UNIVERSITY OF SOUTHAMPTON

FACULTY OF LAW, ARTS & SOCIAL SCIENCES

School of Humanities

Computer Assisted Tracking of University Student Writing in English as a Foreign Language

by

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ABSTRACT

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COMPUTER ASSISTED TRACKING OF UNIVERSITY STUDENT WRITING IN ENGLISH AS A FOREIGN LANGUAGE

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The study tracked development along university levels in writing in English as a foreign language of students of two disciplines: English Language and Literature, and Computer Science.

Informed by the cognitive process theory of writing, other theoretical accounts of development in writing and findings of relevant literature, the study set out to test hypothesized development in fluency, revision behaviour, writers' awareness and concerns and text quality in the writing of university students. Moreover, the study aimed to find out if students from the two majors demonstrate different developmental patterns in terms of these variables; and if variation in text quality can be related to writing process and awareness.

The study utilized a computer logging program (ScriptLog) as the main recording, observing and playback research tool; elicited responses to immediate recall questions; and obtained independent text assessment. It also employed stimulated recall procedure to get a closer look at a small proportion of individual writing sessions.

Quantitative data analysis revealed that along the university levels English majors demonstrated systematic development in their writing process and product, with progressively increased fluency, higher-level and more global revision orientation, and better awareness of the demands of task and audience. They also exhibited considerable and consistent improvement in text quality. Computer Science students, on the other hand, displayed a different pattern. In their fourth level there was a notable increase in the rate of production and the proportion of conceptual revisions, but a significant decrease in text quality compared with their three-semester juniors. In their eighth semester, they demonstrated improvement but remained in a lesser position than their English-major peers in fluency measures and text quality. These findings assert the significance of formal L2 knowledge in assisting automatic access to the mental linguistic repertoire and reducing concerns over local and surface-level

linguistic details; and they stress the importance of continued formal facilitation of L2.

In addition, a number of participants attended individual writing sessions wherein their writing activity was followed by stimulated recall interviews. A close investigation of participants' reports of their writing strategies and concerns asserts the trends found in the quantitative analysis. However the qualitative inquiry offers more insight into the development of university students. It appears that the tertiary academic experience has in the long run benefited both groups of writers. Senior participants of both majors were able to take authority of their texts. They acted less at surface and local levels and more at conceptual and global levels, moving information around and changing larger chunks of text in order to minimize ambiguity and respond to the demands of audience. They showed consideration and utilization of content knowledge they had acquired in their subject area.

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DECLARATION OF AUTHORSHIP

I, Fatimah M A Alghamdi, declare that the thesis entitled

Computer Assisted Tracking of University Student Writing in English as a Foreign Language

and the work presented in the thesis are both my own, and have been generated by me as the result of my own original research. I confirm that:

- this work was done wholly or mainly while in candidature for a research degree at this University;

- 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;

- where I have consulted the published work of others, this is always clearly attributed;

- 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;

- I have acknowledged all main sources of help;

- 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;

- none of this work has been published before submission

Signed: ……………………………………………………………………..

Date:……………………………………………………………………….

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Abbreviations

CS	Computer Science Department/students
E	English Language Department/students
EFL	English as a Foreign Language
ESL	English as a Second Language
L1	Native language
L2	Second or foreign language
PR	Production Rate
QIR	Questions for Immediate Recall
SR	Stimulated Recall
TA	Think Aloud
TSL	Text Span (mean) Length

Part 1: Introduction and Background

- Chapter 1: Introduction
- Chapter 2: The Writing Process
- Chapter 3: Tracking Development in Writing

Chapter One: Introduction

1.1 Introduction

English language is gaining an ever growing status in social, academic and work contexts in Saudi Arabia. The written form of the foreign language has always been viewed as both challenging and significant. It is typically through writing that educational attainment is evaluated, jobs are applied for, and communications are carried out. It seems that in a socio-cultural environment wherein writing in the foreign language is not a common practice of the majority of people, higher education experience is expected to enhance achievement in writing in English. Yet, hardly any previous research was done to track changes in the FL writing practice of Saudi students over the course of their college experience.

This research is concerned with development in writing in English as a foreign language (EFL) within a Saudi university context. It addresses fluency, revision strategies, writers' awareness and concerns, and text quality. It examines keystroke records of the writing process, immediate and retrospective recall, and text quality to find out developmental patterns in student writing as they progress along the tertiary academic levels in two distinct academic disciplines: English Language and Literature and Computer Science. A secondary objective of the study is to find possible relationships among how writers handle the writing task, what they report about their writing, and what they actually produce as an end product.

1.2 The context of the study

English is the only foreign language taught in public secondary education in Saudi Arabia. Starting at grade 7 (around age 12), students get six years of studying English on a four-sessions-a-week basis, each session is forty-five minutes.

For many years, the English teaching practice has suffered from limited focus on vocabulary and grammar. The curriculum has been highly stable over the years, and exhibits striking similarities across the levels with differences mainly in form complexity and the scope of the lexical input. The writing part has almost always been limited to introducing students to pre-constructed models of short pieces of

writing (around 100-200 words). Students are supposed to produce compositions that are similar in both content and form to the models. In most cases, they end up memorising the model pieces and reproducing them for exams. This leaves no room for realizing the composing activity as a purposeful, goal-oriented process that is subject to planning, revising and reshaping, or as a communicative social act that entails attention to purpose and audience; let alone realizing writers' role, voice or authority. In other words, authentic writing processes are not invoked, and effective strategies are not coached.

University entrance examinations do not include writing essays, and freshmen's transition into the university's academic writing is not aided by writing classes in either the native Language (Arabic) or the foreign language (English). As a result, students carry their writing practices and perceptions from secondary to tertiary education. In the university's EFL context students are often observed as lacking fluency, focus on purpose and awareness of an audience.

Upon joining university, all students are required to take two English language courses in their first two semesters. Two sets of general English courses have been designed by the English Language Centre (ELC) to separately accommodate two groups of students: (a) the students of the faculties of Arts and Humanities, Management, and Home Economics; and (b) the students of the Faculty of Science, and the schools of Medicine, Nursery and Paramedical Science. Both programs place very little emphasis on writing. After the first year, students start their subject disciplines and the ELC loses track of them. Students are left to deal with the language demands of their disciplines. This demand varies from no more English at all, to one more terminology unit in Psychology or Sociology disciplines, to courses where English is the language of the books and some of classroom instruction (e.g. Computer Science), to the English Language and Literature department, where English is the main language of instruction and materials (except for the general units that students are required to take, e.g. History, Arabic Studies, etc.). In all the cases, except the last one, no more information about students' English writing abilities is known or sought.

The present study aims to track changes that may happen along university academic levels in the writing processes and strategies, and attention to textual and contextual

aspects of writing, and the quality of produced texts of two distinct groups of students, with two different English learning experiences: English Language and Literature majors, and Computer Science majors.

1.3 Theoretical background

The study investigates student writing within the framework of the cognitive process theories of writing proposed by Flower and Hayes (1980; 1981; and Hayes and Flower, 1980), and expanded by Flower et al. (1986), Hayes (1996) and Chenoweth and Hayes (2001, among others). The study examines development in student cognitive processes and awareness in L2 writing as an outcome of the tertiary academic experience. Cognitive process theory is of two dimensions: process and cognition. The idea of writing as a process started to gain interest in the 1960s as a movement away from focusing only on the end product. Gordon Rohman (1965), for example, advocated considering writing as stages of prewriting, writing and rewriting as an alternative to the focus only on what writers produced. Rohman's concern was of a pedagogical nature; that is to foster effective writing processes in students instead of simply testing what they write against textual criteria. Similarly, Britton et al (1975) introduced a model, which also includes three stages of writing process: conception, incubation and production, but, unlike Rohman's, Britton et al's model notes a non-linearity in the stages of the writing process. Moreover, Britton et al's approach differs in that it tackles the writing process issue with a perspective on development.

The view of writing as a *recursive* process was first brought into attention by Emig (1967), who has also considered the cognitive aspect of writing. Linking that recursive process of writing to human thinking and cognition was the first step into proposing cognitive process models of writing. The notion of writing as a cognitive activity initiated from cognitive psychologists' interest in the writing process as an act of problem-solving that resembles other forms of human thinking (Flower & Hayes, 1981). Psychologists' interest in writing has extended to facilitate writing research with tools for observing the writing process; that is of think-aloud technique and protocol analysis (Flower & Hayes, 1980), more detailed discussion will follow in 2.4.2.

In their analysis of students' think aloud protocols, Flower and Hayes (1980, 1981) proposed a process model that has been widely used, critiqued and modified by fellow researchers ever since. They recognized three constituents of the act of writing, namely: the task environment, the writer's long-term memory and the writing process. Each of them includes sub-elements that interact together within the general framework of that element and interact with sub-elements of the other two general components. The original model has gone through several phases of dissections and expansions. There emerged further studies on the components of the writing process, i.e. planning (e.g. Jones and Tetroe, 1987), text generating (e.g. Kaufer et al. 1986) and revising (e.g. Hayes et al. 1987 & Flower et al. 1986); and the model was modified to account for meta-cognitive and contextual issues in more detail (e.g. Flower 1989, Hayes 1996). These studies, while establishing improved models, pointed to areas of variation among writers. Characteristics of skilled and less-skilled writers were highlighted.

However, when judged against the objectives of the present study, the original cognitive models exhibit a number of inadequacies. First, the subject of focus in the studies that shaped the original construction of the models was L1 writing (i.e. writers performing in their native language). The specificity of L2 writing was not an issue. Second, process-cognitive models do not account for development in writing. Finally, the limitations of think-aloud, the method that has been used for eliciting data, cast doubt on both validity and reliability of findings.

Researchers on L2 writing work within the theory, the tools and the parameters of the cognitive process theory of writing to explain L2 writing processes. They often attempt to assess proficiency in writing by means of comparing L2 writers at different writing proficiency levels (e.g. Zamel, 1983; Sasaki 2000), comparing L2 writers with native writers (e.g. Chenoweth and Hayes 2001), and comparing ESL writers' performance in their L1 and L2 (e.g. Cumming 1989, Thorson 2000). Yet when it comes to L2-specific processing of writing, the original cognitive process theory remains inadequate. The original model was, in the first place, synthesized out of the processes reported by L1 writers, and in fact the competent ones. A glance at the academic and historic context that surrounds the time when the models were first proposed would show how the models developed out of concerns of college

freshman composition practices in North America, i.e. concerns about L1 writing. Moreover, the original model did not include the role of language (not even as an L1), or linguistic knowledge as a contributor to the process of writing, though language might have been implicitly assumed to reside in the long-term memory.

Drawing on the originals, models that are L2-oriented and/or L2-specific were eventually proposed (e.g. Zimmerman, 2000; Sasaki, 2000). The language component was explicitly included by Zimmerman (2000), who has pointed to the significance of L2 in the formulation process in particular. Nonetheless, the view Zimmermann adopted of the L2 role as a "problem solving" is both limited and simplistic. In short, apart from the studies that touched on the role of ESL proficiency (e.g. Cumming, 1989), explanations of L2 writing process have rarely been sought outside the classic components of the cognitive process models (i.e. planning, translating, and reviewing).

The present study is an attempt to utilize theoretical concepts of writing as a cognitive process and parameters of development in writing in the context of a Saudi university to track students' writing practice and awareness along the tertiary academic experience. While doing so, the study addresses the inadequacies of research that embraced the cognitive tradition (of early cognitive models). The study will address socio-cognitive aspects of the writing process; acknowledge the specificity of L2 language processing in writing; propose a coherent and theoretically-based view of development in L2 writing; and investigate a larger sample than is usually investigated in the writing process research. The study will provide a view of the writing process from different angles including writers' own perception of their writing and independent assessment of texts.

In an attempt to deal with methodological limitations of previous research, this project employs keystroke logging as an unobtrusive, non-reactive and accurate observational tool; as well as a tool for providing vivid stimulus for recall of the writing process (Gass & Mackey, 2000). Moreover, computer assessed observing and recording will increase the capacity of the study to deal with a larger number of samples.

1.4 Research rationale

The study explores development in the writing process, writers' awareness and text quality of students from two majors, English language and Literature, and Computer Science. The reason these two groups were chosen is the significant difference between them. In the first case, English language is both the vehicle and subject of learning and it continues to be so right to the end of the four-year program. Once they join the English Language and Literature department students start to take courses on English linguistics (Phonology, Morphology, Syntax, etc) and introductory courses in English literature (e.g. Early English Literature, Introduction to Poetry, etc). They also take two courses in essay writing during the first two semesters. In the first one, they learn sentence combining and embedding, and paragraph structure. In the following semester they learn about essay writing. Throughout, English is the language of instruction, classroom interaction, text books and exams. In exams students have to produce writing that varies from single words and phrases to two-page or three-page essays. Moreover, in the advanced semesters they write term papers (e.g. essays and journal entries) about their subject of study.

In the case of the Computer Science, on the other hand, English is only a tool (sometimes a secondary one) of the teaching/learning process, but it is the language of most of the scientific material. Students of the latter discipline do start with concerns about English as a subject to be learnt in order for them to understand their textbooks and lectures. They are required to attend English Language courses during their first and second semesters. However, in their sophomore year there are no more English language courses, and students start to study content material in the foreign language. At this point, it has been observed, students start to complain about the difficulty of dealing with that material. They gradually develop strategies to overcome the language problem and focus on learning the content of their subject area. These strategies include excessive dictionary usage, taking text material to translators, and getting more proficient English speakers to edit/redraft their written work (when they start to write reports in advanced semesters). In any case, the demand for extended writing in English remains minimal and limited to a handful of reports and projects over the nine semesters. However, there are individual differences amongst the students. Some of the Computer Science students have a

high command of English and/or make extra individual efforts in dealing with the foreign language demands. In addition, the Computer Science group is the most appropriate for the purpose of this research (to compare with English majors) because throughout their university years, they continue to be exposed to the English language (unlike, for example, those in the social sciences, who conduct their studies in solely Arabic).

To test development in writing in English as a foreign language of students with two different academic experiences: experience with English as a subject of learning and practice (in the case of English majors) or as a medium of learning (in the case of Computer Science students), a quasi-longitudinal procedure has been employed. This has involved cross-sectional testing of groups of the two disciplines at three academic levels. The first level is that of students who have just joined the university, the second are those who have spent three semesters and are on their fourth semester, and the third level comprises those at their final year (semester 8). The purpose of the study is to assess development in writing processes and strategies in relation to fluency, revision behaviour, attention to audience and purpose of the task and text quality.

1.5 The research questions

This study looks into the development of writing as an outcome of two different experiences with English as a foreign language in a university context. In particular, the study utilises computer tracking, retrospection and text assessment to answer the following questions.

RQ1. Does writing in English as a foreign language of university students majoring in English Language and Literature and in Computer Science demonstrate identifiable developmental patterns along university academic levels, in terms of fluency, revision behaviour, writers' awareness and concerns, and text quality?

RQ2. Does writing in English as a foreign language of university students of the two majors develop differently along university academic levels?

RQ3. Can variation in text quality be explained in terms of fluency, revision behaviour and writers' awareness and concerns?

1.6 The thesis layout

The thesis is set in nine chapters. The first chapter introduces the research context and situates the study within theoretical background. It presents the significance and purpose of the study, and the research questions.

The second chapter introduces writing as a cognitive process, and provides a description of the components of some of the proposed cognitive process models. The chapter then provides a discussion of how process writing models expanded to account for socio-contextual factors, and how L2 writing fits into the process models. This is followed by a review of the proposed models for L2 writing and a discussion of psycholinguistic accounts of second language production, the role of the working memory and the role of learning and practice. The chapter then introduces in some detail the different tools that have been employed in cognitive process research. The tools fit into four categories: text analysis, retrospection (including stimulated recall), think-aloud methods, and computer tracking.

The third chapter is devoted to the writing process from a developmental perspective. It first puts forward a synthesis of a number of paradigms that underlie development in writing. Then, there is a review of how each of the constructs that have been found to signal skill and maturation in writing has been measured in the studies that dealt with issues of writing proficiency and development.

Chapter Four presents the methodology by which data are elicited to address the research questions. It first reintroduces the assumptions that underpin the research design. The chapter then describes the participants, the setting, the writing tasks, and the research procedure. This is followed by introducing data elicitation instruments: the writing and logging computer program (ScriptLog), the questions that were given to students to elicit recall of some of their strategies and concerns (QIR), and the stimulated recall sessions. The research questions are then restated and the variables are discussed together with several operational measures for each variable. Finally, a summary of the research questions, the measures, the elicitation methods and the statistical tools is presented in a table.

In Chapter Five, analysis of Keystroke-logging quantitative data is discussed in more detail and with extracts from the log files. The results of the analyses are presented

systematically to address Research Questions 1 and 2. Students' fluency, pause and revision behaviour are compared along the three levels and across the two academic disciplines.

Chapter Six presents findings from writers' responses to a set of questions designed to elicit immediate recall on students' attention to task and audience, their focus on linguistic and textual aspects, and their perceptions of their role as writers. In addition, results of raters' assessments of texts are presented and correlated with measures of fluency, pause and revising strategies; as well as with writers' perceptions of their writing.

Chapter Seven provides a qualitative report on nine writing sessions that were followed by stimulated recall interviews. The profiles of the individuals who participated in the interviews are presented together with their group profiles. Moreover a summary of the quantitative trends of the groups is presented and compared to the individuals' reflections on their writing process. Extracts from the stimulated recall accounts are provided and discussed.

Chapter Eight draws together findings from keystroke logging, immediate recall questions, text assessments, and stimulated recall; and it puts forward a discussion of the results in the light of relevant literature. It provides holistic pictures for the participating groups and reports on the significance of findings.

Chapter Nine concludes the thesis and offers possible implications for research practices in second/foreign language writing. While doing so, the chapter revisits the theoretical concepts that underlie the hypotheses of the study, assesses aspects of L2 writing development in the light of the findings of this research, and discusses possible implications for the study on fostering foreign language learning in higher education.

Chapter Two: The Writing Process

2.1 Introduction

Chapter One has situated the study in terms of both its socio-academic context and theoretical background. It has introduced the study within a process cognitive framework of writing, while recognizing its inadequacy in modelling L2 writing and in accounting for development in writing.

This chapter draws on the theoretical introduction of Chapter One, and expands on it. It discusses in detail different cognitive models of writing including L2-specific ones; and lays out a detailed discussion of the tools available in observing the writing process. It introduces keystroke logging and retrospective recall as alternatives to the traditional observation tools and think-aloud procedure.

2.2 The cognitive process approach to studying writing

2.2.1 Writing as a process

One of the factors that has effectively contributed to our understanding of writing behaviour is the recognition that writing is not a sequence of discrete stages that happen one after the other. The recursive interaction between the sub-processes of the writing activity was first captured and visually presented in the much acknowledged cognitive process models proposed by Flower and Hayes (1981, 1980, and Hayes and Flower 1980). However, there had been an earlier recognition of writing as stages, though sometimes without acknowledging its recursive nature. These stages were referred to as *pre-writing*, *writing* and *re-writing* by Gordon Rohman (1965); and as *conception*, *incubation* and *production* by Britton et al (1975). However, while Gordon Rohman seems to have seen the writing process as a set of linear stages that take place one after another and result in a gradual emergence of the text, Britton et al are aware of the fact that the processes of writing cannot be viewed as discrete stages:

> *In any case, even if there has been time for conception and incubation, these processes do not end when the writing begins- the*

> *redefining, the planning and sorting are still going on. (Britton et al, 1975, p. 26)*

This recognition has led to assumptions about the processes that underlie the hypothesized 'stages' and the interactions between these processes.

> *... writers then define and redefine the task, and plan ahead, and sort out their ideas, while they are writing, and it is very difficult, retrospectively to separate the three activities.* (Britton et al, 1975, p. 26)

During the course of planning and incubation, according to Britton et al, writers are influenced by the need to present accepted, and perhaps known, information; and the need to put things in a way that satisfies them, or represents their own way of seeing the world. Sometimes one of these needs predominates, e.g. in summaries vs. in poetry. This view of writing as a relationship with either the outside world/knowledge or one's own perspectives is, in a way, similar to Gordon Rohman's concepts of "subject context" and "personal context". It highlights the role of the writer in relation to self as opposed to the others. This relationship was later captured, with a developmental perspective, by Flower (1979) and Scardamalia and Bereiter (1987).

One of the constructive critiques of the early models of writing stages was presented in Sommers' (1980) study of revision. She criticized the view of the writing process as linear, discrete stages and opposed the view that revision is a final stage that takes place after pre-writing and writing. She described it as a view that does not distinguish writing from speech. She explained that speech is "irreversible" and thus it is "impossible" to make revisions to it. While revision of speech can only be an "afterthought", making revisions to writing can occur at any point in the writing process. However, subsequent research in revision has failed to acknowledge Sommers' view of reversibility of writing as a developmental attribute in revision behaviour.

2.2.2 Writing as a cognitive process

The concept of a recursive relationship between elements of the writing process was an essential ingredient in the cognitive models that followed. The first effort to study writing through attempted introspection with the aim of gaining access to the

working of the mind during composition can be traced back to the late sixties and early seventies, in particular, to Emig (1967, 1971) who …

> *argued against a linear model of composing … was among the first writing researchers to act on calls for research on cognitive processes … described composing as "recursive" … appropriated from psychology more than case-study approach and think-aloud methodology … provided not only a new methodology but an agenda for subsequent research, raising issues such as pausing during composing, the role of rereading in revision, and the paucity of substantial revision in student writing. Her monograph led to numerous observational studies of writers' composing behaviour during the next decade.* (Faigley 1986, p.p. 531-532)

Improvements in process-oriented writing research allowed for establishing a link between writing theories and cognitive psychology. A major technical contribution of cognitive psychology to the writing process research was the think-aloud protocol technique, which elicits a concurrent account of articulated thought during writing. It is often argued that this technique has made possible the viewing of the writing process as it takes place and provided a window to the working of the inner mind (Levy & Olive, 2001). This is not to say that think aloud (and analysis of its protocol) is a flawless technique. (A detailed discussion of think-aloud as a research tool will follow in 2.4.2).

In their analysis of students' think aloud protocols, Flower & Hayes (1981) recognized three constituents of the act of writing, namely: the task environment, the writer's long-term memory and the writing process. Each of them includes sub-elements that interact together within the general framework of that element and interact with sub-elements of the other two general components. The writing process starts with identifying the rhetorical problem, which, despite including a seemingly stable set of knowledge about the topic, situation, audience and purposes, varies amongst writers even if they were given the same topic to write about (Flower & Hayes, 1981).

The task environment comprises the rhetorical problem and the text written so far. Once the text is composed, it exerts control over the writer. As with identifying the rhetorical problem, the power the emergent text has over the writer varies from one writer to another. The less the power of a text over the act of writing is, the less

coherent a text is likely to be, and vice versa (Flower & Hayes, 1981). This, in a way, is similar to Sommers' (1980) view of language shaping thought.

The second major element in Flower and Hayes' (1981) model of writing is the long-term memory, where knowledge about the topic and the audience, and what one might call blueprints of different writing structures exist. A problem that a writer might face is the retrieval of the appropriate information or plan from the long term memory. However, certain hints from the writing prompts, e.g. "write a persuasive …," can retrieve a certain plan of writing which has been stored in the long term memory (Flower & Hayes, 1981). Knowledge retrieval can be an easier task when there is a lesser concern about the reader, for example, when writing a "writer-based prose" (also in Flower, 1979). Taken the other way round, it is plausible to assume that basic writers (including L2 wirers) tend to produce writer-based prose to ease retrieval of knowledge.

The writing process itself includes planning translating and reviewing. Flower and Hayes describe the planning process as "an internal representation" of the knowledge that will be used in writing, perhaps something similar to what Vygotsky calls "inner speech," which is "thinking in pure word meaning." This internal representation of knowledge, is not essentially represented by a language, "but could be held as a visual or perceptual code, e.g., as fleeting image the writer then must capture in words" (Flower & Hayes, 1981, p. 372). This idea is also supported by Vygotsky (1962, p. 149): "It is a dynamic, shifting, unstable thing, fluttering between word and thought".

In planning, three sub-processes occur: idea generating, i.e. the retrieval of appropriate knowledge from long-term memory; organizing, the structuring of information to suit/address the rhetorical problem; and goal setting, which can be either formed by the writer or retrieved from the long-term memory (Flower & Hayes, 1981). As with all writing processes, goal setting is a recursive act: "Just as goals lead a writer to generate ideas, those ideas lead to new, more complex goals which can then integrate content and purpose" (Flower & Hayes, 1981, P. 373). This marks a shift from earlier understanding of writing. Britton et al (1975), for example, had confined goal setting to the preparatory stages of writing.

The second major process in the writing act, as perceived by Flower and Hayes (1981), is translating ideas into a text. It is probably what Britton et al call "thought - into -word process," and what Gordon Rohman (1965) describes as the moment at which meaning is "fused" by a writer's "consciousness" to make a pattern. Flower and Hayes explain that meaning that might exist as an image, a concept or non-syntactically related words during planning is now put into visible language through the process of translation. Although the language element has not received enough treatment in describing the translating process in Flower and Hayes' model, adopting the meaning/language concept into L2 cognitive writing process has provided the present study with a very useful theoretical tool for exploring fluency and revision behaviour in L2 writing.

Reviewing is the third cognitive process of the act of writing in Flower and Hayes's model, wherein writers make either a conscious or an unplanned evaluation or revision of what they have written so far. It occurs at any point during text production, and it stimulates more planning and translation (Flower & Hayes, 1981).

Revision was once traditionally held as draft cleaning, error correction, and/or lexical adjustment (Sommers 1980), but when highlighted as a main cognitive process in Flower and Hayes's model, it started to receive attention as a central process in the act of writing (e.g. Flower et al, 1986; Matsuhashi, 1987; Hayes 2003). Flower et al identified two elements that underlie experts' revision acts: knowledge (both declarative and procedural) and intention. Although their inquiry was again on native writers, their emphasis on the importance of "active usable knowledge" (p.19) in a revision action highlights the challenging (and difficult to achieve) demand on the part of our L2 writers for language knowledge that can be "usable" (besides being accessible). Flower et al. (1986) have also highlighted the impact of writers' intended representation of text and pointed out that writers will detect problems in their writing less effectively if such a representation is inadequate.

Another conception of revision that is useful to the present study was provided by Matsuhashi (1987). According to Matsuhashi, revision reflects a writer's "shifting focus of attention and pattern of decision-making" (p. 199). In this study revision actions will be dealt with as indicators of writers' "shifting focus of attention", that is possible to trace with the tools the study proposes to use.

One final component of Hayes & Flower's (1980; and Flower & Hayes', 1980 and 1981) model of the writing process that is worth mentioning here is the monitor. The monitor functions as a "writing strategist" that governs the shifts between several parts of the writing process. For instance, it triggers switching from planning to translating, or halts idea generation for the benefit of organization (Flower and Hayes 1981). Britton et al (1975) had recognized the work of such a strategist, at least during initial emergence of the text; and they attributed it to internal as well as external forces:

> *There is usually some specific incident- this may be a purely internal 'mental' incident- which provokes the decision to write. In schools it is normally a request from the teacher ... p. 23.*

Their last statement, however, indicates that their view of what triggers the writing strategist expands to include external prompts, something that falls within Flower and Hayes' task environment.

The cognitive process approach to writing appeals to this inquiry on foreign language writing because a cognitive model would inherently account for language (and thereby second language) processing and production. It is in the memory that language is processed and retrieved. Therefore, it is useful to refer to explanations offered by cognitive science to understand writing as both a linguistic activity and a cognitive process. The writing process is facilitated by skills and knowledge stored in the long term memory, and it exerts a high level of cognitive effort on the working memory, where a number of constraints are juggled at the same time (Kellogg, 1994 & 1996; Torrance, 1996; Torrance & Galbraith, 2006). Cognitive Psychology, therefore, offers explanations of how the knowledge and skills necessary to carry out a writing task are stored, accessed, retrieved and coordinated.

