -.6052      .5708    -1.0603      .2992
```

```
Direct effect of X on Y
    Effect        SE         t         p
   -.6188     .5970    -1.0365     .3103

Indirect effect of X on Y
         Effect    Boot SE   BootLLCI   BootULCI
Score_LE     .0135     .1522    -.2280     .4317

Partially standardized indirect effect of X on Y
         Effect    Boot SE   BootLLCI   BootULCI
Score_LE     .0064     .0737    -.1199     .2070

Completely standardized indirect effect of X on Y
         Effect    Boot SE   BootLLCI   BootULCI
Score_LE     .0046     .0498    -.0869     .1292

Ratio of indirect to total effect of X on Y
         Effect    Boot SE   BootLLCI   BootULCI
Score_LE    -.0224   19.6272   -3.3751     .6614

Ratio of indirect to direct effect of X on Y
         Effect    Boot SE   BootLLCI   BootULCI
Score_LE    -.0219    1.8086   -2.8332     .9150

R-squared mediation effect size (R-sq_med)
         Effect    Boot SE   BootLLCI   BootULCI
Score_LE     .0002     .0230    -.0383     .0593

Normal theory tests for indirect effect
    Effect        se         Z         p
     .0135     .1757     .0771     .9386
******************** ANALYSIS NOTES AND WARNINGS *************************

Number of bootstrap samples for bias corrected bootstrap confidence intervals:
    1000

Level of confidence for all confidence intervals in output:
   95.00
NOTE: Kappa-squared is disabled from output as of version 2.16.
------ END MATRIX -----
```

Regression analysis simple and multiple linear (Experimental group only)

E.8c Value added approach to analysis

```
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RESEARCH\DataentryAnalysis\Datafiles\EXPNewVar.sav'.
DATASET NAME DataSet1 WINDOW=FRONT.
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  FILE='\\soton.ac.uk\ude\PersonalFiles\Users\sm1c11\mydocuments\PhD
RESEARCH\DataentryAnalysis\Datafiles\Datafinal_Variables.sav'.
DATASET NAME DataSet2 WINDOW=FRONT.
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT SIntrpos
  /METHOD=ENTER S_Moti
  /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID).
```

Regression1

[DataSet2] \\soton.ac.uk\ude\PersonalFiles\Users\sm1c11\mydocuments\PhD
RESEARCH\DataentryAnalysis\Datafiles\Datafinal_Variables.sav

Descriptive Statistics

	Mean	Std. Deviation	N
SIntrpos	3.6667	2.13037	27
S_Moti	4.8333	1.00863	27

Correlations

		SIntrpos	S_Moti
Pearson Correlation	SIntrpos	1.000	-.263
	S_Moti	-.263	1.000
Sig. (1-tailed)	SIntrpos	.	.093
	S_Moti	.093	.
N	SIntrpos	27	27
	S_Moti	27	27

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	S_Moti[b]	.	Enter

a. Dependent Variable: SIntrpos

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.263[a]	.069	.032	2.09635	.069	1.851	1	25	.186	1.881

a. Predictors: (Constant), S_Moti

b. Dependent Variable: SIntrpos

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.133	1	8.133	1.851	.186[b]
	Residual	109.867	25	4.395		
	Total	118.000	26			

a. Dependent Variable: SIntrpos

b. Predictors: (Constant), S_Moti

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	Upper Bound
1	(Constant)	6.347	2.011		3.156	.004	2.205	10.488
	S_Moti	-.554	.408	-.263	-1.360	.186	-1.394	.285

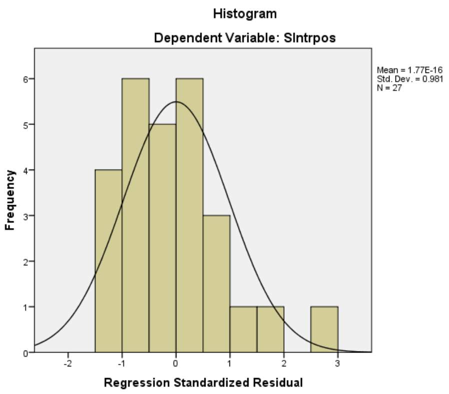
a. Dependent Variable: SIntrpos

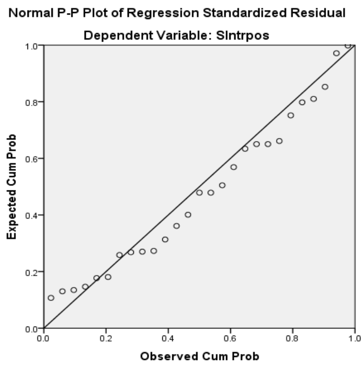
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.5269	4.7448	3.6667	.55928	27
Residual	-2.60506	6.27172	.00000	2.05564	27
Std. Predicted Value	-2.038	1.928	.000	1.000	27
Std. Residual	-1.243	2.992	.000	.981	27

a. Dependent Variable: SIntrpos

Charts





Simple Linear regression 1 and 2

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS CI(95) R ANOVA CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT SIntrpos
  /METHOD=ENTER Score_LE
  /RESIDUALS DURBIN HISTOGRAM(ZRESID) NORMPROB(ZRESID).
```