As was pointed out in Chapter One, explicit discussion of the linguistic element was lacking in the original cognitive process models of writing. However, in later models (e.g. Hayes, 1996; Chenoweth & Hayes, 2001, 2003) the role of the language facility was recognized in both the working memory and the long-term memory. In particular, one would find the differentiation between concept and language processing implied in Chenoweth and Hayes' (2001) model (Figure 2.1) very useful in providing theoretical grounds for the present study.
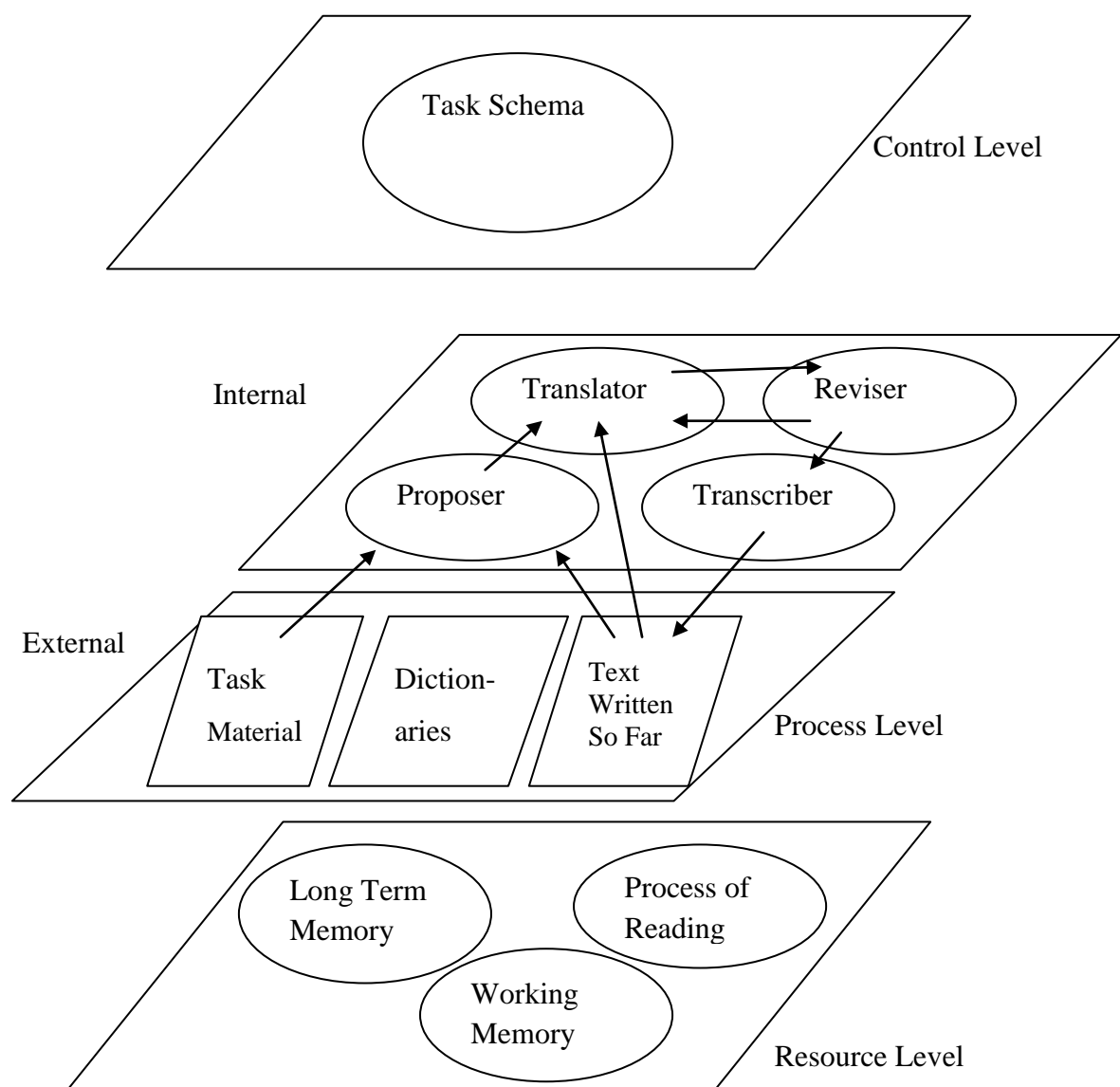
Figure 2.1 Chenoweth and Hayes' (2001) model of written language production

Chenoweth and Hayes (2001) identified components of the writing activity according to the level of internal mental processing. First there is the conceptual *proposer* that apparently has very little to do with language except as a vehicle of providing input from either the task material or the text written so far. In fact one would argue that a proposal can also be activated by non-linguistic external context or another proposed (non-linguistic) concept. The second internal processor that Chenoweth and Hayes identified is the *translator*, which formulates concepts into language. This process of putting thought into language, it seems, signals the first observed differences between L1 and L2 writing processes. While in L1 this process might occur naturally and effortlessly (Flower, 1979), it might, one would assume, present a great challenge to L2 writers. The *transcriber* is the processor which carries out lower-

order orthographic or typing tasks. It is another level that demands the language facility. Although not indicated by arrows in the drawing of the model, it is self-evident that the relationship between the *translator* and the *transcriber* can be both direct and bidirectional. The *reviser* works with all other processes and it can interrupt the writing process at any moment or level of processing. The model depicted in Figure 2.1 does not indicate this role of the *reviser*, but in a graphic representation of an improved version of the model (Chenoweth & Hayes 2003) the *reviser* was given a visually larger space with bidirectional relationships with the *proposer*, the *translator* and the *transcriber*.

Content generating, translating (i.e. formulating) and transcribing are cognitive processes that provide common ground to cognitive-oriented writing research (see Galbraith, 2009, for a recent review). However, recognizing the skills that contribute to managing these cognitive processes has raised interest in writers' metacognitve abilities.

2.2.3 Metacognition

Metacognition has been explained within a cognitive process framework of writing. It refers to writers' knowledge about and awareness of their cognitive skills. This knowledge improves monitoring and regulating the writing process and includes *reasonin*g and *reflective analysis* (Almargot & Fayol, 2009). Metacognitive skills can be subject to improvement and modification in children (Bereiter and Scardamalia, 1987; Rijlaarsdam et al. 2009) as well as in adult writers (Kellogg, 2008). Almargot and Fayol (2009) contend that successful composing processes require a degree of maturation in the metacognitive functions. They explain: "the writer ... needs to achieve a certain degree of maturity in order to be able to analyse his or her writing process and modify them" (p. 39), and they argue that metacognitive skills are not always involved in the specific processes of planning, formulating and reviewing (except in later stages of expertise), but rather related to "general knowledge about writing and sensitivity to audience" (p. 39).

Rijlaarsdam et al. (2009) pointed to the role of communicative writing tasks in the acquisition of audience awareness. They reported on a study wherein writers' metacognition was enhanced by learning about the task requirements and

communicative goals. Their study has also highlighted the need for communication as a motivational factor in writing that makes writers "think about what works in text, raise awareness about the quality of communication and, implicitly about rhetorical strategies" (p. 445).

In the present study, college students' awareness of their cognitive processes (i.e. metacognition) as well as contextual, textual and linguistic concerns is investigated in conjunction with their writing process.

2.2.4 The socio-cognitive factor

The proponents of the cognitive models realized the inadequacy of seeing writing as an individual-centred activity and sought more interpretations of the writing process in the socio-contextual environment. This orientation is reflected in more consideration of both the communicative function of writing and the socio-cultural context (Flower, 1989 & 1994; Hayes, 1996; Grabe & Kaplan, 1996).

The main function of writing is to communicate a message to an audience (Hayes, 1996; Grabe & Kaplan, 1996). Grabe and Kaplan argue that even in writing for the purpose of self expression, writing remains a communicative act and the writer then becomes the (only) reader. When looking at Flower and Hayes' process model, as an influential and widely agreed upon model of writing, the communicative aspect of text production (although not stated explicitly) is influencing the process in two ways: first in the presence of audience as a task-environment component, within the writing assignment prompt, and second in the knowledge of audience that the writer consults in the long term memory. Despite that, the model is, nonetheless, seen by Grabe and Kaplan (1996) to have ignored the communicative component, even in a later modification that incorporates contextual factors (Flower 1994); "the limitation of the Flower model is seen in the minimal integration of textual factors." (Grabe & Kaplan, 1996, p. 224)

Grabe and Kaplan (1996) describe a model of writing that takes into account three communicative competences: linguistic competence, acquaintance with sociolinguistic norms, and knowledge of discourse structure. The two major components of the model are the external "social context" and the "internal verbal processing" of the writing act, also called "the verbal working memory." The latter is

composed of internal goal setting, verbal processing and internal processing output. It is the internal goal setting, according to Grabe and Kaplan that acts as a mediator which links contextual situation to all the language operations that take place within the working memory and result in the production of text. Once again, we are presented with a model that acknowledges the two-directional relationship between text and context on one hand and the composing process on the other hand, but audience is finally explicitly introduced as a socio-cognitive factor. According to Grabe and Kaplan's model, information about the audience (together with information about the task and other contextual settings) are fed into the verbal processing of text, and, at more or less the same time, awareness of the audience, which is facilitated by the writer's working memory, influences text production and, hence, appears in the produced text.

Grabe and Kaplan's (1996) model informs the present study in clarifying a developmental issue in the skill of audience awareness by including the working memory dimension in explaining handling of audience as a cognitive process. Audience awareness can be seen as an added constraint on the working memory. According to Flower (1977), writers might choose to ignore audience until they explore content first. However, in the case of L2 writers audience is ignored because the working memory is already burdened with attention to L2 language problems.

The socio-cognitive element was also discussed as an essential component of the cognitive process model of writing by Hayes (1996), who contends that it is not only the communicative aspect that links writing to the social environment but also the social setting as a whole.

> *What we write, how we write, and who we write to is shaped by social convention and by our history of social interaction. We write differently to a familiar audience than to an audience of strangers. The genres in which we write were invented by other writers and the phrases we write often reflect other phrases earlier writers have written. Thus, our culture provides the words, images, and forms from which we fashion text.* (p. 5)

According to Rubin (1984, cited in Holliway and McCutchen, 2003) there are three socio-cognitive, audience-related abilities: recognising a reader's perspective as different from self, coordinating a reader's perspective with that of the writer, and

anticipating a reader's stance. Hayes (1996) refers to the third ability as experiencing "the message as the audience would" (p.25), which is essential for any written communication to be successful. In this respect Holliway and McCutchen (2003) investigated the influence of taking a 'reader perspective' on revision. They found out that writers who were asked to read other's text and try to respond to a task (identifying Tangram figures) according to the information provided by the text received much higher scores for revising their own texts than those who were asked to carry out revisions after being given feedback. Holliway and McCutchen (2003) defined perspective taking as:

> *the ability to think about another person's thinking. This sociocognitive ability includes thought about others' social, emotional, and physical experiences. Crucial in perspective taking are the metacognitive processes needed to reflect on one's own thoughts and world experiences. (p.88)*

Holliway and McCutchen (2003) spoke of a spectrum of a socio-cognitive ability that ranges from *egocentrism,* wherein writing is mainly self-expression and writers completely ignore the reader, to *decentering,* wherein writers adapt the role of a reader.

Audience awareness was looked at from a developmental perspective by Britton et al. (1975). First, there is writing that is self-directed. Then, writers learn to interact with a reader. Writers' interaction with the reader can either be *transactional,* i.e. to inform*,* or *poetic*, i.e. to entertain. Likewise, Flower (1979) used theorization on egocentric speech to offer a discussion on writers' concerns for the reader's perspective or stance. More discussion of the developmental nature of socio-cognitive skills will follow in Chapter Three.

2.2.5 Motivation and affect

The role of motivation and affect in writing was explicitly considered in Hayes' (1996) "new model" of writing. The constituent of *Motivation/affect* lies within *The Individual,* which is one of two major elements of the model, the second being *The Task Environment.* This constituent interacts in a bidirectional manner with other components within *The Individual*, i.e. working memory, long-term memory and cognitive processes. Information about *goals*, *predispositions*, *beliefs and attitudes*,

and *cost benefit estimates* feed into each part of the writing process (Hayes, 1996). Motivation as discussed by Hayes (1996) differs from the concept of *motivating cues* which was depicted in the early cognitive process model by Hayes and Flower (1980) in that the latter present an immediate goal which the writers were assumed to respond to, while *motivation* was seen by Hayes (1996) as being "manifest ... in long-term predispositions to engage in certain types of activities" (p.9). In that sense motivation resembles other personal traits and skills that are subject to change and development.

2.2.6 The quality of the written product

The notion of linking process to product is a common theme in writing research (e.g. Kellogg, 1994; Breetvelt, van den Bergh & Rijlaarsdam, 1994; van den Bergh & Rijlaarsdam, 1999; Rijlaarsdam & van den Bergh, 2006; Rijlaarsdam et al., 2009). In general terms, studying the influence of certain cognitive and metacognitive strategies has revealed some useful findings on how the handling of the writing process affects the finished text. For example, advance planning and outlining (Kellogg, 1994; 1996), and delayed revising (Fitzgerald, 1987) have been found to result in better text quality.

However, there has been yet another issue in looking at the process product relationship. Other than simple cause and effect relationship, there has been found a "dynamically changing" association between writing processes and text quality (Breetvelt, van den Bergh & Rijlaarsdam, 1994; Rijlaarsdam & van den Bergh, 2006). Distributions of cognitive processes along different temporal stages of the writing activity predicated the quality of texts (Breetvelt, van den Bergh & Rijlaarsdam, 1994). In other words, a cognitive activity that influences text quality positively at a certain temporal stage of writing may have a negative influence at another stage.

Van den Bergh and Rijlaarsdam (1999) and Rijlaarsdam and van den Bergh (2006) explored "functional relations between cognitive activities" by looking at the preceding activities. Accordingly, text generation was categorised into *assignment-driven, rereading-text-driven, translation-drive, generation driven and pause related*. Different associations were found between text quality and different types of text generating. According to van den Bergh and Rijlaarsdam (1999), text generating that

comes from reading the text, for example, did not correlate with text quality at the initial stage of writing but correlated significantly positively when occurred towards the middle of the wring episode.

In addition to cognitive activities, metacognitive awareness influences text quality. Rijlaarsdam et al. (2009) reported a study where writers developed criteria for text quality as a result of their shared efforts in constructing metcognitive knowledge on communicative awareness. They concluded by advocating fostering awareness of task and audience in student writers.

Moreover, the role of metacognition in L1 and L2 writing quality was investigated by Schoonen et al (2003). They found that metacognitive knowledge correlated significantly strongly with L1 writing proficiency, but only moderately with L2 writing proficiency.

The relationship between both cognitive processes and metacognitive awareness and text quality is relevant to the present study.

2.2.7 L2 writing process

It is difficult to separate research on first language (L1) writing from research on second or foreign language (L2) writing. Studies in L2 writing have often looked into L1 writing as well, or integrated findings of L1 writing research for comparisons. Zamel (1983), for example, compared the writing processes of 'skilled' and 'less-skilled' L2 writers providing a profile of skilled L2 writers that is similar to some of the findings of L1 writing research. Cumming (1989) carried out a study to look into the relationship between writing performance in a second language on one hand and L1 writing expertise and ESL proficiency on the other. The purpose was to find out if either writing expertise or ESL (English as a second language) proficiency influences the writing process and product.

Other studies that compared writing in L2 with writing in English as a first language include Whalen and Menard (1995), Chenoweth and Hayes (2001), and Thorson (2000). Thorson, for example, attempted to test the relationship between revision in a foreign language and first language. He utilized automatic revision analysis to categorise and differentiate L1 and L2 revisions. Others compared the performance of non-English-native writers in their L1 and in writing in English as an L2 (e.g.

Jones & Tetroe, 1987; Sasaki & Hirose, 1996; Sasaki, 2000; Roca de Larios, Marin, & Murphy, 2001; Stevenson et al, 2006; Roca de Larios, Manchon & Murphy, 2006). However, with very few exceptions, the majority of studies that investigated L2 writing process have not provided an L2-specific cognitive process model of writing that accounts for L2 processing.

One of the first constructive attempts to model L2 writing production was that of Zimmerman (2000) who utilized think aloud protocols, interviews and written texts of fourth-year English majors to construct an "overall" model of L2 writing, as well as a model that looks specifically at the formulation process.

As with other cognitive process models of writing, Zimmerman's model (Figure 2.2) includes the three main processes in the act of writing: *planning, formulating, and reviewing. Formulating* is the process that had been referred to as *translating* in the previous models, but due to the possible sub-process of actual translating from L1 to L2 in second language writing, the term *formulating* was used to refer to the process of putting ideas (i.e. plans) into written language. Other differences between Zimmerman's model and the Hayes and Flower's include under representation of the long-term memory, exclusion of *the task environment*, and emphasising the sub-process of *tentative formulation*. Zimmerman used the term *tentative forms* to describe formulations that are voiced in writers' TA before putting them down in writing. These are similar to what Faigley and Witte (1981) called *pre-text* except that Zimmerman's *tentative forms* are those which do appear in the text written so far, subject of course to modifying or deleting.
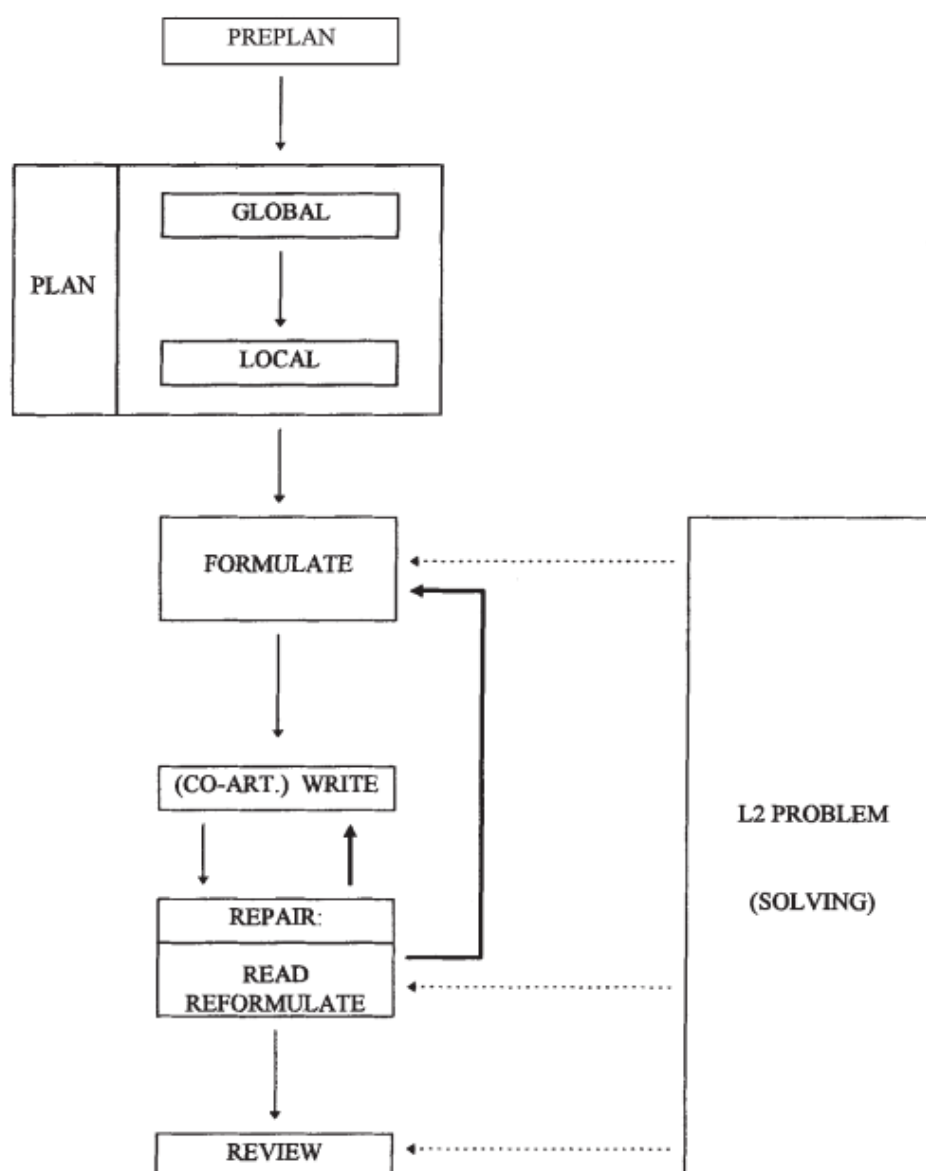
Figure 2.2 Zimmerman's (2000) overall model of L2 writing

As for the treatment of L2, Zimmerman's general model of writing processes (Figure 2.2) shows that the role of L2 knowledge is restricted to the process of problem-solving. This comes as no surprise when considering that the participants of the study are English majors in their fourth year of college. These participants are assumed to have most of their formulation process automatized (Schmidt, 1992) enough as to flow effortlessly until they encounter a language problem then they resolve to problem-solving strategies, (presumably using their declarative knowledge of L2). Apart from dealing with L2 writers, Zimmerman's comment on Flower and Hayes' process model seems to apply to his own model:

... the few data on which it is based are from apparently quite competent L1 writers. Understandably in a first phase of model building, a thorough, full-fledged quantitative analysis of informants with a wider range of writing competence was not attempted. (p. 74)

However, Zimmerman's (2000) model remains a useful one in the sense that it associates the L2 element (however limited the L2 role seems to be) with the formulation process, wherein, probably, the first demand on L2 in the act of writing could emerge. Another contribution of the model to our understanding of L2 writing is in considering both possibilities of direct L2 formulating or formulating that stems from translating L1's *tentative forms,* though the latter type was reported to be rare in Zimmerman's data.

In summary, a cognitive process model of writing can provide a framework for the present inquiry into development in university students' L2 writing. However three limitations have to be considered: The scarcity of models dealing with L2 writing; the virtual absence of discussion of cognitive development in L2 writing (this will be dealt with in Chapter Three); and the need to develop a tool to replace the TA procedure because of its possible reactive effect and to be able to increase the sample size.

2.3 Tools for observing the writing process

In the previous discussion on theorising about the writing process, different methods have been mentioned. The methods vary in the degree of how commonly they are used to elicit data on writing processes and strategies, and areas of writers' focus and attention. Generally the methods fall into four categories: written product analysis/assessment, concurrent verbalization of thought, retrospective account and computer tracking (keystroke logging). It is worth mentioning, however, that direct observation and recording tools (i.e. audio- and video-taping) are not put in separate sections but embedded within some of the methods. Observational notes in second language research, in fact, are usually considered data on their own right, but in writing research they are often accompanied by interviews (Zamel 1983), or stimulated recall (Wong, 2005).

2.3.1 Analyzing the written product

Analyzing the product of the writing process serves different purposes. Text features have been assessed for their own sake as indicators of writing quality and/or language proficiency. Terms like development, support and organization echo in almost all the academic holistic and analytic scoring guides. Other text features such as syntactic complexity and lexical richness have been quantified and compared across L1 and L2, native and non-native, and high- and low-quality writings (e.g. Ferris, 1994; Silva, 2001; among many others). However, written products have also been considered on the basis of a different perspective, that of the writing process. Texts have been analyzed to understand writing processes such as planning, revision, etc (e.g. Faigley & Witte, 1981; Matsuhashi, 1987).

One of the earliest methods in measuring revision, for example, was comparing drafts (e.g. Sommers, 1980; Faigley & Witte 1981, among others). Researchers compared drafts of the same writing task so that they could trace changes that would otherwise be masked by the neatness of the final essays. For instance, by analyzing the many revisions done to subsequent drafts, Faigley and Witte (1981) were able to put together a taxonomy of revision that is widely acknowledged and applied (however partially), not only in text analysis studies but also in coding computer-logged online revisions (e.g. Thorson, 2000; Lindgren & Sullivan, 2006; Stevenson et al 2006). Many studies, including the one in hand, benefited from their main division of revision as surface changes and text-based changes as well as from their distinction between revisions that affect meaning and those that result in formal changes, e.g. grammar, spelling, etc.

Matsuhashi (1983) combined both video-taping and text analysis to categorize revisions into two types, sequential (affecting form) and conceptual (affecting meaning), at different locations from the point of inscription. Although her inquiry fits more into on-line, 'real-time', tracking of the writing processes, details of her text analysis are relevant here. She notated revisions in the texts in an unprecedented manner that accounts for positions of pauses and the revisions that follow. The way she notated revision was the basis of the computerized revision tracer S-notation, developed by Severinson Eklundh and Kollberg (1996a&b; and Kollberg & Severinson Eklundh, 2001).

Text is central to the present inquiry in two ways. First, independent raters' judgment will be sought for finding textual evidence of two of the tested measures: task fulfilment and audience awareness. Second, the linear texts (explained in detail in Chapter 4) will be manually analyzed with the help of both pause information and the playback facility to determine how far from the points of inscription revisions are and the effect of these revisions on meaning or form.

2.3.2 Concurrent verbalization of thought

Process-oriented writing research was initially, and mainly, informed by cognitive psychology. Writing theories that emerged from this orientation modelled the writing process from the perspective of the cognitive operations that contribute to the production of written language. A major technical contribution of cognitive psychology to the writing process research was the think-aloud technique that has been claimed to make possible the viewing of the writing process as it takes place (Levy & Olive, 2001). At a time when all researchers could get was a neat finished text (or several drafts of it) or a retrospective account of whatever writers could remember of what they had thought about while writing or why they had made a certain change, think-aloud protocols provided a breakthrough as a concurrent research tool that continued to inform researchers until these days.

In most cases (e.g. Cumming, 1989; Wong, 2005; Stevenson et al. 2006) participants receive training on the think-aloud procedure. This is often done, following Ericsson and Simon (1984, cited in the relevant studies), by first giving participants arithmetic problems to solve while talking loudly of whatever thoughts come to their mind in solving them. Participants are often instructed to articulate everything that comes to their mind including "stray notions, false starts, and incomplete or fragmentary thought" (Flower and Hayes, 1981, p. 368). These articulations are either audio- or video-taped, and then transcribed. The transcriptions are called protocols.

Researchers vary in analyzing the think-aloud protocols, each according to their objectives and the questions they raised and proposed to answer. Generally, the protocols are initially coded so that the articulated thoughts, the (eventually) transcribed parts, and the rereading of an already written text can be distinguished one from another. This is often accompanied with more detailed and purpose-

oriented coding. For convenience, the protocols are usually divided into segments separated by certain pause length (e.g. Flower & Hayes, 1981; Cumming, 1989; Chenoweth & Hayes, 2001; Roca de Larios et al., 2006), or acts of text transcription. In other instances the whole writing activity is divided into episodes determined by time or amount of text (e.g. Breetvelt et al, 1994).

When carefully administered, think-aloud-while-composing procedure provides rich data as to how writing progresses and about the mental processes that underlay text production. Instances of planning, formulations and revisions could be identified; hesitations captured; and intentions (Cumming 1989), attention and concerns recognized (Cumming, 1989; Victori, 1999; and Wong, 2005).

The think-aloud procedure, however, is much criticized for its obtrusive effect on the writing process, as well as for its reactive effect (Smagorinsky, 1994; Janssen et al, 1996; and Thorson, 2000). Thorson (2000) commented that both being under observation and verbalizing one's thoughts while composing could intimidate the writer and alter the writing process. If think-aloud does alter the writing process then the validity of what it measures is alarmingly threatened.

In addition, having to pronounce the flow of ideas while composing and persist with it, (if it does not come naturally, I assume), is difficult, at its best. Writers sometimes find it annoying and distracting too. Kellogg (1994), for example, reported professional writers' inability to think-aloud while composing. Some had even dropped out of the research writing sessions because they could not talk and write at the same time. Similarly, Raimes (1985) lost half of the participants because it was too difficult for them to think-aloud while composing, and Whalen and Menard (1996) had to dismiss a number of participants because they did not show willingness to think aloud. It appears that participants who agreed to think aloud did so either out of obedience to the researcher, often because the researcher was their teacher, or out of their commitment to participation in the research. This commitment is sometimes motivated by promised feedback or instruction (Cumming 1989), exam practice (Spelman Miller 2000) or a prize (Chenoweth & Hayes 2001, Bosher 1997).

Janssen et al (1996) applied a computerized tracking tool to investigate the effect of the conventional think-aloud technique on the writing process. They found out that,

when writing a complex text, writers paused longer at sentence boundaries when they were thinking aloud than when they were silent. Longer pauses, according to them, entailed modifications to the planning process. Although the only interaction examined was between think aloud condition and both pause length and level of planning (again measured by pause location), one can draw a general conclusion that the think-aloud protocol can affect other aspects of the writing process. Janssen et al (1996) have, nevertheless, noted the richness of data that the think-aloud procedure provides.

Another drawback of think-aloud procedure is the potential subjectivity of protocol analysis. Sometimes coders remain in doubt of how to label simple utterances into, for example, planning, idea generating or formulating. Roca de Larios et al. (2001), for example have reported recognizing problems with identifying processes. Such labelling is central to understanding and representing the writing process and thus preparing it for investigation. Mistakes with coding reduce the reliability of the measures. Valid claims about the writing process can never be made out of unreliable data.

Finally, think-aloud, although it is still a commonly accepted procedure in writing research, is particularly unsuitable to the present study for three reasons: (1) With L2 writers, there is always the possibility for writers to articulate their thought in their own language. In this case transfer might occur, adding an uncontrolled variable. (2) Alternatively, participants would speak in English which makes it difficult for them to articulate their thinking. Think-aloud imposes a double effort in this situation, the effort of attending to writing and the effort of speaking the foreign language. Moreover, variation amongst participants in the ease or difficulty of oral expression of thought in English will create another variable. (3) Think-aloud could raise writers' awareness of the writing task (Rose, 1981, cited in Bosher, 1998). Since I am addressing task attainment, such an inflicted focus on task will reduce the construct validity of *attention to task* measure.

2.3.3 Retrospective inquiry

Retrospective accounts of the writing process can be gained from writers after they finish writing. Researchers who did not wish to disturb writers or create a reactive

effect (by making them think-aloud while composing) chose to let writers write as they would normally do, and after they have finished writing, they interviewed them about what they have done. The interviews often follow observation or audio- or video-recording.

Retrospective accounts are elicited in many ways: by structured or semi-structured interviews, by using observation notes as a prompt, or by replaying parts of the recorded writing activity.

A major shortcoming of this method lies in the inaccuracy that might accompany retrospective interviews. Levy et al (1996) conducted a study to find out the correspondence between immediate/concurrent and retrospective views of writing sessions. In video-taped writing sessions, students were asked, when they paused during writing, to choose one of 15 predetermined writing processes that describe their situation upon pausing. These included things like planning, thinking about the reader, thinking of support, etc. When a writing session was over, the video recording was played and the students were asked, at the same pause points, to announce their choices again, (video playing was stopped at those pauses so that previous decisions are not shown to students). Correspondences between students' direct and retrospective views of their writing processes were low. Levy et al. (1996) explained that retrospection required remembering which in itself involved forgetting. They commented on relevant research:

> *... these findings should give some uneasy feeling to those who have embraced retrospective reports as the most appropriate for providing a window into the participants' minds to view the psychological processes of writing (p. 546);*

and reflected on theirs:

> *In less advantageous experimental conditions, where the retrospective reports sometimes hardly differ from guessing behavior, their use to make inferences about mental operations is highly problematic. (p. 555)*

In spite of this, retrospection remains a powerful tool in recovering the writing processes, especially within two circumstances: when triangulated with other data resources, and when coupled with vivid stimulus (Gass and Mackey, 2000). In the

latter case, recall of relevant thoughts and strategies can be stimulated by visual screening of the actual event, a technique that proved to boost accuracy of retrieval (Gass and Mackey, 2000).

2.3.4 Stimulated recall

Stimulated recall is based on the concept of retrospection (Gass and Mackey, 2000). It differs from conventional retrospection in providing a stimulus which is usually part of the activity to enhance accurate remembering. Stimulated recall practices in writing research varied slightly in the extent to which participants were prompted to talk about their writing strategies. In fact, the procedure attracts inconsistent and subjective approaches. Lindgren & Sullivan (2006), for example, instructed participants to talk "as much as possible about what was happening on the screen". Unlike in other research, they employed a peer to ask the student writer questions "if anything appeared unclear". A teacher motivated talk with open questions such as "What are you doing now?" and "Can you talk about that revision?" They used both spontaneous and prompted recalls to elicit responses about the different moves and strategies that shaped the writing process. Wong (2005), then again, used observation notes (not a replay of the writing activity) as stimuli and asked about certain junctures in the writing process. He asked why the writers "adopted certain composing strategies" (p.35) and how they thought about the purpose and audience.

As with other research tools, the details of stimulated recall procedure have to be thought through carefully. Gass and Mackey (2000) advised that a lot of decisions be made on the specific stimuli and on the degree of recall structuring. In any case: "Adequate direction is often needed to keep participants on track and in the "there and then" as opposed to the "here and now" (p. 52). Moreover, because stimulated recall seems to be sensitive to context and participants' reactions, deliberate efforts have to be made to draw measures of consistency and to stick to them.

Bosher (1998) employed the "stimulated recall" technique to explore the writing processes of Southeast Asian students of different educational backgrounds. She addressed differences between students in the attention they gave to different aspects of their writing, as well as differences in the use of strategies to generate solutions to problems. In particular, she examined participants' attention to gist, discourse,

intention, language, and procedure. Her approach to the stimulated recall procedure informed a number of inquires that embraced stimulated recall as an alternative to introspection (e.g. Sasaki 2000).

Similar to the stimulated recall methods is the immediate recall (Mackey and Gass 2005), wherein, immediately after completing an activity, participants are asked to provide self-reports about the activity. It differs from stimulated recall in that it does not employ recording of the event as a stimulus (Mackey and Gass 2005). In the present study, I designed some questions to elicit immediate recall of some of the strategies and areas of focus participants have been engaged in. Answering questions instead of self-reporting was necessitated by the large number of participants attending writing sessions at the same time, as well as by time limitation. Moreover, stimulated recall has been used to elicit data from a small number of participants.

2.3.5 Computer tracking

Computer logging programs record all keystrokes and mouse movements created by the writer within the programs' own word-processors. They generate log-files with large amounts of data. The representations of the writing events (e.g. arrow and mouse movements) are complex and often difficult to read. However, the programs are often developed so that the log files can be exported to analyzing tools, e.g. Trace-it of JEdit (Severinson Eklundh & Kollberg, 1996a & b; 2003). Data can also be exported to other files that visualize linear texts with pause time, deleted items, statistics, etc (e.g. ScriptLog, Stromqvist & Karlsson 2002).

Logging programs provide temporal and spatial data (when, for how long, and where things happen) which can be interpreted according to the variables we need to look at. Keystroke logging has therefore been used to locate pauses and compare their durations across different locations (e.g. Spelman Miller 2000, 2006). Inferences about processing and cognitive loads can be made in the light of length of pauses and their location in a hierarchical syntactic system (Schilperoord, 2001), or their location within elements of discourse structure (Spelman Miller, 2000, 2006). Moreover, keystroke logging provides data on location of revisions in relation to the point of inscription (e.g. Thorson 2000). This is particularly useful when looking at writer's revision behaviour in moving around the text.

In addition, logging programs provide data on change behaviour, generally referred to as revisions. As with paper drafts, individual revisions are difficult to capture in log files, unless (of course) one runs a slow and extensive replaying of the session and notes all the changes that happen to the text. Severinson Eklundh and Kollberg (1996 a & b) introduced a notation system (S-notation) that is embedded in Trace-it where two windows represent both the notated text and the complete writing session played entirely or revision by revision (Severinson Eklundh & Kollberg, 1996 a & b; Kollberg & Severinson Eklundh, 2001). Revision events are recorded as either an insertion or a deletion. Insertions are all text production events including the first event when a writer starts producing a text. The adapted notation system is similar to the one created by Matsuhashi (1987) in that a serial number is assigned to each break during text inscription and the same number is allocated to the corresponding revision (insertion or deletion).

Computerised revision notation is particularly useful when the approximation of revision to the point of inscription is one of the target measures, such as the case in the present study. However, the revision notation tool is absent from other logging programs such as ScriptLog, but other facilities can assess revision analysis in similar ways. In ScriptLog, for example, revisions can be tracked through cross-using of linear log texts, the playback facility and linear deletions files.

In addition, a very useful feature of logging programs is the ability to replay the writing session as a whole, by time intervals or revision by revision as in Trace-it (Severinson Eklundh & Kollberg, 1996). Some of the replay facilities allow for rewinding, forwarding and pausing in order to observe or discuss certain parts of the activity. The playback facilitates "self-paced discussion of the writing event" (Spelman Miller, 2005).

In second language writing contexts, keystroke logging has been used to replay writing sessions for research, educational and self/peer-monitoring purposes. Trace-it, for example, was used by Lindgren and Sullivan (2002; and Sullivan & Lindgren, 2002; 2006) who examined writers' reflections coupled with replaying of specific writing events, a procedure that completely avoids disruption of the writing process. Using their visual representation of the writing process, the LS graph, Lindgren and

Sullivan (2002) could detect differences between the writing processes of different tasks as well as differences among individuals.

In addition, the replay facility can be of a particular usefulness in observing second language writers as they struggle with L2 limitations. Spelman Miller (2005) explains the usefulness of online observation of writers in a second language.

> *... when writing is contextualized as a set of constraints on the second language writer within the demands of the task, we can gain a clearer understanding of the type of the interactions between concerns at linguistic, rhetorical, generic, discoursal and broader socio-contextual levels. (P. 311)*

The amount of research on writing behaviour using keystroke logging tools has surged in the past fifteen years (see Levy & Olive, 2001, for an overview). Researchers have often looked at pause and revision behaviour as well as other features in student writing (e.g. Lindgren & Sullivan, 2002 & 2006; Sullivan & Lindgren, 2002 & 2006; Spelman Miller, 2000 & 2006; Thorson, 2000). However, quite occasionally researchers carried their tools to work places and examined professional writing activities (e.g. Perrin 2001). In any case, keystroke logging provided an accurate and non obtrusive tool in observing and analysing writing. Another advantage of keystroke logging is computerized observation and recording of writing activities allow for handling larger samples than other methods, such as videotaping, analysing think-aloud protocols, etc.

In the present study ScriptLog has been chosen as the writing and logging tool both for its technical capabilities and for convenience as well, i.e. J-edit can only be run by older systems of Macintosh that are not provided in the updated computer labs where data collection has taken place.

2.3.6 Triangulation

Different sources of data can be triangulated with introspection or retrospection to promote reliability and validity of the measures. Lindgren and Sullivan (2006), for example, combined keystroke logging data (discussed in 3.3.4 below) with data from stimulated recall sessions that immediately followed the writing activity. By doing

so, it was possible to get the information necessary for the analysis while at the same time sparing the writers from the disturbance and influence of thinking-aloud.

Sasaki (2000) combined stimulated recall data with pausing behaviour, written texts and analytic scores given to the written text to explore fluency, pause behaviour and strategy use of EFL expert and novice writers.

Although retrospection in normal writing sessions has been criticized as being inaccurate (Flower and Hayes 1981, Levy et al 1996), in keystroke logged writing sessions, there is the advantage of replaying the writing session that can follow the event immediately. This enables writers to see their texts as they were produced and, presumably, will enable them to recall the events more accurately. In addition, carefully chosen prompts (Gass & Mackey, 2002; Lindgren & Sulivan, 2006) encourage retrieval of the necessary data from the pool of information writers could remember.

2.4 Summary

This chapter has provided an overview of the body of research that informed the theoretical and methodological choices of the present inquiry. It has been established that the cognitive process approach, although originated in modelling L1 writing, is useful in explaining L2 writing. The cognitive process approach informs the present inquiry of what to look at when examining student writing: the process of planning, retrieving relevant content and linguistic knowledge, and formulating the proposed plans (e.g. fluency in written language production); the trade off amongst levels of processing (e.g. revision strategies and writers' concerns); and the degree of attention given to the social environment and the text. Moreover, metacognitive awareness has been established as equally influential in the writing process. In particular, regulating the writing processes during different temporal stages in the writing activity has been found to affect the quality of text.

A socio-cognitive perspective has been overviewed as an essential complement to the cognitive models to help us understand the interaction between the inner cognition of a writer and the task environment. In the centre of the socio-cognitive debate lies the issue of audience awareness. Processing of text is affected by understanding, or otherwise ignoring, a reader's stance in relation to the text.

In addition, the chapter has overviewed the main research tools that have been employed to elicit data on different variables in the writing process and writer's attention to contextual matters. Text analysis was shown to be a valuable tool in uncovering some of the strategies of text structuring and as an assistant measure to revision analysis.

Think-aloud, although a fairly common method in process-oriented research, has been shown to have a number of drawbacks, and is particularly unsuitable for the present study. On the other hand, retrospection, when immediately follows the writing activity or is accompanied by vivid stimulus, can elicit data on writing strategies and areas of concern without disturbing the writers or altering the writing process. However, since retrospection can be subject to inaccuracy or forgetting, it is important to validate its outcome against data drawn from a different source, e.g. text analysis or online tracking.

Computer tracking has been presented as an appropriate method of measuring or co-measuring the variables that were proposed to be tested in the present study. It provides accurate accounts of fluency measures and revision behaviour. It records changes to the text as it unfolds in real-time, and provides spatial and temporal details of where and when changes have happened. It facilitates manual analysis of text spans and revisions. Moreover, computer logged writing sessions can be replayed to provide vivid stimulus for writers to recall their writing strategies and areas of focus, and the replay facility aids revision analysis.

Chapter Three: Tracking Development in Writing

3.1 Introduction:

Chapter Two looked at the concepts that have dominated writing research and the significance of cognitive process research to the present study. It has overviewed studies that considered cognitive, metacognitive, and socio-cognitive dimensions in the writing process. The chapter also listed in some detail the different procedures and tools that have been used to elicit data in writing research. The discussion in the chapter was concluded with the recognition that systematic representation of development in L2 writing is relatively lacking in writing research in general and in the cognitive models in particular. And that in order to measure development in writing we need to define our concept of development, and identify elements in the cognitive matrix that facilitate development

This chapter provides a synthesis of some developmental paradigms that have theoretically informed the study at hand. Central to this issue is the load writing puts on cognitive resources. Juggling knowledge about task, audience, context, and conventions, together with linguistic, cognitive and metacognitive resources requires high capacity processing ability in order for writing to be successful (Torrance & Galbraith, 2006). The capacity theory of working memory provides a framework for explaining maturation in writing in general as well as a number of observed developmental phenomena in L1 and L2 writing. This chapter will look at these developmental phenomena first before providing a detailed account for the central role of the working memory in writing development.

The chapter will also provide a discussion of the extent to which certain cognitive strategies, linguistic and contextual concerns, and textual features, which probably characterize writing proficiency, emerge developmentally.

Drawing on the cognitive process models of the late 1970s and early 1980s, researchers have attempted to find writing strategies that signal skill and maturation

in writers. Certain strategies were highlighted as characteristic of competent writers. These include global planning (e.g. Jones & Tetroe, 1987; Bosher, 1998; Sasaki, 2000) fluent production (Sasaki & Hirose, 1996; Chenoweth & Hayes 2001), global revising (Fitzgerald, 1987; Stevenson 2006; Lindgren & Sullivan, 2006), revising at the conceptual level (Sommers, 1980; Faigley & Witte, 1981) heuristic searches for solutions (Flower & Hayes 1979, Cumming 1989), etc. However, apart from psychological perspectives on the developmental role of the working memory (Kellogg, 1994, 1996, 2008a&b; McCutchen 1996, 2000; Ransdell & Levy, 1996), development in both the cognitive processes and the socio-cognitive awareness within writers remains minimally explored in the writing process canon.

The few studies that investigated writing with a fairly explicit perspective on development fall into one of three different, though related, categories: (1) development of L1 writing in children (e.g. Britton et al, 1975; Bereiter, 1980; Bereiter & Scardamalia, 1987; Bourdin & Fayol, 1994), (compared sometimes to adult writing, e.g. Scardamalia and Paris, 1985); (2) skill development in L1 adult writing (e.g. Flower 1979; Bereiter & Scardamalia, 1987); and (3) development in writing in ESL/EFL (e.g. Sasaki, 2000, Chenoweth & Hayes 2001). Although the practices of these enquiries and the measures used in assessing writing abilities exhibit notable similarities, little effort, as far as I know, has been done to theoretically link the three areas.

3.2 Development in L1 writing

Because of the lack of coherent theoretical grounds in writing development, a working model will be constructed here. The model consolidates concepts from four developmental paradigms offered by relevant research. Three of these paradigms underlie the developmental nature in the relationship between (1) child egocentric speech and writing; (2) speech and writing; and (3) child writing and adult writing. The fourth paradigm is derived from recent theorization on (4) the capacity of working memory, which provides a theoretical matrix for development in both L1 and L2 writing.

3.2.1 The egocentric speech paradigm

One of the early explanations of development in writing draws on theories of child thought and language offered by Vygotsky and Piaget. In particular, Flower (1979) used the terms *writer-based* and *reader-based* prose to differentiate two practices in writing. Simply differentiated, writer-based prose exposes ideas as they come in the writer's mind; and reader-based prose considers readers' stance while composing, by minimizing ambiguity and anticipating contextual variation. Flower argues that writer-based prose shares features with inner speech in child as hypothesised by Vygotsky (1962), or egocentric speech as proposed by Piaget (1971). The writer-based mode of expression is natural; it is cognitively less demanding; and "if Vygotsky is right," it reflects the cognitive processing of thought into verbal expression (Flower 1979, p. 22).

Children fail to see the world from a perspective other than theirs (Piaget 1971). In their egocentric speech, they do not communicate with a listener or care if anyone is there (Vygotsky, 1962, cited in Flower, 1979). They may not, for example, mention the subject because it is known to them. As a result, egocentric speech is often "elliptical" and words are loaded with personal meanings (Flower 1979). Sometimes adults write in a way that reflects this mode of expression. They adapt writing strategies that require less cognitive load and reflect the inner flow of thought with minimal modification (Flower, 1979). Such writing can demonstrate two characteristics: "the absence of expressed causal relations and the tendency to express ideas without proof or development" (Flower 1979, p.27). The result is "writing whose meaning is still to an important degree in the writer's head" (p. 30).

According to Flower (1979), the relationship between writer-based and reader-based prose is not necessarily developmental; rather, it is sequential. She has ultimately seen writer-based prose as a useful tool in exploring one's concepts and as an initial stage of writing to lessen the cognitive load and allow "the writer freedom to generate a breadth of information and a variety of alternative relationships before locking himself into a premature formulation" (p. 36). Writing a writer-based prose is, according to Flower, a first step in presenting information as the writer had explored or acquired them (i.e. as they are presented in the data input). This step is followed, in skilful writing, by a transformation of ideas to clear ambiguities and to

accommodate readers' stance. However, differences between the two practices can feasibly be perceived as developmental; and thus can provide discriminating criteria for describing maturation in writing (to serve the objectives of the present inquiry).

Development from egocentric-speech-like mode of expression would consequently entail modification to the natural flow of ideas, as well as more consideration of the presence, attitude, and reaction of a receiver other than self. This includes the skill of giving the reader access to what is being said, i.e. to the intended meaning of the text. This is partially done, according to Flower (1979) by avoiding concepts that are loaded with personal meanings. In the present study evidence of audience awareness and of conceptual processing of text will probably reveal developmental patterns in the writing of university students along the academic levels.

3.2.2 The speech-to-writing paradigm

Child inner/egocentric speech aside, written language has also been considered to have evolved from spoken language generally. Drawing on Olson's (1977), Flower (1979) explained:

> *According to David Olson the history of written language has been the progressive creation of an instrument which could convey complete and explicit meanings in text. The history of writing is the transformation of language from utterance to text from oral meaning created within shared context of a speaker and listener to a written meaning fully represented in an autonomous text. P.29-30*

In this perspective development in writing might have been envisaged as a spectrum that ranges from the least skilful transcribed speech to the most skilful autonomous text that is independent from the prosodic and contextual facilities of speech. Simon (1973, cited in Bereiter 1980) provided evidence for the developmental nature of the relationship between speech and writing. Simon reported that school children articulate what they write in their first year at school (i.e. they speak aloud while writing). This articulation disappeared by the third year in girls and fourth year in boys. This yields further evidence to the speech-to-writing developmental paradigm proposed here. It seems that as children grow up they become more able to transform the content and form of what they would say to a present interlocutor to a written form that communicates meaning across contexts.

Although it is feasible to assume that children start to write by simply transcribing their speech, the act of putting speech into writing, however, has been considered by Kroll (1981) as a developmental stage in its own right. When children start to write, Kroll explains, their mechanical skills of writing are much more limited than their fully developed skills of speech. Therefore they perceive the two processes as separate. As soon as children master the essential mechanical skills of writing, the two modes become "consolidated". At this stage, children's writings "rely heavily on [their] spoken language repertoire ... and writing is very nearly "talk written down" (p.39). Children eventually become able to differentiate the two modes of expression and develop "well articulated forms and functions" (p.39) for both skills while continue to systematically integrate the two.

A successful integration of the two skills would arguably require recognition of the facility of writing as providing opportunity for revisiting and amending text at different spatial latitudes. In speech there is a need only to manage the immediate utterance. Speech is virtually "irreversible ... [and] you cannot make revisions to [it]" (Sommers 1980). Sommers argued that adult inexperienced writers fail to revise substantially because they are influenced by this irreversibility concept. Writing, on the other hand, has the capacity to hold on to a broader argument. Writers are able to 'see' and spatially 'move' around the text in a way not possible in speech. In return, the text produced so far influences decisions writers make. This power of text over the act of writing is acknowledged by Flower and Hayes (1981). Recognition of the recursive capacity of writing, it seems, provides writers with control over the whole text as to negotiate organization and develop global concepts. Whether writers exploit this capacity or not seems to depend much on their level of skill and maturation in writing. In the present study, participants' perception of text as evolving and amendable stretch of language, which can be subject to manipulation, will be tested through their revision behaviour.

The speech-to-writing paradigm proposed here provides the study with measures for assessing development in writing. Writing as opposed to speaking requires a number of facilities. It requires (1) a writer's ability to stay connected with the reader despite the physical distance that separate the two, in the usual circumstances; (2) an ability to remain focused on the task (purpose) in the absence of motivation and feedback

from a receiver; (3) awareness and skill to work against ambiguity. Readers are often not able to ask for clarification and it is the responsibility of a writer to anticipate readers' needs and interaction with the text. As writers develop skill and expertise they adapt "a reader-based strategy which includes the reader in the entire thinking process (Flower 1979, p. 34)."

3.2.3 Child writing and adult writing

The significance of child writing development in this context is twofold. As mentioned earlier in this chapter lack of a coherent developmental model in L2 writing necessitated looking at stages of development in L1 writing. It would be useful to know, for example, if development in early L2 writing resembles development in one's L1 writing.

Another common ground between early L1 writing and L2 writing is the constraints language limitations put on processing writing. Limitations of inscription and syntactic skills in children place a high cognitive load on the working memory and reduce the ability of text production (Bereiter & Scardamalia, 1987). This delays attention to other aspects of writing, e.g. audience. It would also be useful to know the extent to which L2 linguistic constraints influence writing in a foreign language and delay more advanced writing behaviour. The following sections present some of the attempted theorization on development in L1 writing.

3.2.3.1 Stage paradigm

Several developmental stage models of L1 writing have been proposed (e.g. Britton et al, 1975; Bereiter, 1980). One of the comprehensive stage models is that of Bereiter (1980). While Bereiter argues that there is "no natural order" (P.89) for development in writing, he suggests stages of development that young L1 writers go through. A number of developmental paradigms that have been mentioned so far are reflected in the stages of development in writing that Bereiter proposed. The first and simplest of these stages is *associative writing,* which combines fluency in language production with the skill of idea generation. Bereiter acknowledged that a similar notion was proposed by Flower (1979) in describing writer-based prose as presenting information (ideas) in the way perceived by the writer, not in an order that can be easily accessible to the reader. The similarity between the two concepts (i.e. Flower's

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and Bereiter's) comes from an implied recognition of the act of putting thought into language as a basic stage in writing. However, the two concepts are fundamentally different. Flower perceived writer-based prose as a basic writing activity that facilitates generating and exploring content. It can even be produced by writers who have long acquired the conventional tools of writing. Bereiter on the other hand observed it as a primitive ability to associate thought with language, which most probably happens before acquiring formal and stylistic conventions of language. Bereiter further noted the similarity between associative writing and transcribed speech, and based that on the evidence given by Simon (1973, cited by Bereiter) of child writing that resembles speech. This similarity yields further support to the speech-to-writing developmental paradigm adapted in this study.

Britton et al (1975) also identified the overlap between writing and speaking in what they saw as a developmental mode of writing. Britton et al (1975) used the term *expressive* to describe written language that relies on the reader to interpret what is being expressed according to shared understanding.

The stage of *Performative writing,* according to Bereiter (1980), happens as a consequence of incorporating stylistic and mechanical conventions with associative writing. It is the type of writing that is required by and comes out of schooling. Moreover, *performative* writing, Bereiter argues, is the stage when concerns over these formal conventions tend to hold back content development.

Communicative writing, according to Bereiter, refers to writing that demonstrates the social cognitive skill of considering an audience. It is the writing that Flower (1979) calls "reader-based". Britton et al assigned two terms to this writing: *transactional* (to convince the reader) and *poetic* (to entertain the reader). In general terms, it is writing with the reader in mind.

The last two stages in writing development as proposed by Bereiter (1980) are *unified* and *epistemic*. Unified writing benefits from the writer's perspective as a reader. It represents writers' evaluation and critical judgment of what is being said, thus establishing "a feedback loop". Bereiter explains:

> *Writing comes to be shaped according to one's own standards, which in turn are shaped by what one has written. As a result the*

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writer begins to develop a personal style and a personal viewpoint. Writing becomes more authentic and satisfying. ... One does not argue simply to convince a reader but also to present an argument that oneself finds convincing. P.87

Epistemic writing takes place when unified writing is combined with reflective thinking in a way that writing is integrated into thought and becomes "personal search for meaning" Bereiter (1980).

In the present study, all participants are assumed to produce text in English at both *associative* and *performative* levels, using Bereiter's terms. There is once again a feasibility of comparing child L1 writing to the emergent L2 writing. However, there is a possibility that the stages may occur in a different order. The main difference between children's *associative* writing as reported by Bereiter and what we can consider as a first stage in L2 writing may be that putting ideas into language could be the most difficult stage in writing development because it is constantly hindered by limitations of language itself. However the paradigm remains useful to the present inquiry when considering the other stages. In *performative* writing, for example, acquiring more formal conventions can be assumed to facilitate writing at later levels of college education. This facilitation might result in writing with more *communicative*, *unified* and maybe *epistemic* character.

3.2.3.2 Knowledge-telling and knowledge-transforming

Another developmental view of the writing process that takes into account the cognitive aspect of the act of writing is that of Bereiter and Scardamalia (1987). In their longitudinal investigation of the mental activities involved in writing, Bereiter and Scardamalia contend that writers of different ages and levels of expertise follow distinctly different strategies and get involved in different kinds of thinking while composing a text. However, they also contend that sometimes neither age nor experience accounts for the differences. They proposed a two-model description of the writing processes. The process of writing, according to them, can either be a *knowledge-telling* or a *knowledge-transforming* act, the first being simple and naturally acquired, and the second being complex and problematic. Interestingly, both models can produce good or bad writing. It is not the outcome that distinguishes the simple from the "more-studied" process:

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> *What distinguishes the more studied abilities is that they involve deliberate, strategic control over parts of the process that are unattended to in the more naturally developed ability. P 6*

A knowledge-telling composing process can begin as a response to a writing assignment or as self-motivated writing task, either of which creates a mental representation of the task. This mental representation includes topic identifiers that vary in complexity according to the experience of the writer. The the more complex topic identifiers are, the more relevant the retrieved knowledge is. Retrieving relevant information happens as a result of the psychological process of "spreading activation". The mental representation of the task also includes discourse identifiers, the complexity of which depends (again) on the level of sophistication the writer possesses (Bereiter and Scardamalia, 1987):

> *Some immature writers may have an opinion-essay schema that contains only two elements – statement of belief and reason. Others may have more complex schemas that provide for multiple reasons, anticipation of counter arguments, and so on. p. 8-9*

Discourse identifiers work with topic identifiers in providing cues to retrieve content that is both relevant to and structurally fitting in the writing assignment. This content is then tested for its "appropriateness", a test that also varies in sophistication from appropriateness to the writing assignment to more considerations of interestingness, rhetorical power and genre. When the content passes the test of appropriateness, it is put into a written form, and the writer moves on to the following idea that is triggered by a cue that might exist in the so far produced text. (Bereiter and Scardamalia, 1987)

The second model that Bereiter and Scardamalia hypothesised is the knowledge-transforming model of writing. While the knowledge-telling process can be described as retrieving relevant content from memory, the knowledge-transforming process invokes thought. People who use knowledge-transforming strategies often reconsider what they have written and test it against what they want to say and their knowledge about audience. They also allow text to reshape their knowledge of the subject.

> *But the distinctive capabilities of the knowledge-transforming model lie in formulating and solving problems and doing so in ways*

that allow a two-way interaction between continuously developing knowledge and continuously developing text. P. 12

Bereiter and Scardamalia (1987) have identified four indicators of the composing process that discriminate knowledge-telling and knowledge-transforming processes: start-up times, note making, think-aloud protocols, and revision. In general terms knowledge-telling is constructing knowledge as soon as it is retrieved while in a knowledge-transforming strategy knowledge is modified to meet communicative goals. It is the evolution, as Almargot and Fayol (2009) put it, from writing "which must be said" to writing "which can be said to whom, and in what way" (p.27).

In writing research, the knowledge-telling model has continued to be frequently consulted when discussing limitations in writing proficiency (e.g. Flower, 1989; Grabe and Kaplan, 1996; Lindgren & Sullivan, 2002; etc). However, the model remains inadequate in that it does not account for difficulties faced by L2 writers in the very process of knowledge-telling. Adapting the knowledge-telling/knowledge-transforming paradigm will assume that knowledge-telling processes occur naturally and effortlessly while, in fact, it is a very difficult skill to start with in L2 writing. Writers have to deal with L2 demands before or as they attempt to "tell" knowledge. The present study proposes to track development from stages that may be well below that of knowledge-telling.

3.2.4 The working-memory capacity paradigm

The act of writing involves a great deal of retrieving and managing knowledge. The working memory plays a central part in *orchestrating* the cognitive processes of writing. The working memory paradigm provides explanations of a significant proportion of the stages of development that have been mentioned so far. The assumption that underpins this paradigm is that the *working memory* has a limited processing *capacity*, and that this capacity is of a developmental nature (McCutchen, 1996). In writing, high-level (e.g. planning) and low-level (e.g. inscription) processes "compete for mental resources" (Bereiter & Scardamalia 1987, p. 95; also Olive et al, 2001). The limitation of the working memory in handling cognitive processes can explain a number of developmental patterns in writing, including the ones presented so far in this chapter. However, explicit acknowledgement of the developmental

nature of the role of working memory capacity in writing has emerged only recently. Difficulty in writing can come from two conditions: reduced working memory, and too many constraints on the working memory (Kellogg, 1994 &1996; McCutchen, 1996 & 2000; Torrance, 1999; Torrance & Galbraith, 2006).

Writing processes create a demand on the working memory; and according to Kellogg (1996), formulation lays the heaviest demand: what can be automatic in speech (e.g. syntactic processes) requires great effort to formulate in writing. Kellogg reported on previous research wherein the skill of lexical selection was found to decrease when the capacity of the working memory is limited by other tasks. This can be true for other functions, e.g. global content, audience awareness, etc. (Kellogg, 1996).

McCutchen (1969, 2000) explained that the working memory has a limited capacity to access and use knowledge from the long term memory. She reported that the link between the working memory load and performance in writing is causal. Increasing load on working memory has been found to cause a decline in the quality of written product (McCutchen, 2000). Accordingly, mastery of encoding skills (e.g. inscription and spelling) helps reduce the load on the working memory, and increase the quality of writing. McCutchen (1996) has also pointed out to *age-related maturation*, and argued that the capacity of working memory increases with time.

Since writing processes (i.e. planning, generating ideas, formulating and revising) occur within the working memory resources, any effort to automate recall from the long term memory will free some space that allows working memory to 'work' more effectively. The case of experienced writers vs. novices provides evidence to that effect (e.g. Flower & Hayes, 1980; Faigley & Witte, 1981; Flower et al, 1986). Experienced writers, one would conclude, write more fluently and effectively not only because they possess, in their long term memory, healthy writing practices and conventions but also they have easier access to them. Being free from worrying about these conventions makes them focus on producing better texts.

Further evidence of how lessening the load on working memory results in better writing is the fact that native speakers do produce pieces of writing that are better than those of non-native writers (e.g. Chenoweth & Hayes, 2001). Automatic recall

of language conventions and prefabricated strings of texts allows the sub-processes within the working memory to engage in the global structure and meaning instead of worrying about, for example, syntax.

This is true for language knowledge; and it is also true for any type of knowledge stored in the long term memory. Genre knowledge and topic knowledge would also lessen the load on the working memory (Torrance, 1996; McCutchen, 2000). Torrance contends that genre related writing may exhibit writing processes with less planning and revision. And that a rhetorical problem is not really a problem for writers who are familiar with the rhetoric of their genre, where the rhetorical problem is already defined and solved.

Torrance and Galbraith (2006) argued that maturation in writing involves developing strategies that minimize the demands of writing on the cognitive resources. These include practising the lower level skills of transcription, developing skills to increase the efficiency of recalling relevant information from the long term memory, and reducing the number of processes to be juggled at the same time during writing (e.g. by making outlines, notes, etc). However, Torrance and Galbraith (2006) concluded:

> *No matter how skilled we are at managing the writing process, there is an irreducible core of potential conflicts and writing will always be a struggle to reconcile competing demands. (p.78)*

The working-memory capacity paradigm underlies the other developmental concepts introduced earlier in the chapter. For example, Flowers' (1979) subjects, who chose to delay attention to audience, did so to increase the capacity of their working memory in order to process content first. Moreover, children who improve over the early years of writing do so because as they acquire the skills of handwriting and inscription more space of the working memory is freed from attention to these orthographic basics (e.g. Bereiter and Scardamalia, 1987).