Regression 2

Descriptive Statistics

	Mean	Std. Deviation	N
SIntrpos	3.6667	2.13037	27
Score_LE	3.8395	.43481	27

Correlations

		SIntrpos	Score_LE
Pearson Correlation	SIntrpos	1.000	-.025
	Score_LE	-.025	1.000
Sig. (1-tailed)	SIntrpos	.	.450
	Score_LE	.450	.
N	SIntrpos	27	27
	Score_LE	27	27

Appendix

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Score_LE[b]	.	Enter

a. Dependent Variable: SIntrpos

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.025[a]	.001	-.039	2.17186	.001	.016	1	25	.900	1.934

a. Predictors: (Constant), Score_LE

b. Dependent Variable: SIntrpos

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.076	1	.076	.016	.900[b]
	Residual	117.924	25	4.717		
	Total	118.000	26			

a. Dependent Variable: SIntrpos

b. Predictors: (Constant), Score_LE

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	4.144	3.784		1.095	.284	-3.650	11.938
	Score_LE	-.124	.980	-.025	-.127	.900	-2.142	1.893

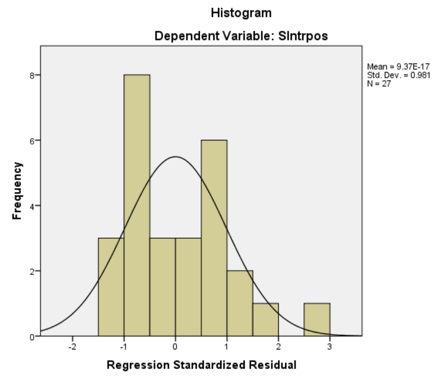
a. Dependent Variable: SIntrpos

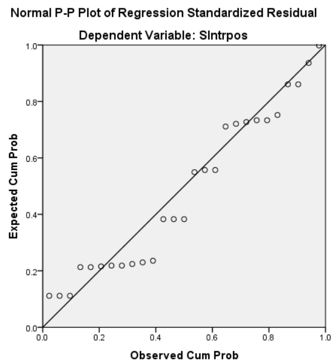
Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.5224	3.7918	3.6667	.05406	27
Residual	-2.64671	6.35329	.00000	2.12968	27
Std. Predicted Value	-2.669	2.314	.000	1.000	27
Std. Residual	-1.219	2.925	.000	.981	27

a. Dependent Variable: SIntrpos

Charts





Regression multiple linear (Experimental group only)

Multiple linear regression 3, 4 and 5

3: Regression(S-I-Post, MCognitive -self-regulation, Extrinsic-Intrinsic Goal orientation)

Descriptive Statistics

	Mean	Std. Deviation	N
S_I_post	3.6667	2.13037	27
MCog_SR	4.7037	1.40917	27
Ex_IntG	5.4568	.90157	27

Correlations

		S_I_post	Cog_SR	Ex_IntG
Pearson Correlation	S_I_post	1.000	-.457	.147
	MCog_SR	-.457	1.000	.088
	Ex_IntG	.147	.088	1.000
Sig. (1-tailed)	S_I_post	.	.008	.233
	MCog_SR	.008	.	.331
	Ex_IntG	.233	.331	.
N	S_I_post	27	27	27
	MCog_SR	27	27	27
	Ex_IntG	27	27	27

Appendix

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Ex_IntG, MCog_SR[b]	.	Enter

a. Dependent Variable: S_I_post

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.494[a]	.244	.181	1.92801	1.884

a. Predictors: (Constant), Ex_IntG,M Cog_SR

b. Dependent Variable: S_I_post

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.787	2	14.393	3.872	.035[b]
	Residual	89.213	24	3.717		
	Total	118.000	26			

a. Dependent Variable: S_I_post

b. Predictors: (Constant), Ex_IntG, Cog_SR

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	4.607	2.551		1.806	.084		
Cog_SR	-.716	.269	-.474	-2.657	.014	.992	1.008
Ex_IntG	.445	.421	.188	1.056	.301	.992	1.008

a. Dependent Variable: S_I_post

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	MCog_SR	Ex_IntG
1	1	2.932	1.000	.00	.01	.00
	2	.056	7.242	.04	.94	.11
	3	.012	15.417	.96	.06	.89

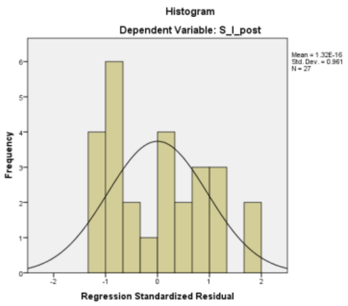
a. Dependent Variable: S_I_post

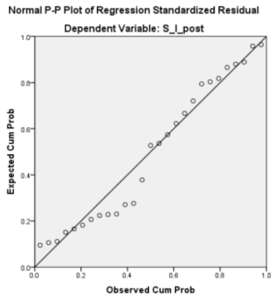
Residuals Statistics[a]

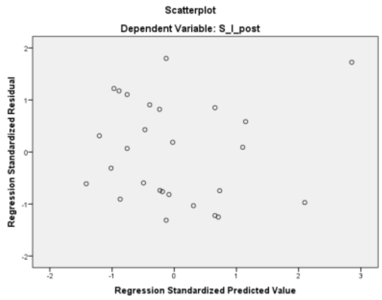
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.1777	6.6707	3.6667	1.05222	27
Residual	-2.52937	3.47063	.00000	1.85237	27
Std. Predicted Value	-1.415	2.855	.000	1.000	27
Std. Residual	-1.312	1.800	.000	.961	27

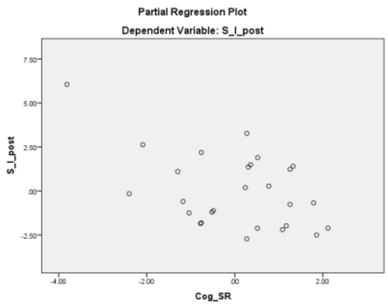
a. Dependent Variable: S_I_post

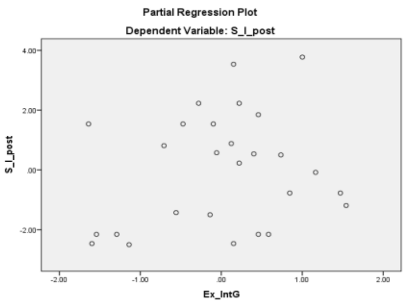
Charts











4: Stepwise Multiple Regression(S-I-Post, metacognitive -self-regulation, critical thinking subscales)

Descriptive Statistics			
	Mean	Std. Deviation	N
S_I_post	3.6667	2.13037	27
MCog_SR	4.7037	1.40917	27
Cr_Th	4.7037	1.20304	27

Correlations				
		S_I_post	MCog_SR	Cr_Th
Pearson Correlation	S_I_post	1.000	-.457	.200
	MCog_SR	-.457	1.000	.355
	Cr_Th	.200	.355	1.000
Sig. (1-tailed)	S_I_post	.	.008	.158
	MCog_SR	.008	.	.035
	Cr_Th	.158	.035	.
N	S_I_post	27	27	27
	MCog_SR	27	27	27
	Cr_Th	27	27	27

Variables Entered/Removed[a]			
Model	Variables Entered	Variables Removed	Method
1	MCog_SR	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).
2	Cr_Th	.	Stepwise (Criteria: Probability-of-F-to-enter <= .050, Probability-of-F-to-remove >= .100).

a. Dependent Variable: S_I_post

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.457[a]	.209	.177	1.93247	.209	6.598	1	25	.017	
2	.599[b]	.359	.305	1.77554	.150	5.614	1	24	.026	1.825

a. Predictors: (Constant), MCog_SR
b. Predictors: (Constant), MCog_SR, Cr_Th
c. Dependent Variable: S_I_post