In addition, the working-memory capacity paradigm has the potential of explaining inadequacies in L2 writers, which makes it particularly useful for the present inquiry. L2 writers are expected to develop in their attention to conceptual and global structure aspects of writing as a result of acquiring more L2 knowledge.

3.2.4.1 The role of learning and practising

The relationship between competence and performance, i.e. knowledge and using that knowledge, can be perceived through the role of instruction and learning. Explicit learning bridges the gap between what is being learnt and the way writers perform.

The idea of practising, in general, and practising at carefully chosen levels, in particular, as means of improving writing performance has been advocated by many (e.g. Lindgren, 2005; Kellogg & Raulerson, 2007; and Kellogg, 2008a&b). Setting achievable goals and training writers at the immediate next level of difficulty explain a trend in writing instruction that perceives writing as a skill. Kellogg contends that writers (apprentices) need to be coached to learn the skill of writing. In his article "Training College-Level Writers through cognitive Apprenticeship" (2008a), Kellogg lays emphasis on deliberate practice "with effortful workout" to improve the writing performance, motivation, appropriate tasks, feedback and repetition.

> *The cognitive demands of serious writing are addressed in part by providing a scaffold that boosts training performance beyond what the apprentice can achieve on his or her own. In addition, the apprentice must deliberately practice writing skills with (1) effortful exertion to improve performance, (2) intrinsic motivation to engage in the task, (3) tasks that are within reach of the individual's current level of ability, (4) feedback that provides knowledge of results, and (5) high levels of repetition. (Kellogg, 2008, abstract)*

Kellogg provides evidence on the usefulness of modelling, scaffolding, and deliberate practice. He also discusses the difficulties of using the cognitive apprenticeship model to train college students. Kellogg and Raulerson (2007) suggest spaced practice and timely feedback in order for the training-to-write practice to be successful. This practice, one assumes, is the one that English major participants of this study have probably gone through.

The notions of tasks "that are within reach of the individual's current level of ability," and that of "a scaffold that boosts training performance beyond what the apprentice can achieve on his or her own" both seem to echo the principles of

comprehensible input and *comprehensible output* hypotheses, proposed by Krashen (1981) and Swain (1993) respectively.

> *Effective use of knowledge will require that college students deliberately practice the craft of writing extended texts, in English composition Writing Skills courses and across the curriculum in all subjects. Without training to use what they know, their knowledge too often remains inert during composition.*
>
> *... For written composition, such practice could in theory reduce the intense working memory demands of planning, generating, and reviewing, thus freeing limited capacity for controlling and monitoring these operations. (Kellogg & Raulerson, 2007, p. 238)*

3.3 Development in L2 writing

The paradigms presented so far can provide explanation of how certain writing skills emerge developmentally. Since in the present study the main subjects of inquiry are cognitive processes in writing and writers' awareness, rather than the linguistic nature of L2 texts, concepts in L1 writing process development can be useful in tracking development in L2 writing. In particular, the cognitive load L2 places on the working memory seems to resemble other loads that L1 writing might have, e.g. lexical and stylistic choices. However, while understanding that modelling maturation in L1 writing provides tools for measuring development in L2 writing (e.g. fluency, text autonomy, concern for audience and access to conventions), there remain fundamental distinctions that need to be considered when attempting to explain progression in L2 writing. The most prominent of these is the extent to which L2 language concerns facilitate or limit written production.

As pointed out in Chapter Two, research that looked at L2 within an explicit developmental framework is scant. Level of L2 writing is often investigated in relation to L1 writing (e.g. Cumming, 1989; Whalen & Menard, 1995; Chenoweth & Hayes, 2001). In order to understand the rationale of research that compares L1 with L2 writing, we have to acknowledge their underlying assumption that approximation to native-like writing indicates skill and maturation in L2 writing. On one hand, it has been reported that L1 and L2 writing processes, at least in broader terms, are similar (e.g. Jones & Tetroe, 1987; Cumming, 1989). Basic processes such as

planning and revising have been reported to occur in both first and second language writing (Raimes, 1985; Zamel, 1983). On the other hand, two similar associations were maintained: one between L1 writers and skilled L2 writers (e.g. Zamel, 1983; Chenoweth & Hayes, 2001), and another between less skilled L1 writers and L2 writers generally (e.g. Raimes, 1985). Zamel (1983) used direct observations and interviews to identify skilled L2 writing behaviour. She argued that skilled L2 writers' performance exhibited similarities with skilled L1 writers. She noted that skilled L2 writers focused first on the meaning they want to convey and then on how to "order it" and express it. Less skilled writers, in contrast, edited extensively and focused mainly on word choice[1]; without major revisions across drafts.

Raimes (1985) analyzed the think-aloud protocols of eight unskilled writers and compared their writing processes to L1 writing processes that were highlighted in the literature. She concluded that L2 writing processes, similar to unskilled L1's, lack planning and are pre-occupied with sentence-level concerns. However, L2 writers showed some interesting differences as well; they seemed to be more committed to the writing task than less-skilled L1 writers and they wrote longer essays. Raimes suggested extra care be taken when judging skill in writers. She commented that skill in writing is often confused with ESL language proficiency.

3.3.1 The role of linguistic knowledge

This leads to another assumption that explicitly or implicitly underlies perceptions of L2 writing development; that is the influence of second language (English) proficiency (ESL) on L2 writing. Studies that demonstrated independence from such assumptions and sought to examine the extent to which ESL proficiency predicts writing ability have come up with interesting results. Cumming (1989), for example, studied the effect of ESL language proficiency (measured by oral proficiency and effective communication), writing expertise (assessed according to holistic scoring of the participants' L1 compositions, self rating of their writing abilities in L1 and self report of whether or not they have professional experience in writing), and task (letter, argumentation and summary) on three aspects of L2 writing: text quality,

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[1] In Cumming (1989), however, focus on word choice was found to be a characteristic of expert (L2) writers. I assume that Zamel's concept of 'word choice' (like that of Sommers, 1980) refers to lexical choices (or limitations of lexical choices in the case of L2 writers), while Cumming's 'lexical choices' are included within stylistic choices that have more considerations of audience and purpose, and deliberate expression of tone and voice.

attention to aspects of the writing process, and problem-solving behaviours. He maintained that second language proficiency did not seem to affect problem-solving processes during writing. Rather, writing expertise appeared to be "a central cognitive ability- with second-language proficiency adding to it, facilitating it and enhancing it":

> *Writing expertise appeared to be a specially developed intelligence with unique cognitive characteristics that can be applied across languages. Second-language proficiency, in contrast, entails the development of language faculty to function appropriately within the parameters of a specific language code (differing from the mother-tongue). Both ... appear to contribute different elements to second-language writing performance p.124*

However, it seems that the role of ESL proficiency is evident in different aspects of the writing process. Better linguistic knowledge facilitates writing in more than one way: it improves fluency (Schmit 1992); and it frees the working memory from low-level linguistic concerns (Kellogg, 1994 & 1996; Chenoweth & Hayes, 2001), which leaves more space for attending to content and global organization. Moreover, one can suggest that there is an indirect role of ESL proficiency. Writers who are more proficient in ESL could have been exposed to more L2 input, including a variety of structures, lexicon and discourse norms. Accordingly, they might have acquired a sense of what sounds right, appropriate, and/or logical in the written mode of the target language.

It is relevant to point out here that the language level/proficiency variable has been defined in different ways. Some studies conducted language tests for the purpose of identifying language level as a research variable (e.g. Cumming, 1989). Sometimes they segment the language proficiency construct into a number of measures (e.g. Hirose & Sasaki, 1994; Sasaki, 2000). Less often, though arguably feasible, language level is defined as the number of years of experience with the language (Chenoweth & Hayes, 2001).

3.3.2 Automatization

Beside process model theories, the processing of written language, especially the relationship between language competence and writing ability, can be understood in

light of second language acquisition (SLA) theories, particularly within the psycholinguistic perspective of SLA. According to psychologists, there are two ways of processing language, namely, automatic and controlled (Schmidt, 1992). Although one would perceive the dichotomy between the two processes as somehow arbitrary, it is useful to speak of the writing process in terms of the contrasting factors between the two types of processing. Automated processing is different from controlled processing in terms of speed, effort, memory capacity, voluntary control, being subject to modification or inhibition, and being accessible to introspection. As language skills develop with practice, they undergo a shift from controlled to automatic processing (Schmidt, 1992). Accordingly, practising writing and acquiring large amounts of linguistic and rhetorical knowledge will result in writing processes that are faster, more automatic, produced with less effort, and not limited by the capacity of the working memory.

As far as text production is concerned, fluency characterizes the automatic type of language processing. According to Chenoweth & Hayes (2001), fluency in writing increases as the writer's language proficiency increases. This can be explained in Schmidt's terms: As the language proficiency increases, more linguistic tools would be acquired and stored in the long term memory. With practice, these tools become automatically accessible to the writer, and thus result in a fluent production of linguistic output.

The concept of automatization (Schmidt, 1992) is dealt with as a fifth developmental paradigm in this investigation of L2 writing development. It is very much related to the working-memory capacity paradigm (McCutchen, 1996 & 2000). But besides capacity of the working memory, automatization accounts for accessibility to and ease of retrieval of knowledge stored in the long term memory, and touches on the role of practice rather that experience in the development of L2 language production.

3.4 Assessing development in writing

From the discussion of development in writing for L1 and L2 certain measures appear to be instrumental in investigating development in writing. The parameters of writing proficiency proposed in this study account for the cognitive and socio-cognitive demands of writing.

Development in writing has been found to be reflected in a number of processes and areas of attention. It entails more automatic and quicker access to linguistic knowledge, a skill that results in fluency. In addition, it requires detachment from self and awareness of the others (reader awareness); focus on the purpose of writing; and engagement with the text as a modifiable entity. Moreover, with experience, writers get to focus on global content, rather than individual words or orthographic representation of words. This is usually reflected in revision behaviour. Finally, maturation in writing means that writers take a more effective role as to transform knowledge and other cognitive recourses to account for the needs of an audience.

However, very little research has embraced the paradigms that have been mentioned so far. Research has instead explored the variables offered by the cognitive models eclectically. There have been investigations of planning, text generating, formulating and revision, some of which are integrated in the components of the developmental paradigms presented in this study. However, the present study has considered investigating measures that can be explained in developmental terms. Ideally, these are the ones that have been tackled in research that looked at L2 writing at different developmental stages. However, because such research is not very widespread, research that compared L1 with L2 writing, often with a perspective that L1 represents the advanced type of writing, has been deemed relevant. The following review traces five measures in the existent literature that have been found to either indicate development in writing or signal differences between L1 and L2 writing. These are measures of fluency, pause behaviour, revision strategies, audience awareness, and focus on purpose.

3.4.1 Fluency

That fluency is a valid indicator of writing proficiency is a widely acknowledged fact. L1 writers are more fluent than L2 writers (Chenoweth & Hayes 2001); and more-skilled L2 writers produce more text with less difficulty than their less-skilled counterparts (Sasaki, 2000). Fluent production has been proven to result in better quality text. Schoonen et al. (2003), for instance, found positive correlation between fluency and overall writing performance in both L1 and L2.

The relationship between fluency and language proficiency can be explained in psycholinguistic terms. It is assumed that when language is not yet *automatized* (Schmidt, 1992), writers' involvement with retrieving basic linguistic information (e.g. word searching, grammar and spelling checking, etc) occupies the working memory leaving little space to attend to "higher-level concerns such as generating detailed content and organizing the discourse (e.g. Chenoweth & Hayes, 2001, p.82)." As learners progress up the linguistic levels, linguistic knowledge becomes *automatized*, fluency increases and more working memory space is freed to attend to content and organization, an attention that would normally result in better texts.

Besides psycholinguistics, a developmental perspective on fluency has been provided in cognitive process models. Chenoweth and Hayes (2001), for example, proposed a model in which the internal process level includes the translator and the reviser. They hypothesized that language proficiency will increase fluency in that it speeds up language (e.g. lexical) retrieval from the long term memory, which in turn shortens the time it takes the translator to produce text. They also argue that language proficiency, (operationally defined in their study as experience with language,) will also affect the reviser to the better. Producing correct text right from the beginning, according to them, will reduce revising time, and thus increase fluency.

The most straightforward measure of fluency is text length. In writing tasks that are not time-limited, however, rate of production (words per minute) could be an alternative measure; otherwise text length will depend more on the time spent on the writing task than on fluency. Text length is significant in L2 writing because it accounts for the claim that is often made about L2 writers' inability to generate text. Victori (1999), for example, reported that poor writers' struggle to generate text after they state their opinion. In this case, one would assume, it is likely that such a statement of opinion could have been prompted by the wording of the writing task. Text length has been found to increase with experience (Sasaki, 2000), and over the years (Lindgren et al, 2008). However, Spelman Miller et al (2008) did not find significant improvement in text length along three secondary academic years.

Chenoweth and Hayes (2001) put forward four measures of fluency, all of which are concerned with the rate of production rather than, for example, accuracy. These measures are words per minute, average length of strings of words proposed between

pauses or revision episodes "bursts", number of revision episodes, and the proportion of accepted text to the proposed candidate text.

Unsurprisingly, Chenoweth and Hayes reported a higher rate of production (as measured by words per minute) in L1 writing than in L2. However, although the ratio of L1 to L2 fluency appeared to have increased by 69% as experience with L2 language increases (i.e. between semesters 3 and 5), the increase was, in part, due to a decrease in L1 fluency in semester 5 (Chenoweth & Hayes 2001). Spelman Miller (2000) has also employed word per minute measure and found that L1 writers produce text at a significantly higher rate of production than L2 writers. In addition, rate of production was also found to increase along the years of L2 learning experience (Lindgren et al, 2008; Spelman Miller et al, 2008).

Average length of bursts (string of words between pauses) was an instrument that has occasionally been used as a measure of fluency (e.g. Kaufer et al. 1986; Chenoweth & Hayes, 2001; Lindgren et al, 2008; Spelman Miller et al, 2008) or as pause related measure (Spelman Miller 2000). Chenoweth and Hayes (2001) hypothesized that burst length can be a central contributor to fluency: "It reflects the amount of ideas writers could access and translate in one time span (p. 83)." In their findings, burst length proved to be a developmental measure with the potential of finding differences both between L1 and L2 writing, and along the levels of experience in L2. L1 writers produces bursts that are considerably longer that those of L2 writers. Likewise, Kaufer, Hayes and Flower (1986) had found significant differences between expert and novice writers in the "length of sentence parts" produced between pauses in the writer's verbal protocols. They attributed expert writers' superiority over novices to the amount and variety of "sentence pattern knowledge" expert writers had obtained through practice.

Using a different measure that is fundamentally similar to burst lengths, i.e. length of text span, Spelman Miller (2000) found significant differences between L1 and L2 writers in the length of text spans they produce between pauses, with L1 writers producing longer text spans. Roca de Larios et al (2001) and Whalen and Menard (1995) have found similar results. Other studies calculated burst length from data provided by keystroke (by dividing the total number of characters by the total

number of revisions and pauses) and found significant differences over time (Spelman Miller et al, 2008), and between L1 and L2 (Lindgren et al, 2008).

The third measure Chenoweth and Hayes considered in their study of fluency is the number of revision episodes. According to the cognitive model they produced (described in Chapter 2), there is a two-way relationship between fluency and revision. When the translator is less able to produce grammatical and appropriate text, the reviser can still detect problems once the text is produced. Frequent revisions slow production and reduce fluency (Chenoweth & Hayes, 2001). While maintaining an understanding of this causal relationship between fluency and revision, the two measures are treated separately in this study.

Chenoweth and Hayes' (2001) fourth measure, the proportion of the accepted to the proposed text is specific to think-aloud methods. Identifying this measure requires separating the following three sections one from each other: the proposed text (i.e. what writers articulate as candidate text), the transcribed parts (i.e. the parts that are actually put on paper), and rereading what has been written. This involves juxtaposing and cross analyzing the text, the video record of the writing session and the transcription of writers' articulations (TA protocols). However the measure of proportion of proposed text to the final text can plausibly be applied to the present study but within the research tools. In the present study, the proportion of text in the final product to the proposed text will be measured using the statistics supplied by a keystroke logging program.

Apart from Chenoweth and Hayes, the proportion of accepted candidate text has not been seen elsewhere in relevant research as a measure of fluency. On the contrary, putting down more of the proposed text was interpreted, differently, by Cumming (1989) as an indication of lack of control. He argued that less experienced writers write everything that comes to their mind "without reflections or modifications".

In summary, four measures of fluency have been found useful and feasible for the present study. The two straightforward measures are text length and rate of production. The third measure of average length of burst can be adapted, with modifications, into the silent writing activity. The average length of uninterrupted text spans between pauses of certain lengths will be calculated in the present study as

a measure of fluency. The fourth measure is proportion of linear text to final text which corresponds to Chenoweth and Hayes' (2001) proportion of accepted candidate text.

3.4.2 Pause behaviour

According to Matsuhashi (1987), an understanding of pauses and hesitations (which are temporal aspects of revision) can shed light on mental processes. Pause in the present study is treated within two limited measures. The first is in its association with initial planning. And the second is in its relation to fluency.

Flower and Hayes (1981) describe the planning process as "an internal representation" of the knowledge that will be used in writing. Planning is perceived within the present inquiry as another measure of maturation in writing, yet it is not without controversy. It is assumed that skilled writers spend longer time planning the global structure of the text during the initial stages of writing (Sasaki 2000). This speeds up, 'facilitates', the process of writing as the text unfolds at later stages of the writing session (Englund Dimitrova, 2006). Unskilled writers, on the other hand tend to make fewer and shorter initial pauses. They do not make enough effort to structure the overall text from the beginning. This is because they are either unable to plan globally or unaware of the importance of global planning. They lack a sense of the overall gist of what they write (Witte, 1983).

In the early studies that marked the cognitive tradition of writing process, planning was detected through what would be an attempt to plan in the writers' articulation of their thought (e.g. Flower and Hayes, 1981). With the introduction of keystroke logging programs, planning started to get a different treatment. The length of initial pauses was particularly seen as an indicator of the amount of global planning. Pauses at paragraph boundaries were seen as platforms of planning paragraphs and the ones that preceded sentences indicate sentence planning processes (Schilperoord, 1996).

The distribution of pause time over the several locations within text was found to associate with the hierarchical structure of the text with boundaries of larger segments of text having longer and higher proportion of pause (Matsuhashi, 1982; Schilperoord, 1996 & 2001; Spelman Miller, 2000). Pause also corresponds to locations in the thematic structure of discourse (Spelman Miller, 2000 & 2006).

Schilperoord (1996) contends that the longer the pause, the more cognitive activities are inferred to be needed to perform the next actions. Accordingly, long pauses reflect "macro-planning" processes while short pauses reflect "micro-planning processes". Since macro planning, i.e. global planning, has been identified as characteristic of skilled writing, longer pauses in the initial stages of writing can be considered as an indication of skill and maturity.

On the other side of the controversy, Cumming (1989) asserts that advance planning is not necessarily an indicator of writing expertise and that "emergent planning" is also found in expert writers. Interestingly, advanced planning strategy was found, by Cumming, in expert writers with technical background, and emergent planning was adapted by writers with literary background, who are equally expert. Advance planners demonstrated long initial pause, spending "several minutes deciding on the major elements they would discuss in their text" (p.115). Expert writers stand out not in certain planning strategies but in the way they control their writing activity and relate their planning to the gist and organization of their writing (Cumming, 1989).

Excluding Cumming's, there seems to be a general tendency, in the findings of other research, for advanced writers to plan in advance (Jones & Tetroe, 1987; Bosher, 1998; Sasaki, 2000), and for basic writers to adapt a "What next?" strategies in their writing processes (Bereiter & Scardamalia, 1987; Grabe and Kaplan, 1996; and Sasaki 2000). The effect of outlining, in particular, has been recognized in Kellogg (1994).

In the present study, the initial-pause measure in particular has been utilised to test tendencies of global planning.

The second consideration of pause in the present study is in relation to fluency. Fluent production entails spending more proportion of time on producing text, rather than halting. It has been found that L2 writers spend more time pausing than L1 (Spelman Miller, 2000; Lindgren et al, 2008); and more than L2 at earlier stages in L2 experience (Spelman Miller et al, 2008). This is similarly true for frequency of pauses. However, Warren (1997) found out that learners were similar to natives in terms of the frequency of pauses but the duration of their pauses were longer, and

that learners paused more at T-unit[2] juncture than native speakers. As for the cause of pauses, learners paused more to make lexical and structural decisions than native speakers (Warren, 1997).

3.4.3 Revising strategies

Revision behaviour has been another distinguishing measure in writing proficiency. For one thing, it is related to fluency in text generation. Their effect on each other is recursive. Limited L2 knowledge results in interruption of the flow of writing to revise forms; and repeated local revisions of form slow down the act of writing and affect fluency. One of the repeatedly addressed issues is the differences in revising strategies between good and poor writers, (also called experienced and inexperienced, skilled and unskilled, basic and advanced.) It has been reported that skilled writers revise more globally. They revise overall organization and content because they are aware of the overall content of their texts. Less skilled writers on the other hand are often preoccupied with low-level revisions which result in surface changes (Fitzgerald, 1987; Flower and Hayes 1981; Flower, Hayes et al. 1986) In general terms student writing (as opposed to proficient writing) is said to lack substantial revisions (Emig, 1976; Sommers, 1980; Faigley & Witte, 1981; and Faigley 1986).

Sommers (1980) addressed differences between students and experienced writers in the way they view revision. On interviewing writers, they were asked to classify their revision concerns as primary, secondary and tertiary; and to state whether they scale their revision concerns the same for all the three drafts, or their concerns change according to which draft they are working on. Sommers found out that students are almost always concerned with revising vocabulary, and that their own conceptions of revision underlie this concern. They view writing as a ready-existing meaning that needs (only) to be put in the right words. Experienced writers, on the other hand, revise "to manipulate the conventions of discourse in order to communicate to their reader" (p. 383). Their revision also included discovering meaning (Sommers, 1980). Supportive to this is Witte's (1983) finding that advanced writers focus on the global structure of the text while basic writers tend to make surface changes.

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[2] T-unit is a term that was first coined and used by Hunt (1966) to mean a main clause with its subordinate clause(s). It differs from a sentence in that a compound sentence is considered to contain as many T-units as the number of main clauses in it.

In a similar vein, Faigley and Witte (1981) maintained that good revisers make changes to the meaning of the text as they revise. In their revision taxonomy, Faigley and Witte, distinguished between surface-level and text-based revisions. According to them, advanced students made twice as many changes to the propositions of their texts as those of basic students, and adult writers made about three times as many changes. Moreover, the changes that basic writers made to the text occurred mostly at the surface-level.

Beside revision type, frequency of revision has been identified as an indicator of level of skill in writing. Generally, it has been reported that L2 writers revise more than L1 writers do (Zimmermann 2000, Thorson 2000, Stevenson et al 2006). Again, automatization (Schmidt, 1992), which is a useful concept in explaining fluency in writing, may also result in less frequent revisions. If this is the case, then writers at higher levels of L2 proficiency/skill are expected to perform less revisions that those of lower proficiency levels. Chenoweth and Hayes (2001) reported a decrease in the frequency of revision amongst L1 writers and advanced L2 writers as compared with lower level L2 writers. Moreover, L1 and advanced L2 writers tend to include more of their orally proposed language in the text. According to Chenoweth and Hayes this could mean that good writers revise their mental version of the text before putting it on paper, or that they produce language more automatically.

However, revision frequency has not always been seen as a measure that is linearly associated with development. Witte (1983) had drawn a somehow different conclusion in terms of the amount of revision. Association between the amount of revision and the level of expertise in writing, according to Witte, is neither negative nor positive. It is relative. That is, experienced professional writers revise less than experienced students, but the latter revise more than inexperienced students do. In other words, experienced writers' amount of revision is neither too much nor too little. The reason why they revise less is that they would have generated a mental version of the text- "pre-text"- at initial stages or before they start writing (Witte, 1985).

Similarly, Spelman Miller et al. (2008) observed revision frequency (among other fluency and revision measures) over the years of secondary school students. They found no significant changes along the years. However, in a study conducted by the

same team of researchers (Lindgren et al, 2008) it was found out that frequency of conceptual revisions does increase along the course of L2 experience, while occurrences of formal revisions signal differences between L1 and L2, with writers making more revisions to form in L2 (English) than in their L1 (Swedish).

Matsuhashi (1986) adapted a different taxonomy of revision. Using timed videotapes of her participants' writing, she developed a notational system whereby each pause that is followed by a revision was marked by a number. The numbers pauses carry reflect the pauses' relative positions within a temporal sequence of text production. The number assigned to each pause was then assigned to the subsequent revision(s). Revisions were systematically notated, i.e. deletions were marked by crossed-over text between two square parentheses, and additions were marked by all-side-bordered word or number of words). Matsuhashi's inquiry on the nature of revision distinguished two types of plans: conceptual and sequential. This distinction was influenced by Robert de Beagrande's (1980, cited by Matsuhashi) distinction between "conceptual and sequential connectivity". Matsuhashi suggests that by understanding the nature of revision inferences could be made as to whether the writer's focus (of attention) was on the sequential plan, i.e. "revisions for semantic relationships, grammaticality, and correctness", or on the conceptual plan.

Matsuhashi's taxonomy of revision has proved to be a useful tool in distinguishing revisions according to their effect on the text, a tool that in fact underlies some recent computerized notations of revisions. Moreover, Matsuhashi used the concept of revision "at the point of inscription" which accounts for revisions that are not contextualised enough as to be fully understood by the analyst. Without more information from writers, some of these are difficult to explain.

Similar to "revisions at the point of inscription" Lindgren and Sullivan (2006) proposed the term "pre-contextual" revision and defined it as "changes made to written text before a full context is externalised; formulations and content elaborated upon by writers to shape the progressing discourse at the point of inscription" (p. 38). They categorized revision according to content and location. The first of these categories distinguish external and internal revisions.

Using Lindgren and Sullivan's (2006) categorising of revision into external and internal is not plausible in the present study. The present study cannot be concerned with internal revisions because no direct access to the mental process has been sought through think aloud procedure. Instead, the study seeks to reveal the level of language processing through the externalized revising behaviour. Also, the term pre-contextual revision is somehow at odds with the fact that a revision does not normally occur pre-contextually. Writers seem to have a vision of what they want to say (at least at the intermediate level of an utterance), and when they pause to change something in the middle of what they inscribe, they often do so because something has struck them as wrong or inappropriate; they have found a mismatch between what they say and what they have proposed to put on paper; or they are struggling with the encoding of what they want to say (orthographic, lexical, structural, strategic). In all cases the revision is pre-contextual only to the analyst, not to the writer herself/himself. However, the spatial approximation of the revision to the point of inscription is of a different significance to the study of revision. This will be discussed under revision location towards the end of this section.

The present study seeks to understand revision from both an L2 perspective and a developmental perspective. Very few studies have endeavoured to explain the level of processing from an L2 perspective. However, some have categorised revision processes (e.g. Allal 2003, Lindgren and Sullivan, 2006), or writing processes in general (e.g. Whalen and Menard 1995), according to the linguistic, cognitive, socio-cognitive, and/or strategic knowledge/awareness that underline it.

Allal (2003), for example, recognized three objects of revision processing, which she called *transformation*: (1) semantic, meaning and vocabulary; (2) spelling, of lexical and grammatical aspects; and (3) text organization: "primarily operations of segmentation, connection, cohesion, changes of verb tense, use of narrative organizers" (p.146). Text organization is a category that adds to the traditional form-meaning distinction. Another dimension that Allal (2003) considered in categorizing revision is whether a revision is carried out to correspond to conventional requirements (e.g. of language), or to optional choices (e.g. of topic or audience treatment). In a sense, this dimension in Allal's taxonomy corresponds to Ellen Nold's (1982, cited in Matsuhashi, 1986) distinction between revising to fit

conventions and revising to fit intentions (in relation to meaning, audience and purpose).

In addition, Whalen and Menard (1995) have attempted to explain the interaction between conceptual, strategic and linguistic knowledge during L2 writing process. They contend that linguistic processing inhibits processing at pragmatic and textual levels. Although linguistic level processing, as measured by relevant occurrences in writers' think-aloud protocols, exceeds pragmatic and textual processing in both L1 and L2, L2 writers demonstrated significantly higher proportion of processing at the linguistic level than L1 writers, suggesting, according to the authors, that processing at the linguistic level "apparently inhibits more global processing at the textual and pragmatic levels"(p.391).

Unskilled/FL writers get engaged in surface linguistic processes and ignore overall text content and organization (Stevenson et al., 2006). According to Stevenson et al, inhibition of high-level revisions in FL writing by the writer's engagement in making amendments to the low-level linguistic features affects the quality of texts. Although there were no significant correlations between the total number of revisions and text quality in both Dutch (L1) and English (FL) texts, high and low quality texts in each language showed variation across revision categories.

Writing researchers seem to agree that, there exists a writing/revision skill (ability or knowledge) that makes expert writers write better than novices, L1 writers write more effectively than L2 writers, and advanced L2 writers outperform basic L2 writers. Those who possess such a skill tend to behave similarly when they write/revise. They attend to global structure, they are more able to detect and diagnose text problems, etc. Hayes (1996) hypothesized a "control structure," which includes schema for the revision task. Task schema is a "package of knowledge, acquired through practice, that is useful for performing a task and is retrieved as a unit when cues indicating the relevance of the schema are perceived" (Hayes, 1996, p. 16). It was found that students who were given 8 minutes of instruction on effective revision schema, i.e. focusing on global revision rather than local revision, performed better both in terms of the proportion of global revision and in the overall quality of the revised text than those who did not receive instruction (ref). Again, the role of explicit knowledge is highlighted.

3.4.4 Focus on the purpose of writing

Ideally, writers create a mental representation of the writing task, which (in skilled writers) leads to a representation of the global content and sometimes of the text (Bereiter & Scardamalia, 1987; Lindgren & Sullivan, 2006). Changes to the global representations of text require revisiting the task prompt, either mentally, by thinking about it, or through rereading it. Thus both rethinking and rereading the writing task indicate attention being paid to the global content (i.e. the gist), which is characteristic of good writing (Fitzgerald 1987). It is an area that seems to have been ignored by researchers. Instead, other measures were taken. Changes that were done to larger segments of text (e.g. adding an introduction) instead of individual words, for example, were seen as reflecting a concern of the overall structure of text (e.g. Fitzgerald, 1987; Stevenson 2006). However, Stevenson found no evidence that focus on problems in smaller text chunk would necessarily reflect lesser concern about the global content.

Revising the global content is not the only reason why writers consult the mental or written (in the form of writing prompt) representation of their writing task, writers do this to create a purpose and to adhere to it. Leki (1995) realized rereading the assignment topic as a way of keeping focus on the writing task. He also described rereading the prompt as a coping strategy.

While focus on the purpose of writing, per se, received little interest in the relevant literature, writers' attention to the gist of their essays was an objective of a number of studies. Cumming (1989), for example, found that writers of higher L1 writing expertise (writing in L2) attended to the gist of their texts more often than average or basic writers. Victori (1999), on the other hand, reported: "none of the writers (good or "poor") overtly expressed any concern for purpose.

In the present study, focus on the purpose of writing will be tested as an indicator of the degree of awareness of the global content. While the majority of research measured attention to or attainment of the purpose of writing through quantifying instances of writers' expressed concern for purpose in their think-aloud accounts, the present study will employ two more different measures: (1) Participants' responses to immediate recall questions about their attention to the writing prompt (the number of times they read the task prompt) and the degree of focus on purpose; and (2)

independent raters' judgment of the extent to which the writing task was attained in the written texts.

3.4.5 Awareness of audience

The main difference between speaking and writing abilities is that the latter requires an ability to communicate ideas in the absence of contextual clues. Writers are thus faced with the need to work against ambiguity. This is done by first mentally representing an audience, and manipulating resources to deliver a message to them, which is the main purpose of writing. Purpose and audience are often studied together as indications of either the influence of contextual factors or writers' awareness.

The concept of audience awareness as a developmental skill in writing can be traced back to Piaget's egocentric speech and Vygotsky's inner speech (Britton, 1975; Flower 1977; Faigly, 1986). When children articulate their thought in their private speech, they do so in a way that reflects the natural cognitive process (Flower 1979). Their inner speech is fragmented, does not target audience, is not in response to a communicative purpose or a given task, and words are loaded with personal sense. Development away from this means the language producer is able to communicate with audience, and to respond to a predefined task. Flower argues that when writers gear their text towards a reader they manipulate their natural facility of thought articulation to "create shared context and language" with the reader. Flower explains how a reader is "an extra constraint" for the "inexperienced" writer:

> *Taking the perspective of another mind is also a demanding cognitive operation. It means holding not only your knowledge network but someone else's in conscious attention and comparing them. Young children simply can't do it. Adults choose not to do it when their central processing is already overloaded with the effort to generate and structure their own ideas. Writer-based prose simply eliminates this constraint by temporarily dropping the reader out of the writer's deliberation. (Flower, 1979, p. 36)*

Less skilled student writers are sometimes reported as lacking a mental representation of a real or a hypothesized reader (Victori 1999). With their teacher as a reader and evaluator in mind, they believe that "content and opinion are not as important as linguistic accuracy" (p.544). Skilled writers, on the other hand, write

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with an audience in mind. That results not only in appropriate tone but also in effectiveness of the argument.

Another study that tested the effect of writers' attention to audience was conducted by Holliway and McCutchen (2003), who tested the quality of revision when children (grades 5&9) are asked to revise with a perspective of audience. They compared revisions with a perspective of audience with revisions that are in response to feedback. They concluded that young writers benefited from taking the standpoint of their readers.

Another way of measuring audience awareness is by capturing incidences of writers demonstrating their awareness of audience in think-aloud and stimulated-recall protocols. This might sometimes be successful. While Victori (1999) found little evidence of audience awareness in the think-aloud protocol analysis, others were able to identify more instances and categorize them. Wong (2005), for example, analyzed think-aloud protocols of four English teacher trainees, in video-taped writing sessions with follow-up interviews. He applied Grabe and Kaplan's (1996) framework of audience taxonomy. He found correspondence between writers' mental representations of the intended audience, the rhetorical purpose of writing that writers create for themselves and the composing strategies (cognitive, meta-cognitive and affective). However, it appeared that by choosing advanced learners (who are in themselves teachers), the question of whether they have a mental representation of the audience and the purpose or not was answered in advance. This reduces feasibility of generalizing from such findings to student populations at any level.

Lindgren and Sullivan (2006) tested audience awareness indirectly through examining revisions that are audience-oriented. They reported on writers who made revisions out of their interpretation of readers' knowledge about the topic. They labelled such instances as "audience-oriented revisions". These were captured in think-aloud accounts. It seems that when changes are made to the text to account for the needs of audience, the motivations of these changes can also be captured in retrospective protocol. This is particularly true in stimulated recall where the visualizing of the revision as it has happened will probably enhance remembering the awareness behind the move. In the present study, it is speculated that participants in

the writing activities that have been selected for a qualitative investigation will be able to recall instances of audience awareness in the stimulated recall sessions.

3.5 Summary

This chapter looked into theoretical and practical issues that directed the present investigation in writing development. Research that examined the writing process with an explicit or implicit perspective on development in writing includes studies that compared skilled and less-skilled L1 writers, writers performing in their L1 and L2, and proficient and less proficient L2 writers.

Four parameters of development have been considered in defining measures that can be used to trace development in the writing process and writers' awareness of task and audience: (1) a developmental pattern that resembles developing away from child inner speech to text that is directed by goal and purpose and addresses an audience; (2) developing from the spoken mode to text that is globally and recursively structured and independent from prosodic and contextual limitations; (3) developing away from knowledge-telling to text that "transforms" knowledge to adapt to a variety of contexts and audience; and (4) a pattern of development that demonstrates a release from L2 linguistic concerns, which entails fewer constraints from language proficiency limitations, i.e. inscription (spelling, mechanics), encoding (meaning/lexicon), and structuring (morpho-syntax, syntax, discourse).

In addition, the chapter provided a discussion of research variables which are of particular significance to the present inquiry; and how they might be indicators of skill and development in writing. It had been established that skilled writers adopt certain strategies. They plan their writing globally, and thus hold a vision of how the text will look like or what it will include before they start writing. This is assumed to be indicated by longer initial pauses. As the writing activity progresses skilled writers attend to the gist that they had conceptualized throughout the process of writing. This awareness of the overall content of their texts leads them to revise more globally, i.e. overall organization and content. In the case of pre-identified tasks (such as academic writing prompts), the gist is assumed to be represented, in part, in the assigned writing task. In these cases attending to the general gist equals attending to the purpose that is suggested by the writing prompt.

The measures that I have included in this review, and will be using for my data analysis, are the ones that were reported to have distinguished between degrees of skill and maturation in writing. It would be useful to know if progressing in academic levels will bring about, for example, revisions that are oriented towards enhancing the overall message of the text, rather than surface adjustments or localized over-editing; and if students who have gone through different learning experiences (to write in EFL) would demonstrate different orientations in their revisions.

The next chapter will restate the research questions with the measures that stood out in the research that (explicitly or implicitly) considered development in writing and proved to be instrumental in tracing writing development. The chapter will present in detail the research methodology, and explain data analyses.

Part 2: The Study: Methodology, Analysis and Findings

- Chapter 4: Procedures, Tools and Data
- Chapter 5: Keystroke Analysis and Findings
- Chapter 6: Writers' Immediate Recall and Text Assessment
- Chapter 7: Stimulated Retrospective Recall.

Chapter Four: Procedures, Tools and Data

4.1 Introduction

As has been established in the previous chapters, the purpose of this study is to trace development in students' writing process and awareness along three academic tertiary levels, while comparing the pattern of development of students from two distinct academic majors: English Language and Literature and Computer Science. The study is set within the framework of the cognitive process theory and expands to account for socio-cognitive aspects and meta-cognitive awareness.

The underpinning measures of the hypothesized development in writing have been drawn from four paradigms: egocentric speech and writing, developmental relationship between speech and writing, progression in child and adult writing in L1 and the capacity of the working memory. Besides, development in L2 writing has been particularly associated with the psycholinguistic concept of language acquisition, i.e. automatization. In common, the paradigms share the perspective that increased cognitive, socio-cognitive and linguistic knowledge and awareness may contribute to a writing process that is fluent, more focused on meaning than on form, and reader-oriented; and result in autonomous texts. Based on this understanding, a quasi-longitudinal study was designed to assess these developmental measures in the writing processes and strategies of students of two disciplines at three levels of tertiary education.

Drawing on the discussion in Chapter Three on writing development, a set of measures have been selected to investigate possible changes in student writing as an outcome of college experience. The measures that were used to assess writing were mainly drawn from the cognitive process models. They have been investigated in the process writing literature and have either proved to be distinguishing factors of skill and maturation in writing or raised controversy over the matter. These are measures of fluency, revising strategies, focus on the writing task, awareness of audience, and attention to linguistic and contextual concerns. Measures that take into account the

writing product were also considered. The written texts were assessed to complement process assessment in finding textual evidence of focus on purpose and audience; to evaluate language and discourse proficiency and to find out possible relationships amongst how students handle the writing task; what they think about it, and the quality of what they actually produce as an end product.

The study has utilized computer tracking techniques, stimulated and immediate recall procedures, and text assessment to elicit data on the cognitive and contextual aspects of the participants' writing process as well as on the features of the written product. By doing so, the study proposed to answer the following questions.

RQ1. Does writing in English as a foreign language of university students majoring in English Language and Literature and in Computer Science demonstrate identifiable developmental patterns along university academic levels, in terms of fluency, revision behaviour, writers' awareness and concerns, and text quality?

RQ2. Does writing in English as a foreign language of university students of the two majors develop differently along university academic levels?

RQ3. Can variation in text quality be explained in terms of fluency, revision behaviour and writers' awareness and concerns?

A quasi-longitudinal study was designed to track developmental patterns along university levels. The main method of inquiry is quantitative. Measures of fluency, pause behaviour, revision strategies, writers' concerns and textual features were quantified and statistically tested for significance. However a secondary qualitative procedure was followed with a small proportion of participants.

The first section of this chapter provides a description of the participants, the setting, and the procedures of both group and individual writing sessions will first be provided. This will include the writing tasks that were used to elicit written responses. This will be followed by a section on research instruments and data, which will first introduce ScriptLog, the computer programme that was used as a tool for writing and logging. Then there will be a discussion of the 'questions for immediate recall' that were given to students to immediately after they had finished writing to elicit recall of relevant strategies employed during the writing sessions,

and of the data that were proposed to be elicited by stimulated recall sessions. The section will then introduce text assessment procedure and assessment criteria. The third major section of the chapter will introduce research data and operational definitions of the variables. This will include a synthesis of measures for each variable. A table of the research questions, the variables (dependent and independent), data elicitation methods and statistical tools will sum up the chapter before providing a conclusion.

4.2 Procedure

The study employed two procedures. First there was the large scale quantitative inquiry of all participants' writing process, awareness and texts. Second, a number of participants went through individual writing sessions where interviews and other qualitative measures were used to gain an in-depth insight into their writing process. These include, but are not limited to, textual and contextual concerns, focus on the writing task, awareness of audience, and their role in the writing activity.

4.2.1 Participants and sampling

The participants of the study are Saudi female university students majoring in two different subjects: English Language and Literature (E), and Computer Science (CS), and studying at three different levels within each major. The first level is that of students who have just joined the university (labelled Level 1), the second level comprises students in their fourth semester (labelled Level 4), and the third level is that of students at their final year (Level 8). The six groups of investigation were given the following codes: E1, E4, E8, CS1, CS4 and CS8. The target number of participants was 120 (20 students from each of the six groups). However, as will be explained below, the target number was not met, and the final number of participants varied amongst the groups.

Until they enrolled to King Abdulaziz University (KAU), the participants of both subject areas had had similar formal experience in learning English as a foreign language at the secondary school level, although they have been studying in two separate divisions in the final two secondary years, i.e. Science and Arts. Most of them had started to learn English at the age of twelve and, for the six years that followed, they continued to get forty-five-minute English lessons four times a week.

Those who had been in private schools started English earlier, but upon reaching the seventh grade they joined the main stream of English national curriculum. The English curriculum in primary private schools is not reinforced by accreditation within the national educational system, and is thought to be rudimentary and lacking a substantial influence on pupils' L2 proficiency.

The significance of selecting participants from the two subject areas (English Language and Literature, and Computer Science) lies in a number of factors. It clear that when testing writing processes and awareness in English as a foreign language in university students one of the best groups to look at are those who have been going through a systematic program of study where English is both the medium of instruction and the subject of learning. However, by looking at this group advancing up the academic levels (in a quasi-longitudinal setting) it would not be clear if the developmental patterns they show can model development of writing in students from other disciplines. In particular, it would be useful to compare English majors' writing with those who are similarly exposed to the English language in their day to day learning but without the formal linguistic instruction.

In addition, over recent years there has been such a great demand for places in these two disciplines in the university that selection criteria for candidate students became very high. Only those who achieved 90% or more in Secondary School National Exams were successful in getting places. The scores in the English Language unit usually correspond to the general average. This leaves the study with a highly homogeneous group of participants.

Other factors contribute to the similarity between subjects. The majority of the students in this university graduated from high-schools in the same city. The small numbers of students who are not local to the city have come from places with similar culture, and graduated from high-schools with identical curricula. They all speak Arabic as L1. Moreover, the majority of participants were found to have had their secondary education in public schools, and almost all have not been to an English speaking country for more than a few weeks.

It is relevant to mention here, however, that it is commonly known that Science high-school students may be more motivated than Arts' students to study English because of its potential significance in the fields of their future study and work endeavours.

This could mean that upon enrolling to the university, the English proficiency level of Science students could exceed that of Arts students. For this reason first-level participants were screened for their achievement in Secondary School National Exams and only those who achieved 88 and above out of a hundred in English language tests were included in the study. Apart from this, sampling of all the groups followed similar principles, as explained below.

"Purposive" sampling (Mackey & Gass, 2005) of participants was initially considered, i.e. participants were selected from three different levels in two certain majors (the English Language and Literature and the Computer Science) to serve the purpose of the research. That is to assess development of writing along the levels as an outcome of two learning experiences (i.e. in the two majors). On the other hand, sampling within each group was that of convenience, i.e. participation was welcomed from all students who volunteered to participate. Some instructors agreed to further motivate their students by giving one or two bonus points for participation. In the assessment schemes of some of the courses these points were to be calculated towards a 10% of the total grade points assigned for attendance, participation and/or extracurricular activates. Participation in the individual sessions was further motivated by offering money-value vouchers for a popular bookstore. There has been over participation in groups CS8 and E8. This was dealt with on random basis. The 20 participants were randomly picked up from the rest. In the rest of the groups the target of 20 participants was not met either because of low participation or technical problems. In the logging program texts were sometimes corrupted by cut and paste or drag and drop actions in a way that it was not possible for them to be retrieved in complete final-text files.

The participants in the individual cases, for the qualitative inquiry, were selected from the main sample on convenience-sampling basis as well. Participants who agreed to allow more time for the interview from each of the six groups were asked to attend individual writing sessions. Thereafter, they were interviewed about their writing, (details of the individual session procedure will follow in 4.2.2.2). The total number of all participants was 93. The following table shows numbers of participants in each of the groups for both individual and group sessions.

Table 4.1 Numbers of participants in group and individual sessions

	Group sessions		Individual sessions		Total	
	E	**CS**	**E**	**CS**	**E**	**CS**
Level 1	9	9	2	1	11	10
Level 4	14	16	1	2	15	18
Level 8	18	19	2	1	19	20

'Call for Participation' sheets were distributed to students from the target groups (Appendix 1 shows the Arabic and English versions). They included information on why participants had been chosen and the general purpose of the research. This was kept brief and general at that stage to avoid any influence this might have on student's writing behaviour. However, I explained that they will need to allow 60 minutes for the session (90 to 120 minutes for the individual sessions), and that they require a reasonable degree of experience and comfort with typing in English. Participants were reassured that their personal information and texts would remain anonymous and that whatever they write (or say) will be used for research purposes only. It was particularly important to reassure participants of the anonymity of their texts and answers to the QIR so as to discourage them from altering their normal writing behaviour or over-reporting on their writing strategies.

4.2.2 Setting and procedure

4.2.2.1 Group writing sessions

Group writing sessions refer to the situations whereby a number of students were assembled in one place to participate in the study, as opposed to one participant at a time. Practically, this needed to be done in a number of sessions to accommodate participants' free slots of time amongst different schedules and academic loads. The sessions took place in computer labs. The participants wrote on the writing processor of ScriptLog, a logging computer program, which allows basic word processing: writing, deleting, arrow scrolling, and mouse movement.

At the beginning of each session, participants were instructed by the researcher, with the aid of a data projector, to prepare their writing files by filling in information requested by the program: first and last names, their age, and sex. Students were allowed to use pseudonyms if they wished to, but were asked to use the same name for both the text file and the question sheet that was going to be given to them after

they finished writing. They were also instructed on positioning the editing window and on the workings of the recording panel. They were asked not to click on the recording icon until they receive the writing prompt sheet.

I explained to the students (in Arabic) that the writing prompt was put first in English and then in Arabic, and that they were free to read it in whatever language they prefer. I also explained that they were expected to finish writing in 40 minutes; that they should write as they would for an English writing assignment; and that the writing session would be followed by answering some questions about what they would have written. After that, the writing prompt sheets were distributed and students were asked to click the recording icon before they read the writing task. For most of the time I stayed in the lab, sitting quietly at a side desk, and read something.

When the students finished writing they were individually instructed to click on the stop button and they were given two-page question sheets, which I called questions for immediate recall (QIR). The questions included in the sheets were aimed to elicit immediate recall (Mackey and Gass, 2005) of writers' broad strategies and concerns during the writing sessions. The questions were written in Arabic to give the participants quick access to them, and to avoid adding an English comprehension ability variable. (A discussion of QIR and the data elicited by them will follow in 4.3.2 below).

After all the students left the lab, I retrieved the log files from the computers, collected the immediate recall sheets, and made sure the names that appear on them matched the names on the log files. Sample log files were later put to extensive analysis to elicit data on temporal and text processing aspects of the writing activity, e.g. pause, revisions and deletions.

The main large-scale data gathering was preceded by a small-scale pilot study. During the pilot, practical issues were put to test. These included installing the logging program in the lab computers using a shared file in the server, dealing with time and space limitations of organizing the writing activity and post writing questionnaire with a large group of students, and instructing the participants on the working of the program to minimize text loss or corruption.

4.2.2.2 Individual writing sessions

The individual writing sessions took place in a study room in the University's central library. Individual participants attended a writing session one at a time. As with the larger writing groups, each participant was instructed on the basic workings of the logging program. Then she was given the writing prompt and instructed to click on the record button just before she started. She was then left by herself for most of the time. At the end of the session, the record was saved, and I prepared for an audio-recorded retrospective interview. Recall (Gass and Mackey, 2002) was stimulated by the playback facility of the logging program (ScriptLog).

Deliberate efforts to draw measures of consistency and stick to them were made. Accordingly, certain steps were designed beforehand, and the same steps were followed in every session: (1) I started by asking the participant (in Arabic) what she thought of the writing prompt and how she planned to address the task. (2) I explained to the participant that I would run the playback, and instructed her as follows: "As you watch your text emerging on the screen, try to recall what you have been thinking about at the time and say your thought aloud. You can do that in Arabic. At times I will stop the recording and ask you questions." (3) I stopped the record at long pauses, (which I had highlighted in a separate printout of the linear text), and asked the participant why she stopped.

The records were then translated into English as they were transcribed, and coded in preparation for analysis.

4.2.3 Writing tasks

The selection of the writing task for the study was unconventional. In the pilot study, the topics that were given to students proved to be unclear or difficult to understand, according to their own reflections on the writing tasks. This is why in the main data gathering phase students' suggestions were sought, though on a small scale. Three Computer Science students who were not participants of the study were asked about a writing task that would be motivating to students to write, would not require specific technical knowledge and would be appropriate to all levels of Computer Science students, including the new comers. Another criterion that I was keeping in mind was the adaptability of the writing task to English majors. One of the students suggested that students would be motivated to write about Computer Science as a

field of study. She explained that one of the arguments they get involved in with people from outside their discipline is about the extent to which a degree in Computer Science (as opposed to short courses in computer applications) is necessary. The other two students agreed. (In fact, later on, not less than ten participants commented about the writing topic as being motivating, as they were leaving the computer labs during data collection.) Significance of their field of study, it seemed, is an issue that would concern members of all academic disciplines (including English majors). It is also a concern that starts as early as when one decides on choosing a subject area. Therefore it would prompt written responses from students of both majors and at all levels.

Having decided on the general writing topic, I made a few more decisions as to how to frame and word the writing prompt that will be given to students. It was to be a "framed prompt" (Kroll & Reid, 1994), wherein "a situation or set of circumstances is presented, and then a task is presented based on the interpretation of the frame" (p. 233). The usefulness of such writing prompts lies in the contextualization they provide. This aids content accessibility (Kroll & Reid, 1994; and Reid & Kroll, 1995), and reduces the variable of how much preliminary information the subjects will have about the situation. The second decision is to present the prompt in Arabic as well as in English. This is to increase comprehensibility, clarity and non-ambiguity (Kroll & Reid, 1994; and Reid & Kroll, 1995). Putting the prompt in a language that students could all understand will reduce the possible effect of varied task comprehension in the foreign language. Finally, the writing task called for an argumentative stance in order to encourage participants to engage in defending their position. It was hoped that a task of this nature will motivate writers of both subject areas (English and Computer Science) to generate text, and will compensate for the lack of familiarity with the rhetorical demands of this kind of writing on the part of Computer Science majors.

Figure 4.1 shows the writing prompt sheet as was presented to Computer Science students. The writing task was first presented in English then in Arabic on the same sheet.

The writing task
Some people who are not majoring in Computer Science think that you do not need a degree to study computers, and that short term courses and workshops can be sufficient.
Write a short essay about your opinion on this topic. Explain why it is important to do specialized and in depth studies on Computer Science. Support your viewpoint with examples and details.
يعتقد بعض الناس من غير المتخصصين بأن دراسة الحاسب الآلي لا تحتاج إلى برنامج بكالوريوس وان دورات تطبيقات الحاسب قد تفي بالغرض. أكتبي مقالاً حول رأيك في هذه العبارة، مع توضيح أهمية الدراسة المتخصصة و المتعمقة في مجال الحاسب الالي، و دعم رأيك بالأمثلة والتفاصيل.

Figure 4.1 The writing prompt as was given to the Computer Science groups (levels 4 &8)

While maintaining the topic and tone of the prompt, I slightly modified the writing prompt to generate a writing task for the students of English Language and Literature. This modification produced two forms: one suitable for level 4 and another suitable for level 8. The main difference is in the focus of the topic. The writing prompt that was designed for level 4 focused on studying English language at degree level, the other on English literature. I assumed that students at level 4 will perceive studying English literature as a language exercise or as a treat, i.e. they may find pleasure in being able to read literature in English. Not until their sixth or seventh semester are they likely to be able to grasp, and thus communicate, the significance of specialized literary studies, e.g. as a linguistic/stylistic study, as a window to historical and social contexts, as means of learning about experiences (love, agony, triumphs, etc) of fellow humans, as aesthetic indulgence, etc. The writing prompts for levels 4 and 8 of English Language and Literature students are presented in Figures 4.2 and 4.3 respectively.

The Writing task
Some people who are not majoring in English think that you don't need a degree to study English, and that short term language courses can be sufficient. Write a short essay about your opinion on this topic. Explain why it is important to do specialized and in-depth studies on English. Support your viewpoint with examples and details. يعتقد بعض الناس من خارج تخصصكم بأن دراسة اللغة الإنجليزية لا تحتاج إلى برنامج بكالوريوس وان دورات اللغة اللتي توفرها المعاهد قد تفي بالغرض. أكتبي مقالاً حول رأيك في هذه العبارة، مع توضيح أهمية الدراسة المتخصصة و المتعمقة في مجال اللغة الإنجليزية، ودعم رأيك بالأمثلة.

Figure 4.2: The writing prompt as was given to the English majors (level 4)

The Writing task
Some people who are not majoring in English Literature think that you don't need a degree to study English literature, and that you can get as much knowledge/pleasure through free, unspecialized reading of English literary works. Write a short essay about your opinion on this topic. Explain why it is important to do specialized and in-depth studies on English literature. Support your viewpoint with examples and details. يعتقد بعض الناس من خارج تخصصكم بأن دراسة الأدب الإنجليزي لا تحتاج إلى برنامج بكالوريوس، وان القراءة الحرة والغير متخصصة للأدب الإنجليزي قد تحقق نفس الفائدة والمتعة. أكتبي مقالاً حول رأيك في هذه العبارة، مع توضيح أهمية الدراسة المتخصصة و المتعمقة في مجال الأدب الإنجليزي، ودعم رأيك بالأمثلة والتفاصيل.

Figure 4.3: The writing prompt as was given to the English majors (level 8)

During pilot trials, the writing prompts proved to be unsuitable for level-one students, as they have not yet had any considerable experience with their subject areas. Two more writing prompts were designed: one on higher education for girls (A) and another on women's work (B). They both maintain the motif of the previous prompts in that they both challenge the significance of what the students are doing (i.e. higher education endeavours) or what they will probably do in the near future (i.e. women's work). The following Figures (4.4 & 4.5) present the two writing task that were given to semester-one students of both subject areas.

The writing task

Some people might think that higher education for girls is a luxury and not a necessity.

Write a short essay about your opinion on this topic. Explaining why higher education is necessary for girls. Support your viewpoint with examples and details.

قد يعتقد بعض الناس بأن التعليم الجامعي للفتيات رفاهية وليس ضرورة.

أكتبي مقالاً حول رأيك في هذه العبارة، مع توضيح أهمية التعليم الجامعي للفتيات ، و دعم رأيك بالأمثلة والتفاصيل.

Figure 4.4: Writing prompt A as was given to level-one participants

The writing task

Some people might think that women's work is a luxury and not necessity.

Write a short essay about your opinion on this topic. Explaining why work is necessary for women. Support your viewpoint with examples and details.

قد يعتقد بعض الناس بأن عمل المرأة رفاهية وليس ضرورة.

أكتبي مقالاً حول رأيك في هذه العبارة، مع توضيح أهمية العمل للمرأة، و دعم رأيك بالأمثلة والتفاصيل.

Figure 4.5: Writing prompt (B) as was given to level-one participants

4.3 Research instruments and data

The study's quantitative data were obtained from three tools: keystroke logging of the writing activities, responses to immediate recall questions, and the scores assigned by independent assessors to the written essays on certain features (Figure 4.6). Qualitative data, on the other hand, were obtained from the retrospective accounts of the participants who attended individual writing sessions followed by stimulated recall interviews. Details of the three quantitative sources and the nature of data elicited by them, as well as the data elicited by stimulated recall, are presented in the following sections.
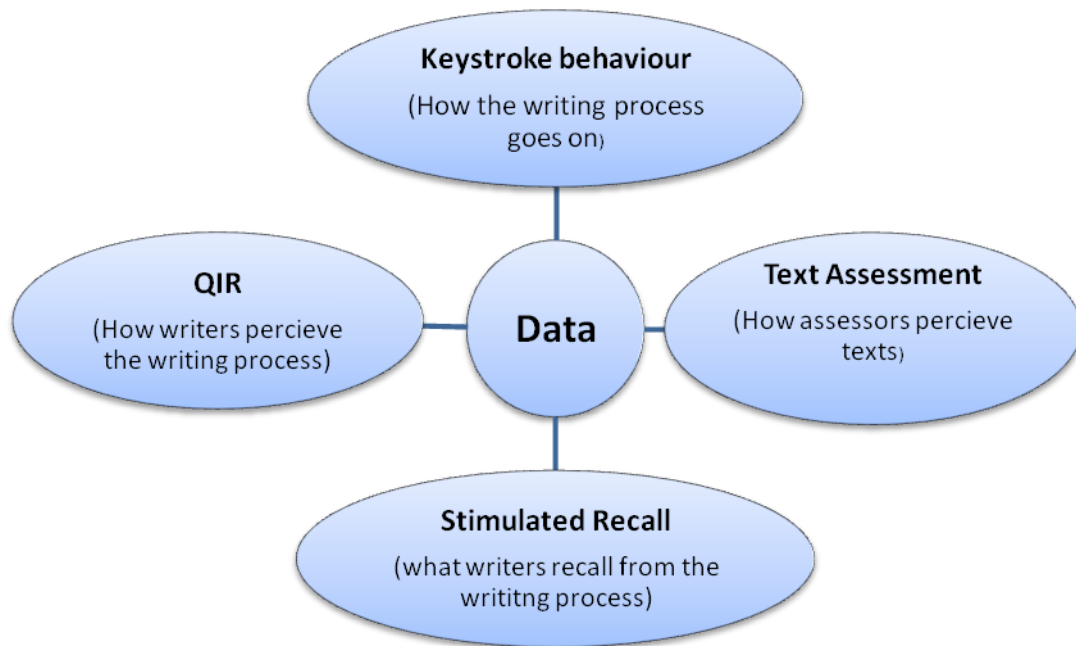
Figure 4.6 The data domains (quantitative and qualitative).

4.3.1 Keystroke logging

Keystroke logging was the main data elicitation tool. The study has utilized the word processing environment of ScriptLog (Stromqvist and Karlsson 2002) as the writing tool. ScriptLog is a logging computer program that records the writing activity as it happens in real time. The most important advantage of using this tool in recording and observing writing is that writers are not disturbed by videotaping, by an observer, or (as in think-aloud methods) by having to articulate their thoughts while writing. The tool provides accurate observing and logging feature and allows for including large number of samples. The two technical features that are of central significance to my study are (1) the real-time linear profiles of the written texts that the program generates, which provide rich data on pauses and revisions; (2) and, of course, the playback facility, which provides both an observational tool for tracing revisions and a stimulus that enhances participants' recall of their writing processes.