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24.639	1	24.639	6.598	.017[b]
	Residual	93.361	25	3.734		
	Total	118.000	26			
2	Regression	42.339	2	21.169	6.715	.005[c]
	Residual	75.661	24	3.153		
	Total	118.000	26			

a. Dependent Variable: S_I_post
b. Predictors: (Constant), MCog_SR
c. Predictors: (Constant), MCog_SR, Cr_Th

Coefficients[a]

Model		Unstandardized Coefficients B	Std. Error	Standardized Coefficients Beta	t	Sig.	95.0% Confidence Interval for B Lower Bound	Upper Bound	Correlations Zero-order	Partial	Part	Collinearity Statistics Tolerance	VIF
1	(Constant)	6.916	1.319		5.245	.000	4.200	9.632					
	MCog_SR	-.691	.269	-.457	-2.569	.017	-1.245	-.137	-.457	-.457	-.457	1.000	1.000
2	(Constant)	4.510	1.581		2.853	.009	1.248	7.773					
	MCog_SR	-.913	.264	-.604	-3.454	.002	-1.458	-.367	-.457	-.576	-.565	.874	1.144
	Cr_Th	.733	.310	.414	2.369	.026	.095	1.372	.200	.435	.387	.874	1.144

a. Dependent Variable: S_I_post

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics: Tolerance	VIF	Minimum Tolerance
1	Cr_Th	.414[b]	2.369	.026	.435	.874	1.144	.874

a. Dependent Variable: S_I_post
b. Predictors in the Model: (Constant), MCog_SR

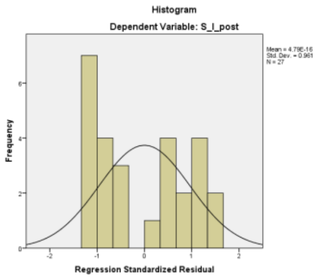
Collinearity Diagnostics[a]						
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	MCog_SR	Cr_Th
1	1	1.959	1.000	.02	.02	
	2	.041	6.947	.98	.98	
2	1	2.923	1.000	.01	.01	.01
	2	.047	7.845	.09	.96	.28
	3	.030	9.922	.91	.03	.71

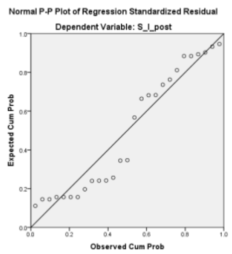
a. Dependent Variable: S_I_post

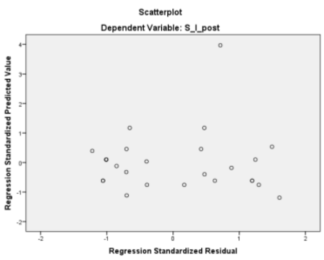
Residuals Statistics[a]					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.1465	8.7320	3.6667	1.27609	27
Residual	-2.16764	2.85347	.00000	1.70589	27
Std. Predicted Value	-1.191	3.969	.000	1.000	27
Std. Residual	-1.221	1.607	.000	.961	27

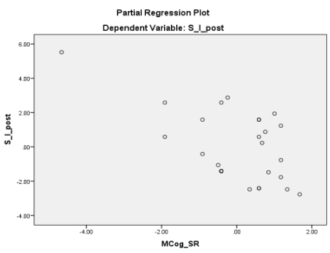
a. Dependent Variable: S_I_post

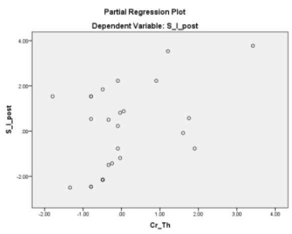
Charts











5: Regression (Gain scores, metacognitive self- regulation and learning environment)

Descriptive Statistics

	Mean	Std. Deviation	N
GainScores_mean	4.1111	1.37515	27
MCogSR	4.7037	1.40917	27
Lea	3.8395	.43481	27

Correlations

		GainScores_mean	CogSR	Lea
Pearson Correlation	GainScores_mean	1.000	-.464	-.344
	CogSR	-.464	1.000	-.049
	Lea	-.344	-.049	1.000
Sig. (1-tailed)	GainScores_mean	.	.007	.039
	CogSR	.007	.	.404
	Lea	.039	.404	.
N	GainScores_mean	27	27	27
	CogSR	27	27	27
	Lea	27	27	27

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Lea, CogSR[b]	.	Enter

a. Dependent Variable: GainScores_mean

b. All requested variables entered.