ScriptLog generates a bin (binary) file for each writing activity. The bin files contain the recording and underlie several processes of analysis. For the purpose of the research in hand, four files were first generated through the "export" facility of the program (See Appendix 3 for sample analysis files): linear (lin) log file, pause time and duration (ptd) file, statistics (sta) file and final edited text (txt) file. Two more files (the log text (log) file and the deletion list linear (dll) file) were used to facilitate

the manual analysis of text spans as well as types and locations of revisions. The final edited texts (txt) were exported to MS Word and coded in preparation for assessment.

Keystroke logging programs provide some compiled and ready to use data (e.g. statistics on pause time, editing distance, etc.). However in most cases the researcher has to use raw data such as a linear file to understand pause or revision behaviour. In ScriptLog, for example, the linear file presents a linear account of the writing activity with pauses between all keystrokes appearing in the order they have occurred in and other information being presented between two angular brackets (Stromqvist & Karlsson, 2002). For example <BACKSPACE5> means that the writer has backspaced any combination of five typed letters, numbers, punctuation marks, or spaces. The extract below is from a linear file of one of the data samples of the present study. The extract is from the beginning of a writing session and it shows the initial pause time (39 second and 719 milieconds), and all other pauses of more than 2 seconds (the length of the minimum pause to be shown can be adjusted to up to 5 seconds). It also shows left and right movements around the text with the number of curser movements, e.g. <RIGHT9>. The extract is a linear representation of the first sentence. In the final text file the sentence read: "*Computer Science becomes one of the most important sciences in the world and this is clearly to everyone since it has strong relationship with other dominion.*"

Example 4.1

```
<START><0.39.719>T<0.02.000>oday<3.02.594><BACKSPACE5>T<0.07.953>
od<0.02.657>ay <0.36.531>bby<BACKSPACE2>y <0.03.953><0.28.750>
<0.18.984><BACKSPACE11>Computer Science <0.03.953>be<0.02.453>
come<0.02.797>s <BACKSPACE2> <0.05.188>one of the <0.06.469>i
<BACKSPACE>most important <0.06.125>sec<0.02.422><BACKSPACE2>
ci<0.03.468>ence<0.08.219> <0.10.562>s<0.02.844>ince <0.46.593>it
<0.02.422><LEFT44>s<0.02.156><RIGHT35><LEFT>s<RIGHT9><LEFT8>in
the <0.03.297>world <LEFT2><0.02.484><RIGHT10> <0.07.625>has
<0.13.360><BACKSPACE12>and this is <0.02.750>clearly <0.02.578>to
every<0.02.047>one <0.05.063>since it <0.02.203>related
<0.09.281><0.02.625><BACKSPACE8>has related <0.02.922><0.06.734>
<BACKSPACE8>strong <0.08.375>relationship <0.03.328>with othwe
<BACKSPACE2>er<0.07.672> <0.27.922>domin<0.02.297>ion <0.06.031>.
```

In addition, ScriptLog (as well as other computer logging programs) has the capacity of recording and replaying the writing event as it took place on the screen in real time. In addition to providing stimulus for retrospective recall, the playback facility was used to assist in quantifying and categorising revisions, and it has been occasionally used to isolate inserted items from text span accounts. The data elicited from all the resources of computer tracking are listed below. The utilization of these data in answering the research questions will follow in section 4.4.1.

1- Basic statistics about texts and text productions: total lengths of texts, total duration of the writing activity, final and linear tokens, number of pauses, total pause time, and median transition time between keystrokes.

2- Pause time data: temporal locations and durations of pauses of identified lengths.

3- Linear log texts: present the linear on-line text with all the pauses of a previously identified length. Once opened with MS Word, it allows for manually identifying and measuring of uninterrupted text spans.

4- Log texts. They contain rather long lists and cannot feasibly be put to manual analysis. However, log texts are only going to be used to assist in finding reference points of time and text.

5- Final texts.

6- Real-time replay of the writing session as it has happened on the screen.

4.3.2 Questions for immediate recall (QIR)

Immediate recall (Mackey and Gass, 2005) elicits data on a certain event immediately after the event has taken place. It differs from stimulated recall in that it does not employ the actual event or part of it as stimulus. I designed a set of questions (Figure 4.7) to be given to the participants in the group-writing sessions immediately after they have completed the writing task. The questions were about the particular writing activity that they had just been involved in. They were intended to facilitate immediate recall of how writers had handled the topic and the degree of attention they had given to certain cognitive and contextual aspects of the process. For this reason I called them *Questions for Immediate Recall* (QIR) although the participants were not meant to report what they could recall orally, as they would in a conventional immediate recall practice (Mackey and Gass 2005). Participants

responded to the questions by selecting general statements that assign rank-ordered scores to certain strategies, focus areas, or concerns. The following figure shows an English translation of the questions. The QIR was given to participants in Arabic.

Questions for Immediate Recall (QIR)

1. Have you read the writing prompt in English, Arabic or both?
   English ☐   Arabic ☐   Both languages ☐

2. How have you thought about the writing task at the beginning? Did you have an overall idea of what you were going to write?

   ----

3. Have you thought of any plans for your essay?
   Yes ☐   No ☐

4. If you have answered 'yes' to (3): What sort of planning have you done?

   ☐ a. I planned all the essay at the beginning

   ☐ b. I planned every paragraph or section one after another

   ☐ c. I planned sentences as I wrote.

5. Have you followed your initial plans?   Yes ☐ NO ☐

6. How often have you read/reread the writing prompt?

   ☐ a. I read it once before I start writing then I never looked at it again.

   ☐ b. I reread it one or two more times while I was writing

   ☐ c. I went back to it several times.

7. How much attention have you given to fulfilling the writing task (so that your essay would address the writing task accurately)
   ☐ a. My essay was focused on addressing the writing task all the time

   ☐ b. At the beginning I thought about what is required in the writing prompt, and then I got busy with grammar and finding appropriate words.

   ☐ c. I got involved in details and examples, and ceased to think about the main writing task.

8. How often have you thought of the reader of your essay?

   ☐ a. I haven't thought of who is going to read my essay.

   ☐ b. I thought about the reader once or twice.

   ☐ c. I thought a lot of who is going to read the essay, and tried to adopt an appropriate way of addressing the reader(s).

9. Which of the following did you pay the most attention to? (*Please number the boxes according to the priority of the items.*)
   ☐ Sentence structure is correct

	Text structure is logical and coherent
	Words and word meanings are appropriate.
	Content is sufficient
	Content is appropriate for the writing task
	Content is convincing to the reader

10. How did you perceive your role as a writer

	a. Because the writing task was set for a research purpose in English language, my main concern was finding the correct structure and appropriate words (to reflect my English language skills).
	b. My main concern was to present the information that I know about the topic by means of what I know about my field of study.
	c. My first concern was to convince the reader of the extent to which the given situation is untrue (or true).

Figure 4.7 Questions for immediate recall, translated from Arabic

The purpose of the first two questions of the immediate recall was to direct students' attention to the writing activity that they had just undertaken as opposed to what they usually do when they write, or what they thought they were supposed to do. The first question asks whether the student has read the prompt in English, in Arabic, or in both languages. The second question asks students to write a general account of how they have handled the writing task and how they thought about it in the beginning. An attempt to compile responses to the latter question failed because some of the participants did not fill it in.

The next three questions assess types and amount of planning. They make a distinction between three types of planning: initial planning of whole text, partial planning of paragraphs, and immediate planning of sentences as the writer proceeds with the text. Testing planning at this broad level was proposed to measure the extent to which student writers have thought globally and in advance of the content of their text.

Responses to the sixth, seventh, eighth and tenth questions elicited scores to three writing concerns respectively: attending to the writing task, consideration of the audience, and perception of one's role as a writer as occupied by skill-display,

knowledge-telling or knowledge-transforming (Bereiter & Scardamalia, 1987). The ninth question explored writers' concerns. It retested attention to task and audience as well as other issues in a list that included six linguistic, textual, contextual aspects. Retesting attention to the task and audience in question nine was assumed to capture a more accurate response. When participants were asked to place these concerns (of task and audience) in a one-to-six priority scale, the participants probably found it necessary to give it enough thought because each point could carry one value only. This way all the points would fit into the scale. This might have encouraged participants to report what really applied to them.

4.3.3 Stimulated recall

In the individual writing sessions, writing events were replayed and participants watched their text emerging on the screen. As they did so, they were asked to say what they had thought while writing. At points of hesitations and struggles, usually marked by long pauses or excessive editing, the replay was stopped to discuss in depth points of difficulties and the processes that were evoked during these points.

Other data that were elicited by stimulated recall and could be captured through protocol analysis included: instances of the writer's perceived role in and awareness of the writing task and audience; reasons for revisions; concern for linguistic and textual issues; and attention to content development, global structuring, and support.

4.3.4 Text assessments

Text assessments were carried out by two experienced British ESL/EFL teachers who have had a considerable experience in rating L2 English texts. There were two purposes for getting participants' written texts assessed: first to find textual evidence for development in focus on task, audience awareness, and linguistic and discourse proficiency. The secondary objective of text assessment is to be able to find a collective text quality measure to be able to correlate it with fluency and revision measures and for writing strategies and writers' concerns.
Assessment sessions took place over two consecutive days in order to avoid inconsistency that might arise from time-spaced sessions. The assessment rubric sheet was discussed by the raters and the researcher to make sure it is clear to the raters. Prior to this, text assessment had been first piloted with a third independent

rater and the presentation of rating criteria was modified. Moreover, all the texts had been reviewed beforehand by the researcher who also chose two anchor texts, i.e. one representative of low-quality and one of high-quality writing. The two anchor texts were discussed with the raters to give them an idea about what range of text quality there would expect to find. The assessment sessions were also structured in terms of the order of presentation of texts. Texts were divided into groups according to the sample groups. The order of assessment followed that of the academic level, starting from semester one and ending with semester eight. Within each level the subject groups' texts were given to the raters in an alternate order.

Assessment was guided by an analytic score. The two assessors were asked to give a score of 1 to 6 points for each of the following five criteria: Task Fulfilment; Development and Organization; Audience Awareness; Variety of Structure and Diction; and English Grammar and Usage. The criteria were selected by the researcher from a large pool of assessment measures, but choices were mostly influenced by 'Test of Written English (TWE) Scoring Guide' cited in (Kroll & Reid, 1994), NWREL, and Nevada's Writing Assessment Scoring Guide (NDE: Nevada Department of Education). NDE's scoring guide was particularly useful to the present study because it attempts to measure development in writing proficiency over the years. Holistic guides in both scoring systems were analysed into their proficiency components and proficiency criteria from each band descriptor were compiled into an analytic rubric whereby each proficiency measure was put in a scale that ranges from 1 to 6 according to the extent to which the piece of writing satisfies that measure (see Appendix 7 for the complete scoring guide). Data obtained from text assessment comprise two scores (one from each assessor) on each of the five criteria. An average of the two scores was calculated for each measure. The assessment sessions were carried out over two consecutive days in order to promote consistency of judgment.

4.4 Data analysis

The first and second research questions were addressed by first reporting the qualitative measures of writing strategies of the two subject groups (English and Computer Science) at the three academic levels. Then differences in the ways the two groups develop along the levels were statistically explored. To answer the third

research question assessed features of the written products were correlated with features and strategies that have been reported qualitatively, i.e. fluency measures, revision behaviour, and writers reported concerns.

4.4.1 Measuring the variables

The research questions present two independent variables: academic level and subject area; and six dependent variables: fluency (including pause behaviour), revision strategies, focus on the writing task, attention to audience, writers' perception of their role, and text quality. Academic level has three values that correspond to the semester at which the participants of each group are: level 1, level 4 and level 8. The subject area variable includes two categories: English Language and Literature and Computer Science. The dependent variables, however, are less straightforwardly identified. The following three sections present in details the way each of the dependent variables is measured, validated and statistically tested. The section divisions reflect the nature of data that measure the variables.

Fluency indicates writers' ability to produce text, their rate of production and their accessibility to language and content as mental resources. Fluency was observed from two different perspectives: Productivity and pause behaviour. Productivity was measured by *length of text* (total number of words), *rate of production* (words per minute), *mean length of uninterrupted text spans*, and *proportion of candidate text to final text* (measured by proportion of final characters to linear characters). Text length and rate of production are commonly used in investigating fluency in writing. Length of text spans between pauses (TSL) has been inspired by "*burst length,*" a similar measure of fluency that has been used by Spelman Miller (2000, 2006) and Chenoweth and Hayes (2001), but it has been treated differently in the literature. The term '*text span length'*, in particular, has been borrowed from Spelman Miller (2000), but has also been given a different treatment, (the method of identifying TSL in this study is presented in detail in 5.2.2, below). The proportion of candidate text to the final text was used by Chenoweth and Hayes (2001), and was measured in terms of the proportion of verbalized thought that is accepted in the final text. In this study, this will be substituted by the proportion of final tokens to the linear tokens (both measured in characters and provided by the keystroke logging program). The measures were correlated to test their validity. Under limited time the text length

variable is expected to positively correlate with production rate. Moreover, the measures were reported as distinct variables. Mean scores for each variable were calculated and compared across the levels and majors.

Pause behaviour was observed in this study in relation to fluency. In particular variation amongst the groups in the *proportion of pause time to total writing time* was examined; together with its effect on fluency. Also, measuring *initial pause duration* was proposed to test if participants vary in giving enough thought to what they are going to say before they start any writing.

Relevant to the initial pause time was the issue of *planning*. Participants' recall of their planning strategies was tested as an indicator of whether or not they have carried out their writing task with a global view of the text as a whole. Students' perception of the planning they had done during the writing activity was measured (with a developmental perspective) by a rank ordered score assigned to their responses to questions 3 and 4 of the QIR. Those who reported that they have not done any planning received 0 as a score for planning, and those who reported a full initial plan received 3. Planning at a paragraph (section) level scored 2, and at sentence level scored 1. Since initial pause duration could indicate the time writers allow for overall planning, it was correlated with the rank-order scores of questions 3 and 4 to test validity of the measures. Durations of initial pauses were expected to correlate with reported planning strategies.

Revisions were tracked through cross-using of linear log texts, the playback facility and linear deletions files. Categorizations of revision have broadly followed those of earlier research. *Location* of revisions was classified into 'distant' and 'immediate', following Thorson (2000). However, a third category was added for the purpose of this study. Revisions that occurred within the immediate surroundings of the point of inscription can either be localized within the word or the phrase at the point of inscription, in this case they were labelled *immediate*, or conducted near the point of inscription within the same T-unit, and these were labelled *proximate*. Revisions that took place in other parts of the text beyond the immediate T-unit boundaries were labelled *distant*. After quantifying occurrences of revisions of both location types, the percentage of each one to the total number of revisions were calculated.

Analysis of *level of revisions* was mainly assisted by linear files, where interruptions of text production by revisions were captured in linear accounts of actions. Together with additions, linear files show backspacing, left and right cursor movements, and mouse movements. Deletion files help with the exact order of deletions. Quite often, though, there is a need for referring to the actual text production process that is provided by the playback facility. Revision actions were coded by the researcher so that location, domain and level of each revision are described and included in the analysis.

To account for differences in text length amongst samples, the calculation of frequency of revision was based on number of revisions per 100 words; and occurrences of revision types in terms of location, level and effect were measured as the proportion of each revision type to the overall count of all revisions.

Audience awareness was first assessed in question 8 of the QIR. Students' responses to the question were assigned rank ordered scores from 1 (I haven't thought of who is going to read my essay) to 3 (I thought a lot of who is going to read the essay, and tried to adopt an appropriate way of addressing the reader(s)). A second measure for attention to the audience is the independent assessors' rating of the extent to which a writer "speaks purposefully to an audience". Both measures were reported distinctly, but correlated to test validity.

Focus on the writing task was measured in terms similar to those of audience awareness. Responses to QIR questions 6 and 7 received rank ordered scores. (The rank order was alternated in the two questions so that they do not present a fixed pattern to the participants.) In QIR 6 participants were asked about the extent to which they referred back to the writing prompt; and in QIR 7 they were asked about the extent to which they remained focus on the writing task. Moreover, in QIR 9, participants were asked to assign a priority level to 'The appropriateness of content to the writing task' among five other concerns in writing. The second measure for focus on the writing task is the assessors' judgment on the extent to which writers address the writing task effectively. Both measures were distinctly reported, but they were correlated to test their validity.

Writers' perception of their role in the writing activity is assumed to be of a developmental nature. This variable was proposed to investigate a much acknowledged developmental trend in L1 writers, that of knowledge-telling and knowledge-transforming (Bereiter & Scardamalia, 1987); and to probe for an assumed role that is specific to L2 writers, that of those who perceive writing as a language practice, an opportunity to display skill in L2. In order to measure this, students' responses to QIR 10 were assigned rank ordered scores:1 for 'Because the writing task was set for a research purpose in English language, my main concern was finding the correct structure and appropriate words to reflect my English language skills'; 2 for 'My main concern was to present the information that I know about the topic by means of what I know about my field of study'; and 3 for 'My first concern was to convince the reader of the extent to which the given situation is untrue (or true)'. Further explanation of how these measures test the target construct of writers' perceived role is provided in Chapter Six (6.2.4)

Text quality is a double-function measure in the present study. On this list of the six variables, text quality is treated as a dependent variable that was cross-tabulated with the two independent variables "academic level" and "area of study" to partially answer research questions one and two. However, an average of all the assessed criteria was calculated and treated as an average quality score. The resulting measure served as an independent variable against which measures of fluency, revision strategies, attention to the audience and focus on the writing task were tested to answer research question three.

4.4.2 Quality of texts and the writing process

As mentioned earlier five text quality criteria were assessed. These are Task Fulfilment, Development and Organization, Audience Awareness, Variety of Structure and Diction, and English Grammar and Usage. The five variables were collectively calculated to produce an average quality score for each text. This average quality measure was correlated with fluency and revision variables to find out relationships between how writers carry out the writing activity and what they achieve in the assessment of their texts; that is to answer research question 3. Moreover, individual components of the analytical scoring guide were used as textual evidence for certain processes and strategies. In particular, writers' reports on

their focus on task, attention to audience and attention to structure and language were correlated with assessors judgment on similar aspects of their texts; i.e. the extent to which a text demonstrates focus on task, concern for audience and command of language.

4.4.3 Summary of research questions, variables and statistical tools

The following table (4.2) shows a summary of the measures, the obtained data and the statistical tools for addressing the research questions. The first column restates the research questions. The second and third columns show the independent and the dependent variables respectively. The fourth column shows the measures that were used in constructing the independent variables. As explained earlier, independent variables have been operationalized in terms of a number of measures to cover several aspects of the variable. The fifth and sixth columns show the elicitation tools and the obtained data; and on the seventh column the appropriate tests of significance are presented.

Table 4.2 Summary of the research questions, the variables, elicitation methods and statistical tests of the qualitative analysis

Research Questions (simplified)	Independent variable(s)	Dependent variables	Measures	Tool	Data	Statistic tests
RQ1 Does writing of English and Computer Science majors develop along university levels? **RQ2** Do the writing of the two majors develop differently?	**RQ1** Academic levels **RQ2** Academic levels & subject area	Fluency	Text length	Text	Word count of final texts	**RQ1** One-Way ANOVA **RQ2** Two-Way ANOVA
			Rate of production	Text+ time record	Words per minutes	
			Uninterrupted text spans	Log files (Lin)	Mean length of uninterrupted spans	
			Initial pause time	Log files (Ptd)	Initial pause in seconds	
			Proportion of pause time to total time	Log files (Stat)	Pause time, total time	
			Proportion of final text	Log files (Stat)	Final tokens, linear tokens	
		Revision behaviour	Frequency	Log files (Lin)	Occurrences of all revisions (per 100 words)	
			Location	Log files (Lin) + playback	Occurrences of immediate, proximate and distant revisions	
			Level of revision	Log files (Lin) + playback	Occurrences of revisions at different processing levels	
			Effect of revision	Log files (Lin)+ playback	Occurrences of formal and conceptual revisions	
		Writers' awareness	Global planning	QIR	Response to Q 3&4	
			Consideration of task		Response to Q 6	
			Focus on task		Response to Q 7&9	
			Attention to audience		Response to Q 8&9	
			Writer's role		Response to Q 10	
		Text quality	Task Fulfillment	Text assessment	Average score of TF	
			Development & Organization		Average score of D&O	
			Audience Awareness		Average score of AA	
			Structure and Diction,		Average score of S&D	
			Grammar and Usage		Average score of G&U	

QIR= Questions for immediate recall; **Lin**= linear log-file; **Ptd**= pause time data log-file; **Stat**= Statistics log-file.

Table 4.2 Summary of the research questions, the variables, elicitation methods and statistical tests of the qualitative analysis (continued)

Research Questions (simplified)	Independent variable(s)	Dependent variables	Measures	Tool	Data	Statistic tests
RQ3 Can variation in text quality be explained in terms of fluency, revision behaviour and writers' awareness?	**RQ3** Average Text Quality	Fluency	Text length	Text	Word count of final texts	Spearman's correlation coefficient
			Rate of production	Text+ time	Words per minutes	
			Uninterrupted text spans	Log files (Lin)	Mean length of uninterrupted spans	
			Initial pause time	Log files (Ptd)	Initial pause in seconds	
			Proportion of pause time to total time	Log files (Stat)	Pause time, total time	
			Proportion of final text	Log files (Stat)	Final tokens, linear tokens	
		Revision behaviour	Frequency	Log files (Lin)	Occurrences of all revisions (per 100 words)	
			Location	Log files (Lin) + playback	Occurrences of immediate, proximate and distant revisions	
			Level of revision	Log files (Lin) + playback	Occurrences of revisions at different processing levels	
			Effect of revision	Log files (Lin)+ playback	Occurrences of formal and conceptual revisions	
		Writers' awareness	Global planning		Response to Q 3&4	
			Consideration of task		Response to Q 6	
			Focus on task	QIR	Response to Q 7&9	
			Attention to audience		Response to Q 8&9	
			Writer's role		Response to Q 10	

QIR= Questions for immediate recall; **Lin**= linear log-file; **Ptd**= pause time data log-file; **Stat**= Statistics log-file.

4.5 Summary

This chapter opened with a brief discussion of the theoretical underpinnings of the present inquiry. The study was set within a framework of cognitive process theory of writing and placed around certain developmental measures. The quasi-longitudinal design reflects the interest in assessing development of writing in English as a foreign language along three tertiary academic levels and across two different disciplines.

The chapter then presented the research methodology. It first introduced the participants, the setting, the writing tasks, and the research procedure. Then it described the data elicitation instruments: The writing and logging computer program (ScriptLog), the questions that were given to students to elicit recall of some of their strategies and concerns (QIR), and the stimulated recall sessions. The research questions were then restated and the variables were discussed together with the operational measures for each variable. A summary of the research questions, the measures, the elicitation methods and the statistical tools were presented in a table. Triangulation of data gathering tools was necessitated by the wide scope of inquiry posed in the research questions. To put it briefly, the study investigated development in how university students write; how they perceive their writing strategies and awareness; and assessors' evaluation of textual features that reflect writers' skills, linguistic knowledge and metacognitive awareness.

The main elicitation tool of data on how students write is the keystroke logging program (ScriptLog). The need for such a tool comes from three conditions that were lacking in previous research. First, it allows for an unobtrusive observation of the writing process as it unfolds in real time without the need for video cameras or a nearby observer. Second, computerized logging overcomes possible reactive effects of think-aloud methods. A writer is left to focus on the writing task uninterrupted by having to articulate her thought, or (even worse) having to alter her thought to suit the expectations of the observer. This allows a natural flow of writing without overloading the working memory with two tasks: writing and thinking aloud. Third, the program provides accurate observation of large number of samples. This makes quantitative

analysis feasible, and contributes to getting reliable findings about the variables at hand.

Following the writing session Questions for Immediate Recall (QIR) elicited responses from writers on how they perceive their writing strategies and on their linguistic, textual and contextual concerns. Text assessment, on the other hand, generated data on readers' judgement on the extent to which texts meet contextual, textual, and linguistic criteria of writing.

While this chapter has introduced the proposed measures of observing the writing process in abstract terms, the following two chapters will demonstrate and exemplify hands-on analyses of the obtained samples. They will report quantitative findings, discuss issues raised by the analyses and report on significance of the findings. The chapter that follows those (Chapter Seven) will report on the individual writing sessions and the insights from stimulated recall protocols in an attempt to find verification at individual levels of group findings.

Chapter Five: Keystroke Analysis and Findings.

5.1 Introduction

Guided by the research questions, this chapter reports the main quantitative results of the research. It primarily presents findings relevant to fluency and revision strategies with subject area and academic level as the independent variables. Writers' own reported linguistic and socio-contextual concerns together with results of assessment of the written texts will be presented in Chapter Six.

The chapter will provide a detailed description of the outcome of measuring, coding and analyzing the elements of the two research constructs that are the focus of this chapter: fluency and revision. The description of the method of analysis for each variable will be followed by a quantitative report, illustrated by a table and/or a figure. Where patterns are observed findings of relevant statistical tests will be provided.

The study is underpinned by an assumption that writing proficiency could develop as students advance up the tertiary academic levels; and that, if so, students of the two distinct subject areas (English and Computer Science) will develop differently. Two research questions have been proposed to address these assumptions (RQ1 & RQ2). The questions are restated below, with only the variables relevant to this chapter[3].

> **RQ1**   Does writing in English as a foreign language of university students majoring in English Language and Literature and in Computer Science demonstrate an identifiable developmental pattern along university levels, in terms of **(a)** fluency and **(b)** revision strategies?
>
> **RQ2**   Does writing in English as a foreign language of university students of the two majors develop differently along university levels in terms of **(a)** fluency and **(b)** revision strategies?

Four hypotheses were formulated to guide analysis:

---

[3] Within RQ1 and RQ2 the four main variables were numbered as **a** (for fluency), **b** (for revision strategies), **c** (for writers' reported awareness and concerns), and **d** (for text quality). This numbering will appear with RQs1&2 and corresponding Hypotheses from this point onward. Only variables relevant to the discussion in the different sections will be stated in RQs.

H1a It is predicted that writers of both subject areas (English and Computer Science) will demonstrate development at different levels of tertiary education in terms of fluency of production.

H1b It is predicted that writers of both subject areas (English and Computer Science) will demonstrate development at different levels of tertiary education in terms of revision behaviour.

H2a It is predicted that writers of the two different subject areas will develop differently along the levels in terms of fluency of production with English majors showing more improvement.

H2b It is predicted that writers of the two different subject areas will develop differently along the levels in terms of strategies of revision, with English majors showing more improvement.

5.2 Fluency: productivity and pause behaviour

As proposed in Chapter Four, fluency has been observed in two sets of measures. The first comprises total number of words, rate of production, mean length of text span and the proportion of final text to candidate text. The second measure of fluency accounts for pause behaviour; it includes initial pause time and proportion of pause time to total time. Duration of the writing activity is also presented in reporting fluency in this study, partially because it is an essential figure in calculating the rate of production, but mainly because it provides clues to L2 writing behaviour among this population, in particular. Moreover pause behaviour has been observed in three measures.

5.2.1 Time, text length and rate of production

The relationship between fluency and the gross amount of time people spend on a writing task is often interpreted in terms of rate of production only. While how much text is produced in a limited time is one of the concerns here, another interpretation of writing time is plausible and particularly appropriate to the population of this study, where matters of motivation, attitude and interest are largely influential. For one thing, attitude towards the concept of research and a researcher taking time that should be spent either in the classroom or, otherwise, as a time-off treat, is likely to affect writing time. In this case, time spent on writing indicates the degree of interest in and involvement with the task in the absence of other motivations, such as assessed coursework or exams. Secondly, writers' observed struggle with the foreign language at all levels could have reduced their appetite for writing. Being able to spend more

time on the writing task while they are constantly faced with their linguistic, pragmatic and rhetorical inadequacies shows students' willingness to challenge these limitations. This kind of attitude was allowed to naturally interfere with students' writing behaviour. Those who wished to continue writing after the expected time was over were allowed to do so.

Table 5.1 below presents the results of three measures of fluency: time spent on writing, text length and rate of production. As the table shows, the average time participants spent in the writing activity is comparable across subject areas, except for E4 and CS4 groups. However, high standard deviations indicate variation among individuals, particularly in groups E4 and CS8.

Although level-eight groups wrote for longer time than level-one groups, no systematic development pattern can be found in the data along the three levels in any of the two groups. Participants in CS4 spent considerably shorter time on the writing task than those in CS1; and E4 participants spent more time than their fellows in the eighth semester.

Table 5.1 Fluency measures across academic levels and subject areas

	Ave. time in minutes (SD)		Ave. text length in words (SD)		Rate of production Words per min. (SD)	
	E	**CS**	**E**	**CS**	**E**	**CS**
Level 1	33.96	31.20	79.8	155.2	2.74	5.03
	(6.77)	(1.42)	(61.76)	(62.89)	(2.16)	(2.16)
Level 4	41.89	19.91	159.2	135	3.90	6.87
	(18.74)	(5.42)	(70.76)	(33.58)	(1.26)	(0.91)
Level 8	39.67	38.82	273.2	218.8	7.11	5.21
	(8.71)	(17.18)	(119.73)	(172)	(3.66)	(2.10)

Due to the fact that participants of all levels and subject areas were allowed similar duration of time (40 minutes) to complete their writing, text length becomes a valid indicator of fluency. It demonstrates how much written text different individuals can produce when given equal time and similar tasks.

Tracing text length along the academic levels (that is down the fourth and fifth columns in Table 5.1) shows a consistent pattern of improvement, excluding CS4. Texts produced by level 8 students of both groups are considerably longer than those of level 1. On average E8 produced texts that are about three-and-a-half times (342.4%) longer than E1. A similar trend is demonstrated by Computer Science students whose texts at the eighth level are 41% longer than at level one. But again, a notably high standard deviation (SD) suggests variations amongst individuals.

Statistical analysis ANOVA was considered to test significance of the differences found in text lengths. As reported above there were significant differences between the groups in terms of text length (F= 7.565; p< .001). In particular, post hoc analysis (LSD) captured the gradual and notable improvement in text quantity in English-major writers: E4 exceeded E1 by a mean difference of 77.182 (p= .023), and E8 exceeded both E4 by 63.368 (p= .032), and E1 by a remarkable mean difference of 140.55 (p< .001). Likewise lengths of texts written by Computer Science participants at the eighth level exceeded both CS1 (mean difference 95.5, p= .004) and CS4 (mean difference102.089, p< .001). No significant progress or decline was observed between the fourth and eighth semesters in Computer Science writers.

While E4 texts have significantly exceeded CS4 texts (p= .047), E8 superiority over CS8 in terms of text length was not proved to be statistically significant.

The significant improvement in text length in group E8 is further demonstrated in the chart below (Figure 5.1). Computer Science groups display a different pattern. Although level one Computer Science group produced longer texts than did their English counterparts, this was reversed to the advantage of English majors at the fourth and eighth levels.
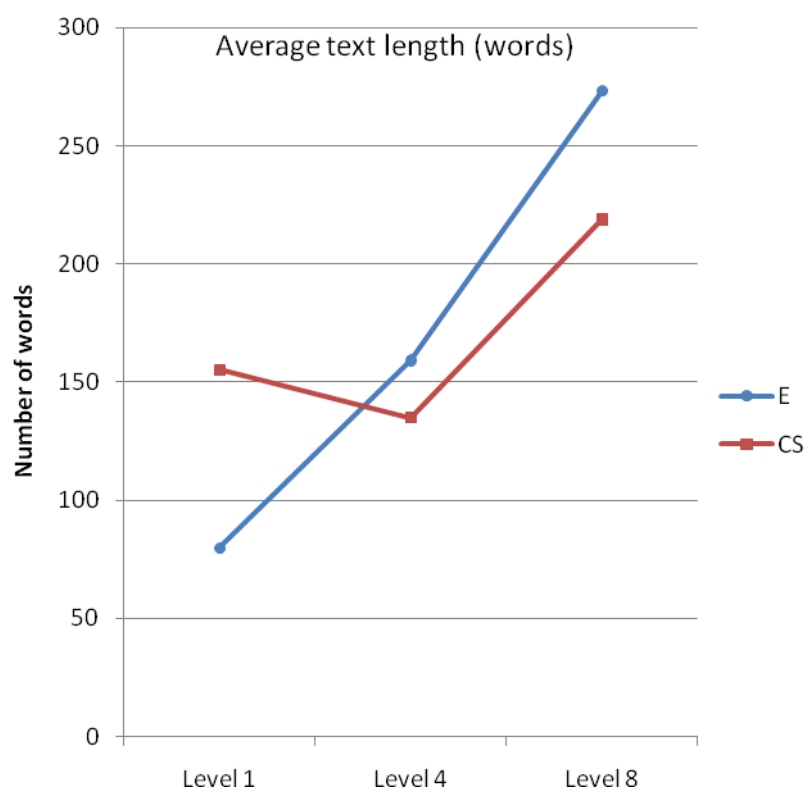
Figure 5.1 Average text lengths (in words) across subject areas and academic levels

.Rate of production (RP) is another measure that confirms Computer Science students' developed fluency in their initial levels at college. Not until reaching the 8th level could English majors outperform their fellow Computer Science students. On the other hand, rate of production is also a measure that demonstrates a pattern of improvement in the groups of the two subject areas. While RP of CS1 is higher than in E1, and while it has improved by 36.58% in level 4, at the 8th level it declined back to a value comparable to that of the first level. English group showed a systematic and more vivid developmental pattern, with RP increasing by 42.34% at level four and by 82.31% at level eight; a pattern that can easily be recognized in the chart below.
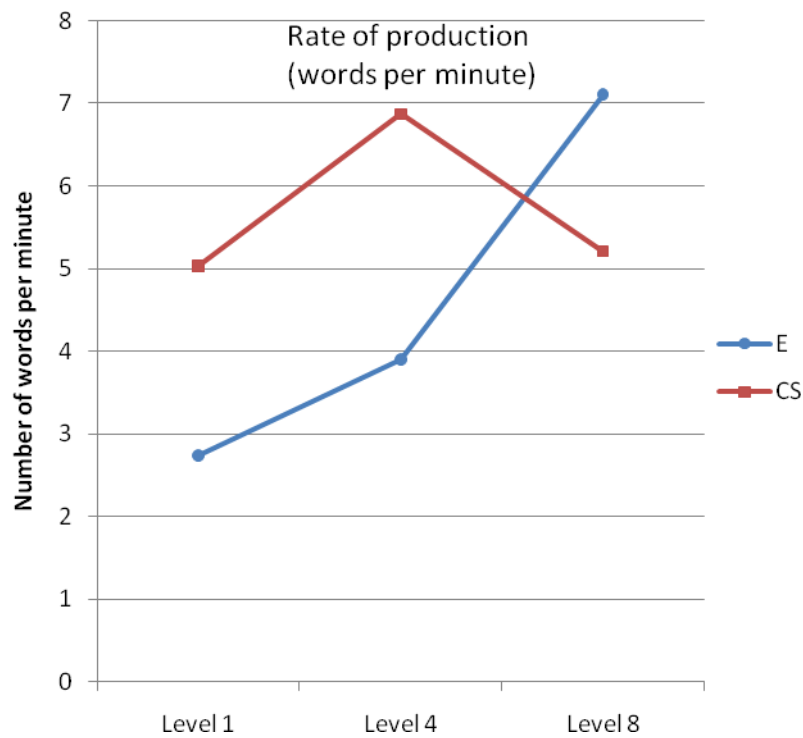
Figure 5.2 Rate of production across subject areas and academic levels

ANOVA test revealed significant differences between some of the groups (F= 3.524, p= .006). Progress along the levels in English majors was demonstrated by a significant difference between E1 and E8 (p= .007) and E4 and E8 (p= .002), though no significant difference was captured between E1 and E4. On the other hand, no significant change in Computer Science writers' rate of text production was statistically proven between any of the groups. As for differences between groups of the two subject areas, only at the eighth level English writers' rate of text production exceeded that of Computer Science writers (T-test statistics is 2.83, p-value= .007).

A different way of measuring rate of production is by discounting pauses that are more that 2 seconds, and calculating the number of words writer produced when they are not pausing. The following table (5.2) shows rate of production during fluent writing.

Table 5.2 Productivity during non-pause time

	Rate of production during non-pause time (average words per minute)	
	E	**CS**
Level 1	14.14	13.77
Level 4	13.26	16.35
Level 8	17.13	15.09

Rate of production during fluent writing demonstrates a pattern of change that is different from RP. Unlike RP, it provides no evidence for systematic development along academic levels in either subject group. Moreover, measuring pauses at the 2-second level might not account for variation in shorter pauses. Accordingly, rate of production during fluent writing variable was not considered for statistical analysis.

5.2.2 Text spans

Mean length of text spans (TSL) was measured as the average number of words in chunks of text produced between pauses. Two problematic issues arise from this matter. The first is the duration of a significant pause. I have chosen five seconds as minimum pause duration that allows the production of a linguistic chunk of information (text span). This is because it has been hypothesized that the process of assembling a chunk of information in the short-term memory takes about 5 seconds (Simon 1969/1981, cited in Matsuhashi 1986, p.202).

The second issue is identifying what makes a chunk of text, which is less straightforward than it seems. One of the problems is to do with counting words whose production is interrupted by one or more pauses. Some of these pauses are quite long. Since fluency is evident in lexical/syntactic productivity, one would argue, pauses of hesitations that are caused by struggle over spelling of one word, or by any other reason, were ignored in TSL analysis (but not in the pause analysis). Any word that has been started before a pause and completed after it, or that could be inferred from the context (even when not completed after the pause), is counted as part of the text span that the word was initiated within prior to the occurrence of the pause.

The third issue is on how to treat the remaining fragments of words: whether or not to count them as zero chunks since they hold no evidence of production at the lexico-syntactic level. It has been realized in the context of this research that it is more plausible to consider them as unsuccessful production because when a writer pauses to amend a word and fails to do so, which often leads her to another pause(s), productivity is affected. In this case, counting productivity as zero and allowing these zeroes to affect the cumulative value of TSL is representative of what this halting actually does to text flow; it lessens fluency.

Example 5.1 demonstrates how hesitation over spelling does slow down text production. The inscription of the word *analyse* produced three pauses, one of them being of more than half a minute. In order for pause analysis to reflect this slowing down, these unfinished productions between pauses should not be counted towards productivity, and instead be considered as a zero text span.

Example 5.1
```
Ana<0.03.438>llyse <BACKSPACE7>lise<0.02.672><BACKSPACE4>aly
<0.31.328>ise(CS8-8)
```

The fourth issue is that of unproductive actions. When two pauses follow each other immediately, as in example 5.2 below, the values of the two pauses are added together because nothing has happened between them, not even a mouse or a cursor movement. In the example the value of the pause becomes 24.348 seconds.

Example 5.2
```
0.14.546><0.10.297><BACKSPACE10>more about these things in a
proffisional
```

On the other hand, hitting the space bar, scrolling or moving a mouse indicate an attempt to add something. In example 5.3.a the writer paused for 8.83 seconds, and then moved the cursor to another place before she pauses again for 11.05 seconds and starts a new paragraph. It is tempting to consider both pauses as one (since no text has been produced between them), add their values, and present the following chunk as a text span that follows one (joined) long pause, but this is misleading. The writer has actually failed to produce text after the first pause and thus produced a zero-word-length text span. This should be counted and allowed to affect the mean length of text

span. Example 5.3.b shows even more unproductive actions between the first two pauses.

Example 5.3.a
```
<0.08.828><MOUSE EVENT><0.11.047><RETURN>so in my opinion I
will not <0.17.015>give a prejudgment on it without (E8-1)
```

Example 5.3.b
```
0.20.203><MOUSE EVENT><BACKSPACE><MOUSE EVENT><BACKSPACE><MOUSE
EVENT><0.16.078><RETURN> <0.08.016><BACKSPACE>therefore we
English (E8-1)
```

Text span analysis (figures presented in table 5.3, standard deviations in parentheses) revealed a developmental pattern along university levels amongst the groups of both disciplines. Improvement of the mean length of text spans produced between pauses is more obvious in the case of English majors, with participants in their eighth semester (E8 group) producing text spans that are four times longer than students in the fourth semester (E4), and three times longer than those who have just entered university (E1); F-test statistics is 6.343, p-value= .019. A pattern of development was interrupted by a decrease in mean length of text span in E4. Changes in the mean length of text spans in Computer Science majors, on the other hand, do not display a systematic or eventual development.

Table 5.3 Mean length of text spans (TSL)

	Mean length of text spans in words (SD)	
	E	**CS**
Level 1	2.65	3.222353
	(1.50)	(1.72)
Level 4	1.903802	5.170707
	(0.60)	(2.17)
Level 8	7.61	4.58
	(3.94)	(0.82)

The figure below further displays the general trend of increase in mean length of text span over time in both groups. English groups remain inferior to Computer Science groups at the first and fourth levels, but at the eighth level there was a considerable

increase in TSL, which has remarkably exceeded both that of the Computer Science majors and levels 1 and 4 of the same group.
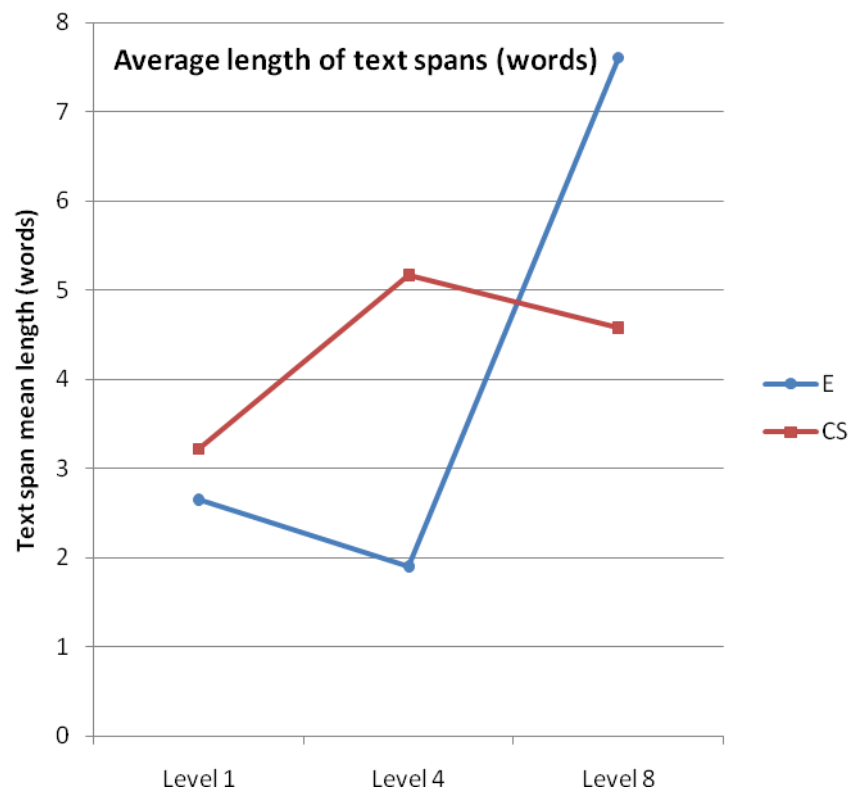
Figure 5.3 Text span mean length across subject areas and academic levels

5.2.3 Proportion of final text

The proportion of final text to linear text was aided by the statistics file of ScriptLog, which provides figures for linear tokens and final tokens; i.e. the number of typed characters and the number of characters that were kept in the final text. Table 5.4 below shows differences in the proportion of final tokens to linear tokens across subject areas and at the three different academic levels.

In their first semester participants kept in their final texts 75.54% of what they typed down. This has increased by around 5% in the fourth semester. However, the difference between semester four and eight is less than 1%. Changes along the levels in final-linear text proportion in Computer Science majors, on the other hand, do not display systematic development with CS4 group notably exceeding both CS1 and CS8.

Table 5.4 Proportion of final tokens to linear tokens

	Proportion of final tokens to linear tokens %	
	E	**CS**
Level 1	75.54	77
(SD)	(14.30)	(8.16)
4	80.79	85.61
(SD)	(9.34)	(8.08)
8	81.75	78.83
(SD)	(8.88)	(7.75)

Graphically represented (Figure 5.4), proportions of accepted text to candidate text demonstrate progressive change amongst participants from the English Language and Literature department along college levels.
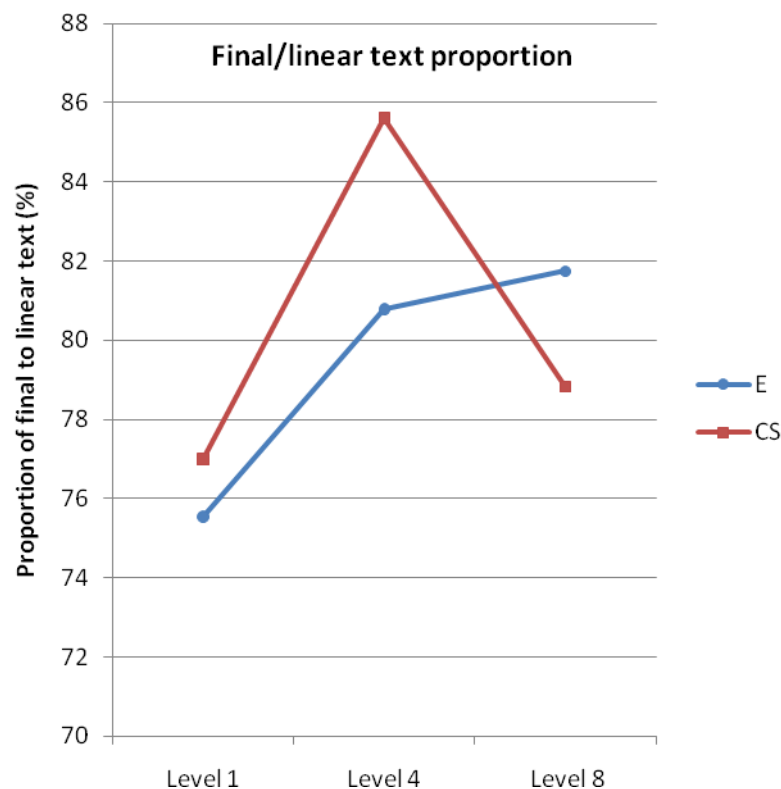
Figure 5.4 Proportion of final text to linear text

However, ANOVA analysis did not prove any significant change along the levels of all English-major groups. Computer Science groups, on the other hand, have shown a significant mean difference of 8.613 (p= .021) between first and fourth levels. The

decline in the proportion of final text to linear text in CS8 was also proved to be significant (mean difference is 6.7849, P= 027).

5.2.4 Pause behaviour

A major effect on fluency is writers' pause behaviour. Two measures have been used to observe pause behaviour of participants of this study: initial pause duration and proportion of pause time to total time. Table 5.5 compares mean duration (in minutes) of initial pauses for all groups (standard deviations in parentheses). Once again, English majors demonstrate a progress marked by a systematic increase along university levels. A Post hoc (LSD) test confirmed two significant mean differences amongst the English groups one between E1 and E8 (1.449, p= .010) and another one between E4 and E8 (1.228, p= .016). No significant change was found between the E1 and E4 groups.

Table 5.5 Average length of initial pause

	Average length of initial pause in minutes (SD)	
	E	**CS**
Level 1	1.17 (1.33)	0.94 (0.52)
Level 4	1.39 (0.98)	0.63 (0.54)
Level 8	2.62 (1.88)	1.56 (2.05)

The graph below displays a progressive change in the average lengths of initial pauses in English majors. In Computer Science what would have been a developmental pattern was again interrupted by a decrease in initial pause duration at the fourth level. Moreover, besides being unsystematic, differences between the Computer Science groups are non-significant.
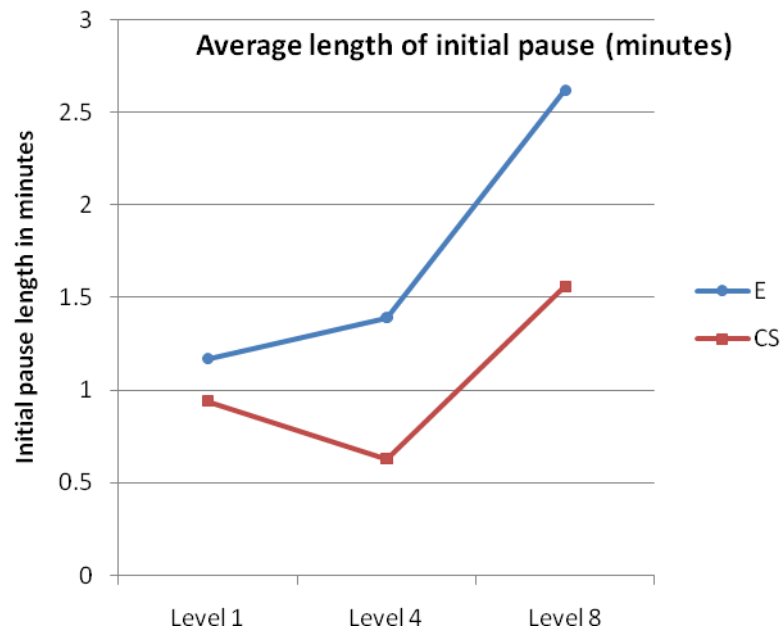
Figure 5.5 Average length of initial pause across levels and groups

Another pause observation measure is the proportion of pause time to total time. It accounts for the time when a writer is halting for more than 2 seconds. The purpose of this is to find out differences between the groups in terms of how much of their time is spent in writing; the smaller the pause time proportion, the longer the productive time. Table 5.6 shows a gradual decrease in pause time proportion in English majors as we go up the levels. However ANOVA tests (F= 2.123, P= .132) has proved differences to be statistically non-significant. Likewise, ANOVA (F= 1.107, P= .339) and post hoc tests have not captured meaningful changes in pause time proportion in Computer Science groups. On the other hand differences between E8 and CS8 participants in their proportions of pause time to total writing time were found to be significant (T-test statistics is 2.64, p= .012).

Table 5.6 Proportion of pause time to total time

	Total pause time (minutes) (SD)		Proportion of pause time to total time (SD)	
	E	**CS**	**E**	**CS**
Level 1	20.1 (9.19)	23.3 (3.33)	67.83 (13.04)	69.78 (9.91)
Level 4	30.34 (14.2)	16.57 (7.84)	65.93 (8.96)	64.76 (10.13)
Level 8	24.50 (8.5)	36.83 (17.09)	60.36 (10.05)	68.82 (9.98)

Figure 5.6 (below) displays a pattern of change that has become familiar in the data of the study, with a consistent decrease in pause time proportion in the English majors.
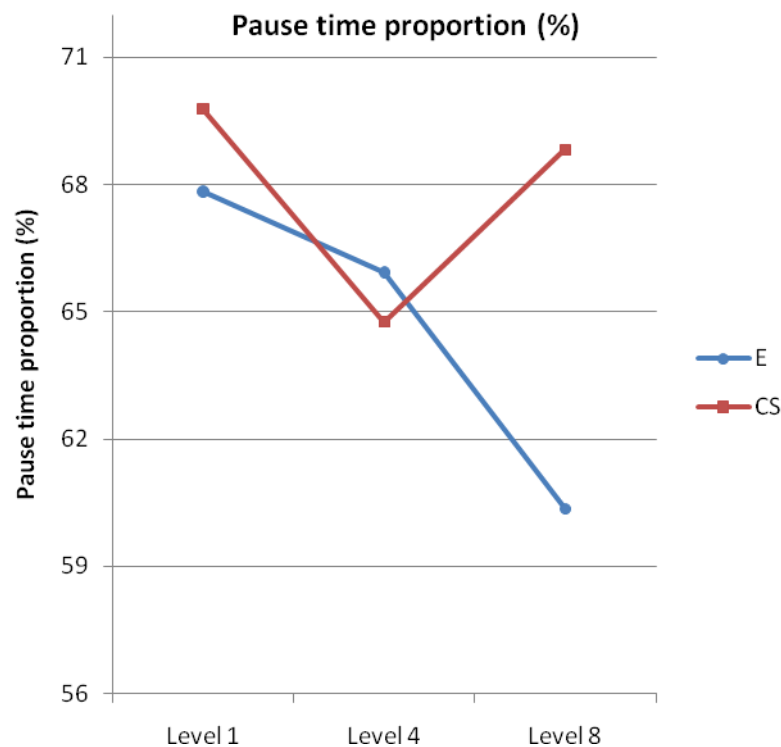
Figure 5.6 Proportion of pause time across levels and groups

To test the validity of the three sets of measures of fluency correlations between the variables were run. It has been found out there is a great consistency between measures of productivity and pause data. There have been, for instance, high negative correlations between PR and proportions of pause time to total time, (Spearman's coefficients are -.854 (E1), -.911 (CS1), -.83 (E4), -.78 (CS4), -.78 (E8), -.73 (CS8), all significant at the p< 0.01 level). Text span length correlated positively with both text length and rate of production (Pearson Correlation coefficients are .594 and .914 respectively, both significant at the 0.01 level).

5.3 Revision

By analyzing revision behaviour, this study seeks to find out possible differences between participants from English and Computer Science disciplines, and to measure changes in revision strategies along the three college levels. The purpose of this is to

find out if writers of different language experiences carry out revisions in different locations and at varying levels of processing (typographic, syntactic, semantic and textual) and how these affect the emerging text as well as other text production strategies.

Faigley and Witte (1981) proposed the terms surface and text-based revisions based on "whether new information is brought to the text or whether old information is removed in such a way that it cannot be recovered through drawing inferences" (p.402). Surface changes are either formal changes or those *that add or delete information* without changing meaning; they add information that could have been inferred from the text or delete information so that they could be inferred by the reader. Meaning changes, as implied by the name, affect the meaning of the text. They moreover distinguished between "simple adjustments" which they called micro-structure, and "more sweeping alternations" which they called macro-structure.

While being informed by these distinctions, revision analysis in this study is framed within a different multidimensional approach, which broadly divides revisions into formal and conceptual; and categorizes revisions according to location, scope of effect and level of processing and awareness.

During data analysis, a great proportion of revisions were found to be typographic, i.e. revisions made to typing mistakes. Those have often been acknowledged in writing studies and listed as a revision category. Several criteria have been set to distinguish them from spelling revisions (Lindgren & Sullivan, 2006; Stevenson et al, 2006). Writers often make immediate revisions to correct errors that resulted from wrong typing behaviour. In example (5.4) below the writer has hit the space bar accidently before finishing the word, but went back immediately omitting the space and adding the final s. Soon after, she hit the *u* key by mistake and, again, corrected that promptly, but while doing that she inserted another unnecessary space after *i* and backspaced it immediately.

Example 5.4
```
i gues <BACKSPACE>s uit=<BACKSPACE4>i=<BACKSPACE>ts important
```
(E8-2)

The examples below show three more extracts with typographical errors where in the first one (5.5.a) a key (w) is hit twice and in the second (5.5.b) a sequence of keyboard presses went wrong, and were corrected promptly, (striking the unneeded neighbouring *n* with *m*, hitting *k* twice, and pressing *v* instead of *c* and *f* instead of *d*).

The third extract in (5.5.b) illustrates a severe lack of control over the keyboard. This has not been noticed elsewhere in the data, not at this level of severity. She hit the *u* key twice, hit *I* (which is adjunct to the intended o); and while correcting that, hit another neighbouring key *9*, back spaced it, typed in *w* correctly but immediately after stroke *b* instead of *n*, and corrected it immediately. Surprisingly, all this did not hamper fluent production. Production rate of this particular participant was 12.44 words per minutes and the mean length of text span was 12.82; both are way above the mean PR and TSL values of E8 group, (7.11 and 9.37 respectively).

Example 5.5.a

`wwere <BACKSPACE5>ere` (E8-2)

Example 5.5.b

`cartoonms<BACKSPACE2>s so that it can be fun and not so boring`
`likke<BACKSPACE2>e a book with blak<BACKSPACE>vk <BACKSPACE3>ck`
`boring works<BACKSPACE2>fs<BACKSPACE2>f<BACKSPACE>ds` (E8-2)

Example 5.5.c

`on youur<BACKSPACE2>r iwn <BACKSPACE4>o9<BACKSPACE>wb`
`<BACKSPACE2>n free time with` (E8-2)

In this study, contrary to most of the relevant studies, revisions made in response to typing mistakes (including revision done to text that has been written while caps lock was on or those resulting from certain keyboard habits) were not counted towards the total number of revisions. While their existence and effect on fluency is recognized in this study (particularly in TSL and PR), they are not included in revision analysis because they do not indicate abilities, or otherwise inadequacies, at the level of language processing. They only reflect operations within the motor functions of the brain.

Analysis in this chapter is guided by the assumption that maturation in writing will lead to revisions that are oriented more towards text structure than individual words, and more towards meaning than form. This entails observing revisions at four dimensions: location of the revision from the point of inscription, scope of revision in terms of unit of linguistic/conceptual processing, and effect of the revision, that is the type of knowledge that has probably activated and/or facilitated the revision.

5.3.1 Frequency of revision

Revisions were quantified first as a total number per text then as a number of revisions per 100 words. The latter measure was necessitated by variation in text length amongst individuals and groups. As the table below (Table 5.7) shows, the number of revisions per hundred words differs across the levels and the academic majors. Generally, there is a notable systematic decrease in the number of revisions as we go up the levels, with the exception of CS8. While English major participants in semester eight made less than half the number of revisions performed by the first semester's participants of the same major, CS8 group have conducted almost the same number of revisions per 100 words as that of CS1 group.

Table 5.7 Frequency of revisions per 100 words

	Revisions per 100 words	
	E	CS
Level 1	40.62	23.74
Level 4	24.05	14.47
Level 8	14.47	24.21

The graph below shows clearly the developmental trend in the number of revisions per 100 words in English majors compared to the unsystematic trend of the Computer Science majors.
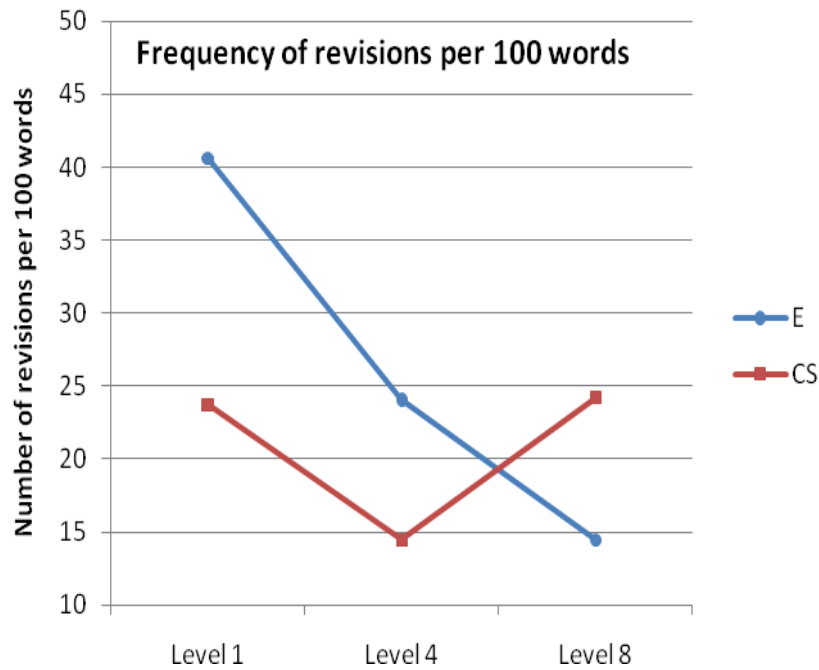
Figure 5.7 Revisions/100 words across subject areas and academic levels

5.3.2 Location of revisions in relation to the point of inscription

The second dimension in revision analysis is location of revision to the point of inscription. Three locations were identified: immediate, proximate, and distant.