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.592[a]	.350	.296	1.15390	.350	6.463	2	24	.006	1.999

a. Predictors: (Constant), Lea, CogSR

b. Dependent Variable: GainScores_mean

Appendix

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.211	2	8.606	6.463	.006[b]
	Residual	31.956	24	1.331		
	Total	49.167	26			

a. Dependent Variable: GainScores_mean

b. Predictors: (Constant), Lea, CogSR

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1 (Constant)	10.791	2.185		4.939	.000	6.282	15.300					
MCog_SR	-.470	.161	-.482	-2.924	.007	-.802	-.138	-.464	-.513	-.481	.998	1.002
Lea	-1.164	.521	-.368	-2.233	.035	-2.239	-.088	-.344	-.415	-.368	.998	1.002

a. Dependent Variable: GainScores_mean

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	CogSR	Lea
1	1	2.937	1.000	.00	.01	.00
	2	.057	7.161	.02	.93	.05
	3	.006	22.590	.98	.07	.95

a. Dependent Variable: GainScores_mean

Casewise Diagnostics[a]

Case Number	Std. Residual	GainScores_mean	Predicted Value	Residual
12	2.450	7.00	4.1729	2.82705

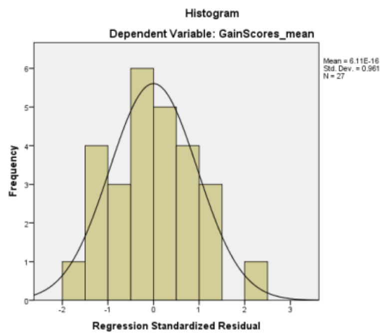
a. Dependent Variable: GainScores_mean

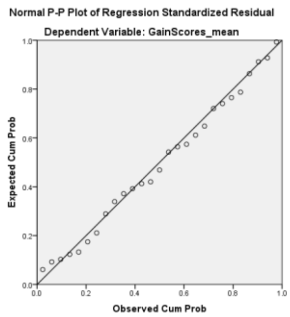
Residuals Statistics[a]

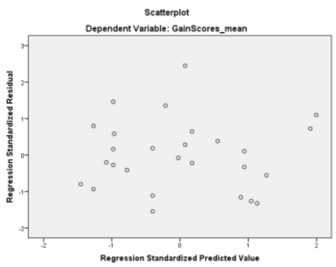
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	2.9270	5.7362	4.1111	.81361	27
Std. Predicted Value	-1.455	1.997	.000	1.000	27
Standard Error of Predicted Value	.243	.664	.366	.120	27
Adjusted Predicted Value	2.9699	5.4388	4.1014	.80994	27
Residual	-1.78504	2.82705	.00000	1.10863	27
Std. Residual	-1.547	2.450	.000	.961	27
Stud. Residual	-1.582	2.506	.003	1.008	27
Deleted Residual	-1.86776	2.95877	.00976	1.22535	27
Stud. Deleted Residual	-1.637	2.856	.015	1.053	27
Mahal. Distance	.189	7.647	1.926	2.027	27
Cook's Distance	.000	.116	.036	.038	27
Centered Leverage Value	.007	.294	.074	.078	27

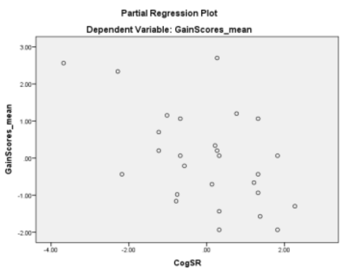
a. Dependent Variable: GainScores_mean

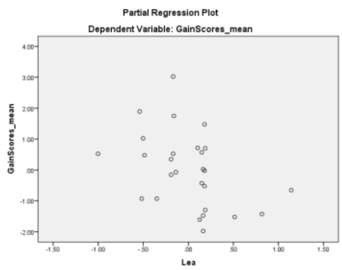
Charts











Appendix G Qualitative part

Semi-structured interviews protocol

Checklist

- Arrange for a quiet and comfortable room
- Thank the participant for agreeing and taking time to provide information, make sure they are comfortable, ask about soft introductory question
- Briefly inform about the aim of the interview and discuss his/her views regarding the experience of the intervention, the process, learning, the difficulties and most important factors for them to influence the process
- Explain the post intervention interview will last approximately thirty- sixty minutes and that timing does not pose any problem for the participant if they are happy to answer in English, Urdu or both
- Ask the participant if he/she has any questions before the interview starts and ask explicitly if he/she is ready to move on to the interview.

Background information

- **Note gender, age, language (spoken during the interview)**
  ✓

Intervention experience questions

1. How did you find the instruction during these four weeks in learning critical thinking?

2. What type of challenges you experienced during this period of time?

3. What design features of instruction e.g.

3.1: learning in community of inquiry,
3.2: working independently and in collaboration
3.3: learning with argument mapping software
3.4: discussions in broader and deeper meaning of curricular topics
3.5: and the teacher's role they found useful during the whole process?

4. In what aspects of personal learning you improved or experienced improvement during the intervention?

4.1: improved focus and self-regulation
4.2: improved motivation
4.3: improved logical thinking
4.4: Any other

5. What could have been improved or implemented in a better way?

6. How would you summarize your learning about critical thinking and argument building after this intervention experience?

7. Anything else you would like to say or share?

Thank you

Unstructured Observations protocol

Preamble

- Meet the teacher beforehand and inform him, you will be observing how the classroom environment is like
- Be as discreet as possible e.g. sit in a position or way that is not intimidating
- Be friendly, but avoid any possible influences or interference with teachers teaching
- Help class teacher with class arrangements
- Enter and leave the class with the class teacher
- Note the class setting e.g. furniture and sitting arrangement, quality of sound, temperature
- Note the teacher and student interaction, flow of communication, lesson delivery and the students participation
- Note your own feeling and observations of implementation
- Write as much during and after the class recall the situation as much as you can
- Thank the class and class teacher for allowing you to be part of their class environment

Qualitative interview questions for participants

2: What are the participants' experiences about how a specific instructional model helped or did not help in the learning of CT skills?
Interview question mainly were based on the following categories to help explaining the outcomes of the intervention first phase

1. Learning Experience
2. Instructional approach
3. Teacher's role
4. Personal learning
5. Feedback on intervention implementation
6. Challenges and difficulties

Interview questions

1. **How did you find the instruction during these four weeks in learning critical thinking?**
2. **What design features of instructional approach you found useful e.g.**
3. **In what aspects of personal learning you improved or experienced improvement during the intervention?**
4. **What could have been improved or implemented in a better way?**
5. **How would you summarize your personal learning about critical thinking and argument building after this intervention experience?**
6. **What type of challenges you experienced during this period of time?**

Structured Observation sheet

Each section has three rating categories evident=3, not evident=2, unable to determine=1. with a column for supporting examples and notes to remember, if any.

1. Adherence

Learning objective is evident to the students.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Evident	• Teacher specifically names objective at beginning of lesson/class. • Students write down the objective. • Students accurately answer teacher's question about objective
Not evident	• Teacher does not mention objective, goal, reason for the lesson.
Unable to determine	• Objective not specifically mentioned, but students seem to have a good understanding of topic and context.

Teacher uses program materials effectively during instruction / intervention.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
Sometimes	• •
No	• •
Unable to determine	• •
Supporting examples	•

Learning objective/objectives are met.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
No	• •
Unable to determine	• •
Supporting examples	•

2. Exposure

_________minutes devoted to instruction /intervention

________ minutes determined to be optimum

3. Quality of Delivery

Teacher appears adequately prepared to deliver instruction or intervention.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
Sometimes	• •
No	• •
Unable to determine	• •
Supporting examples	•

Teacher's interactions with students reflect encouragement and enthusiasm.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
Sometimes	• •
No	• •
Unable to determine	• •
Supporting examples	•

Teacher provides clear, explicit instruction for all students.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
Sometimes	• •
No	• •
Unable to determine	• •
Supporting examples	•

Teacher provides positive, constructive feedback to all students.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
No	• •
Unable to determine	• •
Supporting examples	•

Pacing and transitions are effective.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
No	• •
Unable to determine	• •
Supporting examples	•

4. Program Specification

Teacher adheres to instructional components as designed.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
No	• •
Unable to determine	• •
Supporting examples	•

Teacher demonstrates knowledge of content and intervention strategy.

Rating	Possible Teacher Actions that Might Be Observed to Support Rating
Yes	• •
No	• •
Unable to determine	• •
Supporting examples	•

5. Student Responsiveness

Students appear. . .

	Highly engaged –Most students are authentically and actively engaged.
	Moderately engaged – Most students are engaged or willingly compliant.
	Not engaged – Most students are not participating or are off-task.
Possible **Student** Actions that Might Be Observed to Support Rating	
Possible **Teacher** Actions that Might Be Observed to Support Rating	

Notes