Table 5.6 below reveals differences in the distribution of revision location. Immediate revisions are the most frequent type in both groups at all levels, but considerably more frequent in Computer Science samples. Generally, there is a notable linear writing mode which is evident in the infrequency of distant revisions.

Immediate revisions are sometimes difficult to categorize as the relevant part of the text has not unfolded yet and writers' intentions are not yet clear. It has been referred to as pre-contextual by Lindgren and Sullivan (2006).

Table 5.8 Distribution of revision location

	Immediate (%)		Proximate (%)		Distant (%)	
	E	**CS**	**E**	**CS**	**E**	**CS**
Level 1	65.83	85.95	15.00	12.40	19.17	1.65
Level 4	74.64	72.73	16.67	16.36	8.70	10.91
Level 8	64.82	60	20.60	24.91	14.57	15.8
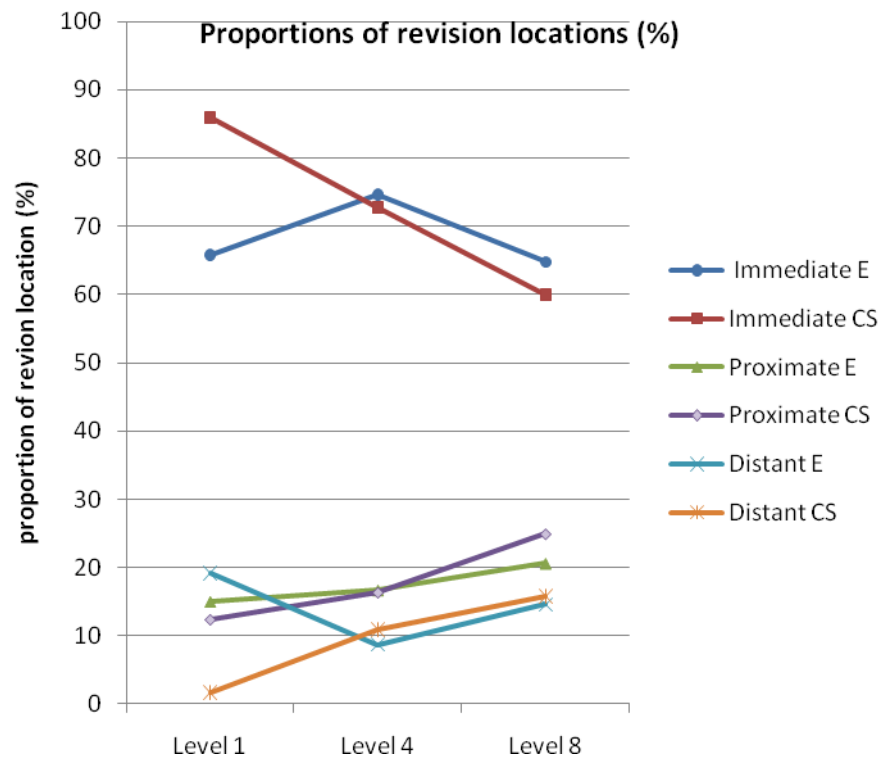
Figure 5.8 Proportions of revision locations across subject groups and academic levels

5.3.3 Formal and conceptual revisions

A broader dimension in analyzing revision distinguishes attention to either the linguistic form or the meaning of the text. This distinction reflects the nature of the mental linguistic processing that probably underlies surface changes. It discriminates revisions that are activated and facilitated by (low-level/ surface-level) formal linguistic concerns and those activated by concerns about meaning, content and text structure.

It is relevant to mention here that categorizing revisions as formal or conceptual is not unproblematic. The following extract, to give but one example, includes a revision (marked with subscripted red number 29) that could be interpreted both as formal and conceptual.

Example 5.6

```
and thy will get conv<0.30.859>vin<BACKSPACE3>incig
<BACKSPACE2>ed₂₉ for sure<0.11.344>.(E4-3)
```

Unlike previous studies (e.g. Faigley & Witte, 1981; Lindgren & Sullivan, 2006), no distinction was made between conceptual revisions that change meaning and those that preserve meaning. This is because once there is evidence for processing at a conceptual level, it does not matter to the objectives of the present study if changes to meaning are made or not. The following extract demonstrates both types.

Example 5.7

```
other part that include myself that doesnt <BACKSPACE4>
<BACKSPACE>₁₀s not em<BACKSPACE>ₜnjoy e<BACKSPACE>ₜreading at al
l<BACKSPACE2>lo <BACKSPACE2> and get distrackte<0.06.703>
<0.07.437><BACKSPACE14>₁₅get no enjoym<BACKSPACE>me
<BACKSPACE7>₁₆ excitment or <0.16.594>ca<BACKSPACE2>peoploe
<BACKSPACE8>cant not really get into the (E8-2)
```

In the example above, revision number 15 was difficult to categorize. The writer substituted *get distracted* with *get no enjoyment*, then (in revision 16) replaced the latter with *excitement*. 'Get distracted' and 'not to get enjoyment' do not mean the same. This revision would accordingly fall into the meaning-changing conceptual category. However, foreign language users fall into such an overlap between two semantically different expressions. The writer has probably meant that people who do not enjoy reading cannot get involved (because of lack of enjoyment/excitement), but she might have realized that the expression 'get distracted' does not convey the intended meaning. The revision accordingly does not signal change to "intention" but to "convention", using Nold's terms (1982, cited in Matsuhashi, 1987). Revision 16 is clearly a meaning preserving one, but it is not a conceptual revision.

Table 5.9 (below) shows the proportions of formal and conceptual processes in the six groups. The second column of the table presents the percentage of unidentified revisions. These are revisions that could not be identified as formal or conceptual. In the third and fourth columns calculations of formal and conceptual revisions included

the unidentified revision in the calculation, but the figures in parentheses represent the proportion of revision without including the unidentified category in the calculation.

Table 5.9 Proportion of formal and conceptual revisions

	Proportion of unidentified revisions		Proportion of formal revisions % (excluding unidentified)		Proportion of conceptual revisions % (excluding unidentified)	
	E	CS	E	CS	E	CS
Level 1	40.62	23.74	74.87 (80.68)	63.92 (72.63)	17.74 (19.32)	23.22 (27.07)
Level 4	24.05	14.47	72.51 (89.12)	64.01 (72.68)	11.56 (14.45)	26.45 (27.32)
Level 8	14.47	6.70	58.36 (61.75)	59.19 (62.23)	35.93 (38.25)	35.54 (37.52)

The graph below, based on the figures in Table 5.3, shows a remarkable difference between proportions of formal and conceptual revisions. Participants of all levels and subject areas demonstrate a tendency to attend to form, in their revisions, at the expense of content. E4 group demonstrate a most apparent preoccupation with form at the expense of concept while writers in CS4, CS8 and E8 show a relatively milder discrepancy between formal and conceptual revisions.
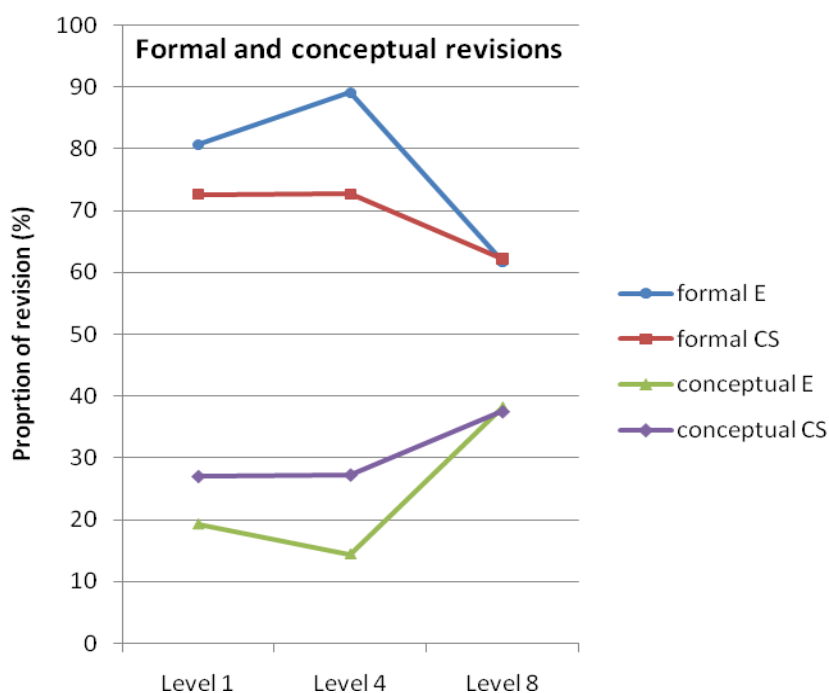
Figure 5.9 Proportion of formal and conceptual revisions

5.3.4 Revision scope:

Scope of revision is the linguistic and/or textual capacity of the element(s) that a writer is working within before analyzing what sort of revision is being made. These hierarchical elements include word, phrase (noun, verb, propositional), clause (nominal, adverbial, adjectival, relative, etc), T-unit and text. A brief explanation on coding revisions in terms of scope is provided in the following sections.

Word

Word revisions refer to both within word changes (i.e. mechanic, orthographic and morpho-syntactic/morpho-semantic), and word level substitutions (i.e. substituting a whole word with one of a similar syntactic and semantic function). Deletions, additions and substitutions with words of different syntactic functions often result in changes to language structures beyond the word level, and changes to word meaning sometimes results in changes in the proposition of larger structural units.

The examples below illustrate within-word orthographic (Example 5.8.a), within-word morpho-syntactic (example 5.8.b), and word-level substitution (example 5.8.c) revisions. In the last one a writer went back to a distant location to replace *go (to)* with *head (to)*.

Example 5.8.a

or desining<BACKSPACE5>$_5$gning web pages (CS8-17)

Example 5.8.b

and thy will get conv<0.30.859>vin<BACKSPACE3>incig

<BACKSPACE2>ed$_{29}$ for sure<0.11.344>.

Example 5.8.c

<MOUSE EVENT> head35<0.05.609><MOUSE EVENT> (E4-3)

Phrase

Phrase-level revisions are done to noun, verb, adverb, and prepositional phrases in a way that is acting within the phrase without affecting higher formal structures. In

example 5.9 adding the determiner *other* is a formal modification to the noun phrase *the part* [4]. It does not affect the sentence beyond that phrase level.

Example 5.9

```
or the p<BACKSPACE2>9 other part that include myself that doesnt
<BACKSPACE4> <BACKSPACE>s not em<BACKSPACE>njoy (E8-2)
```

Clause

Clause revisions are changes within a clause or at clause boundary, e.g. combining it with another clause as to make it part of a larger T-unit. Following is an example of within-clause revision.

Example 5.10

```
are not in high level <BACKSPACE22>5 34did <BACKSPACE3>35on't
a<BACKSPACE>36understand it as it (CS8-17)
```

T-unit

These are revisions made to the components of a T-unit (the term is explained in Footnote 2, p. 61). This includes changes to relationships between clauses of the same T-unit. Moreover, changes at T-unit boundary after a T-unit is complete, i.e. any attempt to add to it, combine it with another T-unit, or punctuate or re-punctuate it as a complete T-unit is also coded as a T-unit revision. In the following extract the writer put *and* to add to the T-unit that she had just finished, but then decided that she wanted to terminate the sentence instead. She backspaced *and,* and put a full stop.

Example 5.11

```
a<0.11.063>nd <0.09.453><BACKSPACE4>15.<0.05.844> forn
<BACKSPACE2> example  (CS1-2)
```

---

[4] By *part*, the writer probably meant *group/party*. Here is the extract from the final text: "but other people enjoy reading for fun more than a deep study of the materials, or the other part that include myself that does not enjoy reading at all and get no excitement or can't not really get into the story if its written"

[5] Semantic revisions are to do with the proposition of an utterance, regardless of whether this attention has resulted in a meaning change or not.

Text

Revisions to text result in moving, deleting and adding a minimum of one T-unit
around text. It also includes adding a title or an introduction, e.g. revision 33 in the
example below. In the midst of the writing activity, the writer went back (`mouse`
`event`) to the top of the document and added as a title: "*The Best Way to English*
Language".

Example 5.12

```
student<0.05.765>.<BACKSPACE>32 .<0.09.141><MOUSE EVENT>33
<0.28.484>th<BACKSPACE2>34<CAPITAL>t<CAPITAL>he
<CAPITAL>b<CAPITAL>est <CAPITAL>w<CAPITAL>at<BACKSPACE>y to
<CAPITAL>e<CAPITAL>nglish <CAPITAL>l<CAPITAL>anguag (E4-3)
```

Text-scope revisions include revisions to paragraphing. These include either separating
the content of a prewritten text by the <return> key, or backspacing a <return> action
to go back to the previous paragraph. Following is an example of the latter situation. At
the end of the first line the writer puts a full stop and, after a pause, attempted to start a
new paragraph, but then decided to go back and continue the previous paragraph.

Example 5.13

```
or any other cares<BACKSPACE>s about it<0.06.782>. <0.09.469>
<RETURN><MOUSE EVENT>6<BACKSPACE> , so <0.07.218><BACKSPACE5>7a
<BACKSPACE>8 (CS8-17)
```

The following table presents proportions of revision scopes of writers of the two
majors at the three academic levels.

Table 5.10 Distribution of revision scope (%)

	word		phrase		Clause		T-unit		Text	
	E	CS	E	CS	E	CS	E	CS	E	CS
Level 1	61	44	6	11	11	20	16.7	9	5.3	16
Level 4	50	50	9	16.7	12	16.7	12	0	5	16.7
Level 8	20	35.7	14	2	34	27.5	26	8.8	6	26

In all groups, except E8, the highest proportions of revisions are made to individual words. This is particularly clear in E1 group for whom 60% of their revisions were carried out at the word level. Revisions to chunks of text beyond the T-unit, on the other hand, were uncommon, especially in English majors. The highest proportion of text revisions were carried out by Computer Science majors in their eighth semester.

In developmental terms, global revisions, which signal skill in writing, have not undergone a remarkable increase along the levels. Revisions remain, to a high degree, local (at word and phrase levels), or intermediate (at clause and T-unit levels). The high proportion of clause and T-unit revisions in the E8 group reflect an ever persistent interest of English majors in syntactic structure.

5.3.5 Revision levels

Scope and level of revisions are related and sometimes one predetermines the other. For instance, all spelling revisions are done within the scope of the word. However, not all word-level revisions are spelling revisions. Some word-level revisions indicate syntactic or higher-level conceptual concerns. The following paragraphs list in detail revision levels that have been compiled during data analysis, with examples for each one. Following this, findings from revision level analysis will be summarized in a table. The proportions of the processing levels of revision in English and Computer Science groups at the three levels will then be presented graphically in pie charts.

Spelling

Spelling revisions should be distinguished from revisions to typographical errors (illustrated in examples 5.4 and 5.5 above). They reflect an awareness of spelling mistakes. Sometimes, such revisions result in successful correction. In example 5.14, for instance, the writer has finally spelled the word *actually* correctly after five amendments to it (all labelled as revision #16). In other cases spelling revisions produce another wrong spelling: in example 5.15 the writer is not certain if a letter *c* exists in the word *excellent,* and, after trying it in different locations before and after the *x*, she eventually leaves the word, wrongly spelled, without one.

Example 5.14

```
acua<BACKSPACE2>16tuall<BACKSPACE5>16ua<BACKSPACE2>16tu<BACKSPACE
2>16ut<BACKSPACE2>16tually (CS8-17)
```

Example 5.15

```
ec<BACKSPACE>9xellent<MOUSE EVENT><LEFT>c<BACKSPACE><MOUSE
EVENT>c<BACKSPACE><MOUSE EVENT>.(CS4-2)
```

Mechanics

These include revisions to punctuations and other mechanics. Whalen and Menard's (1995) interpretation of punctuation revisions as higher level operations was not very useful for the present data analysis, where almost all revisions to mechanics were found to be initiated by surface level concerns, and virtually none has affected the meaning of the text. This category also includes revisions to capitalization (example 5.16), and to the apostrophe in possessives and contraction.

Example 5.16

```
th<BACKSPACE2>34<CAPITAL>t<CAPITAL>he (E4-3)
```

Some apparently mechanical revisions, e.g. removing the space between the two morphemes 'with' and 'out', were included in the lexical revisions category. Unlike in L1 writers, such a change by an L2 writer is probably facilitated by knowledge of the lexical item as made of two morphemes (as opposed to two words) not by knowledge of the spelling. This is because both morphemes had been spelled out correctly in the first place.

Syntactic

Revisions at the syntactic level were defined (for the purpose of this study) as changes to sentence structure; or changes within morphemes, words (etc.) as responses to awareness of their grammatical function/location or relation to the surrounding elements. Such changes have been categorized as *grammar revisions* (e.g. Lindgren & Sullivan, 2006). In this study the term *grammar* was avoided because it covers a broader area than syntax does. It could include the grammar of mechanics (e.g. capitalization) which was put in a separate category.

In the example below, changing *live* to *life* appears to be a spelling correction, while in fact it is a correction to a grammatical category and falls into syntactic adjustment, i.e. the change reflects knowledge of the position and function of the word within the structure of the sentence.

Example 5.17

```
about the live a<0.08.453><BACKSPACE4>₁₁fe (CS1-2)
```

Relevant in this category are revisions made to word order in sentences, including phrase and clause structure. For instance, adding the optional *which* in the following example signals knowledge of an alternative syntactic structure of the relative clause "which they think they have enough information about".

Example 5.18

```
… on the things they thi<BACKSPACE7>7which they think (E8-
1)
```

Included in syntactic revisions are: amendments made to word inflection as a result of a word's position or relationship to other words (tense, aspect, and mood);

Example 5.19

```
help them to asset between<BACKSPACE10>et
betwee<BACKSPACE>en diffrent tradoff<0.05.609><MOUSE
EVENT><0.07.969><MOUSE
EVENT><0.09.906><BACKSPACE7>57,58chose amonf<BACKSPACE>g
diffrents possi<BACKSPACE5>desighn strategies (CS8-2);
```

adding a verb to an otherwise incomplete syntactic structure;

Example 5.20

```
because he famie<BACKSPACE>liar with all <0.05.094>computer
informa<LEFT34>57is (CS8-13);
```

replacing the post modifying clause "information related with the network" with a pre-modifier "network information"; and changing NP into a nominal clause (rev. 14, below) or a nominal clause into a prepositional phrase (rev. 15). All these revisions required syntactic knowledge.

Example 5.21

```
you <BACKSPACE4>You need to learn <0.10.405>how you can
ud<BACKSPACE>ns<BACKSPACE>derstand the
```

```
<0.26.504>14<BACKSPACE4>what is the deeper meaning that
the15<BACKSPACE8>of the writers
```

Semantic

Revisions at the semantic level are changes or modifications made to the proposition of an utterance. In example 5.18 adding the modifier "gradually" has altered the propositional content of the utterance, however slightly.

Example 5.22

```
from the simple <BACKSPACE6>17gradualy<BACKSPACE2>
lly<BACKSPACE2>ly from the simple to the deep<0.50.062>.(E4-3)
```

Included in the semantic category are substitutions at the lexical, phrasal, or clausal levels, even if there is not a significant change to meaning (example 5.23).

Example 5.23

```
14lit<BACKSPACE2>et <0.13.859>har <0.42.360>deel

w<0.05.235><0.24.093><BACKSPACE14>15open for her the clos doors

<0.09.656> (E1-5)
```

Lexical

Lexical changes were not included in the initial revision taxonomy because most changes to lexical items in the initial analysis were realized as either lexico-syntactic (i.e. the change reflects awareness of the function of the lexical item within the structure of a t-unit or a clause) or as lexico-semantic (i.e. the change was carried out to change meaning). This was also in line with Allal (2003) who included lexical and meaning revisions under one category, semantic. However, while compiling data, it has been observed that a number of revisions are neither lexico-syntactic nor lexico-semantic, yet they reflect writers' command of the English language diction, or their struggles with finding a word or between word choices. Example 5.24 below illustrates a lexical revision wherein the writer chose between two words that are (at least in the relevant context) related in meaning, i.e. *false* and *wrong*.

Example 5.24

```
it <0.06.250>understand false<0.17.656> <BACKSPACE5>23wrong
```

Discourse and textual

Discourse and textual revisions both affect the text beyond the T-unit. They reflect awareness of the text as a coherent linguistic and conceptual unit. Textual and discourse revisions indicate ability to step back from the immediate view of discrete propositions/T-units and see relations between parts of the text. The two terms are differentiated as follows.

Discourse

Discourse revisions indicate attention being paid to the global structure of text, mainly sequencing and linking. They probably reflect knowledge of how elements of the discourse fit together. The following revision was carried out by an eighth-semester English major (E8-1, Rev.58); (This revision is simplified in final text format to avoid the complexity of linear text format of this particular production).

Example 5.25

```
a. So my advice to those who just give spontaneous judgment
   not to do so.  because everyone have their interested
   (interests).

b. Everyone have their interested (interests). So my advice
   to those who just give spontaneous judgment  not to do
   so.
```

In the revision above there is no evidence that the writer was acting mainly at a syntactic level. The word order remained the same and the two clauses are re-juxtaposed with no consideration of punctuation or capitalization. Nor is there any change to the semantic content of the two clauses or of the relationship between them. The revision was clearly processed at the discourse level. The writer seems to have been concerned with which of the two clauses comes first (sequencing) and how they are linked (linking), regardless of the inaccuracy of punctuation in 25a. She is aware that when the causal clause comes first there becomes no need for the causal discourse marker "because". Accordingly the revision was categorized as a discourse-level revision.

In the following revision (5.26), moreover, the demonstrative pronoun *this* was used as a coherence device to link to information in the previous sentence. It is true that

syntactic knowledge was needed to replace it with the nominal clause. But what could have triggered the revision is that the writer might have decided to change the coherence device by removing the pronoun reference and using the nominal clause to refer to previously mentioned information.

Example 5.26

```
I disagree <0.07.207>with this  <0.06.084> <0.05.881>6<BACKSPACE5>
what they have<BACKSPACE2> d<BACKSPACE3>said (E8-ind.4)
```

It is useful to think of discourse revisions as the mechanical aspects of textual revisions. Discourse revisions look at formal structures of the text beyond the T-unit, and text revisions are concerned with content beyond the proposition of an utterance.

Textual

Textual revisions are modifications that are activated by awareness of the global content of the text. These include adding, removing and paraphrasing content. In the following example the writer, after starting a new paragraph, carried the idea back to the previous one.

Example 5.27

```
 <RETURN>an<0.19.984><BACKSPACE3>26then if she <0.08.672>have
 (E1–5)
```

Also textual revisions include changes within unfinished units (e.g. clause, T-unit) to alter the way writers choose to present information. In revisions 4 and 6 below voice was shifted from personal to general, within the scope of a T-unit.

Example 5.28

```
I need<0.06.687> <0.10.422><BACKSPACE7>4The special study in
computr<BACKSPACE>er makes alot of information and
<0.09.234>experince

I6<BACKSPACE>The study of computer in university (CS4-2)
```

Sometimes textual changes are followed by discourse arrangements.   In revision 29 below, for example, the writer finally decided that she would not add a textual item to the list which she had already started, although she had signalled the addition with

"and". In 30 she went back and rearranged the linking of the items so that the previous item is introduced with *he* as a termination to the list, she also removed the comma.

Example 5.29
```
and the <0.25.210>25<BACKSPACE9>.<MOUSE EVENT>26 <BACKSPACE>
and<MOUSE EVENT><BACKSPACE> h (E8-ind.4)
```

One of the problems that was faced during revision analysis is the distinction between revision and forward inscription in immediate revisions. Here is an example.

Example 5.30
```
In fax22<BACKSPACE>ct , these applications are programs
<0.20.297>.<0.27.734> <0.08.407>23<BACKSPACE2>where are
<0.09.500>somepeople <LEFT7>24 <RIGHT6> <0.13.187>25
<BACKSPACE22>. (CS8-1)
```

As observed online, revision 23 might not seem as a revision. It appears to be forward inscription. However, a closer look shows that the revision action reflects changing plans. The writer backspaced the full stop to expand the T-unit, in particular to modify the predicate *program*. Then the writer changed her mind about the expansion: this could be due to difficulty in generating content (some of the participants have reported deleting an expansion because they couldn't think of something else), or difficulty in formulating ideas into L2.

Example 5.30 shows how a related revision episode occurs in more than one action: deleting the full stop, and adding the relative clause (23), and removing the added relative clause (25). This revision can be seen as an unsuccessful attempt to modify the predicate "*programs*" within the T-unit.

5.3.6 A summary of coding

Analyzed within the dimensions presented so far, each of the revisions was coded so that its number (sequence of occurrence), its location (as proximity to the point of inscription), and its scope, level and effect on the text are all shown in a single code with symbols separated by commas only (no spacing). This is to facilitate feeding the list of codes into MS Excel worksheet for further analysis. Figure 5.10 below provides

an extract of a coded linear text (See Appendix 5 for a complete revision analysis sample). The following abbreviations were used:

1. Location of revision

Im. Immediate; **Prox**. Proximate; and **Dist**. Distant.

2. Scope of revision:

w. word; **np**. noun phrase; **vp.** verb phrase; **pp**. propositional phrase; **cl**. Clause; **TU**. T-unit; **bT**. T-unit boundary, **T**. text

3. Level of revision

sp. spelling; **mech**. mechanics; **synt**. syntactic; **sem**. semantic; **txt**. textual

4. Effect of revision

fm: formal, **conc**: conceptual

<MOUSE EVENT><MOUSE EVENT><BACKSPACE>c <BACKSPACE> <MOUSE EVENT><0.13.875>. <CAPITAL>i<CAPITAL>t <0.08.156> <0.12.047>give the rirls <0.06.031>more in<0.05.391>formation <0.10.438>**9**<MOUSE EVENT>	9,prox,w,typo,fm
g<0.09.125><MOUSE EVENT>**10**to<MOUSE EVENT>	10,prox,np,synt,fm
a<BACKSPACE>about the live a<0.08.453><BACKSPACE4>**11**	11,prox,w,synt,fm
fe and <0.27.844>seve girle <0.19.813><MOUSE	12,prox,w,sp,fm
EVENT>**12**a<MOUSE EVENT><MOUSE EVENT><0.12.6O9>from the	13,im,w,sp,fm
fute<0.06.672><BACKSPACE>**13** er .<BACKSPACE4>**14**uer	14,im,w,sp,fm
a<0.11.063>nd <0.09.453><BACKSPACE4>**15**.<0.05.844> forn <BACKSPACE2> example <0.10.969>girle a<0.05.032>ter <0.07.562>study <0.08.016>, she	15,im,bT,txt,conc
ca<0.06.578><MOUSE EVENT>**16**f<MOUSE EVENT><MOUSE EVENT>n<BACKSPACE2>n ~~go to the~~ <0.09.625><MOUSE	16,prox,w,sp,fm
EVENT>**17**get <BACKSPACE>a gop <BACKSPACE2>**18**b and she	17,im,TU,sem,conc,mp
<0.40.781>have th<BACKSPACE15>**19**. <0.56.187>she	18,im,w,sp,fm
<BACKSPACE4>**20** <CAPITAL>i<CAPITAL>n<BACKSPACE3>**21**	19,im,TU,T,conc,mp
<CAPITAL>i<CAPITAL>n many c<0.07.563>antery	20,im,S,sem,conc,
girle<BACKSPACE>**22**s can <0.06.406><0.07.312>	21,im,S,mech,fm
<BACKSPACE4>**23**have	22,im,w,sp,fm

Figure 5.10 Revision analysis sample sheet (CS1-2)

5.3.7 Development in revision levels

The proportion of each type of revision to the total number of revisions was calculated. A fairly systematic development was observed in both groups in the proportion of level of language processing. Table 5.11 (below) presents occurrences of revisions at different processing levels.

In their first semester, participants of both majors demonstrate a notable preoccupation with spelling. E1 group have the highest proportion of spelling revisions, but this decreases gradually up the levels to the advantage of syntactic and semantic revisions which both record their highest levels in E8.

Unexpectedly, revisions to the global content and to text structure have remained minimal in English groups at all the three levels, but Computer Science groups have shown better attention to textual concerns in their eighth semester.

To graphically visualize the differences between the groups in the underlying levels of mental processing of revisions; as orthographic, structural or conceptual encoding; and whether revisions were motivated by local or global concerns, they were grouped into five categories. Spelling and mechanics revisions were labelled *inscription revisions*; lexical, syntactic and semantic revisions remained discretely treated; and revisions that reflect textual and discourse concerns were considered one group (on the basis that they reflect concern for the text as a global unit) and were labelled *textual.* Pragmatic revisions are not included in the pie charts because they have not appeared in the revision strategies of E1, and they are not common in the other groups. Figure 5.11, below, shows proportions of revision levels according to the modified taxonomy.

Table 5.11 Distribution of revision level

|		Spelling		Mechanic		Lexical		Syntactic		Semantic		Discourse	
		E	CS	E	CS	E	CS	E	CS	E	CS	E	CS
Level 1	%	43.36	46.85	14.16	9.91	9.73	5.41	7.08	11.71	12.39	10.81	6.19	0.90
	n.	49	52	16	11	11	6	8	13	14	12	7	1
Level 4	%	36.44	40.20	23.73	12.75	5.93	12.75	9.32	8.82	7.63	9.80	9.32	2.94
	n.	43	41	28	13	7	13	11	9	9	10	11	3
Level 8	%	14.89	25.83	10.11	5.17	9.04	8.86	19.68	13.65	17.02	19.93	10.11	5.17
	n.	28	70	19	14	17	24	37	37	32	54	19	14

Table 5.11: Continued

|		Textual		Pragmatic		unidentified	
		E	CS	E	CS	E	CS
Level 1	n.	7.08	11.71	0.00	2.70	5.83	8.26
	%	8	13	0	3	7	10
Level 4	n.	5.93	9.80	1.69	2.94	14.49	7.27
	%	7	10	2	3	20	8
Level 8	n.	14.89	18.45	4.26	2.95	5.53	4.91
	%	28	50	8	8	11	14
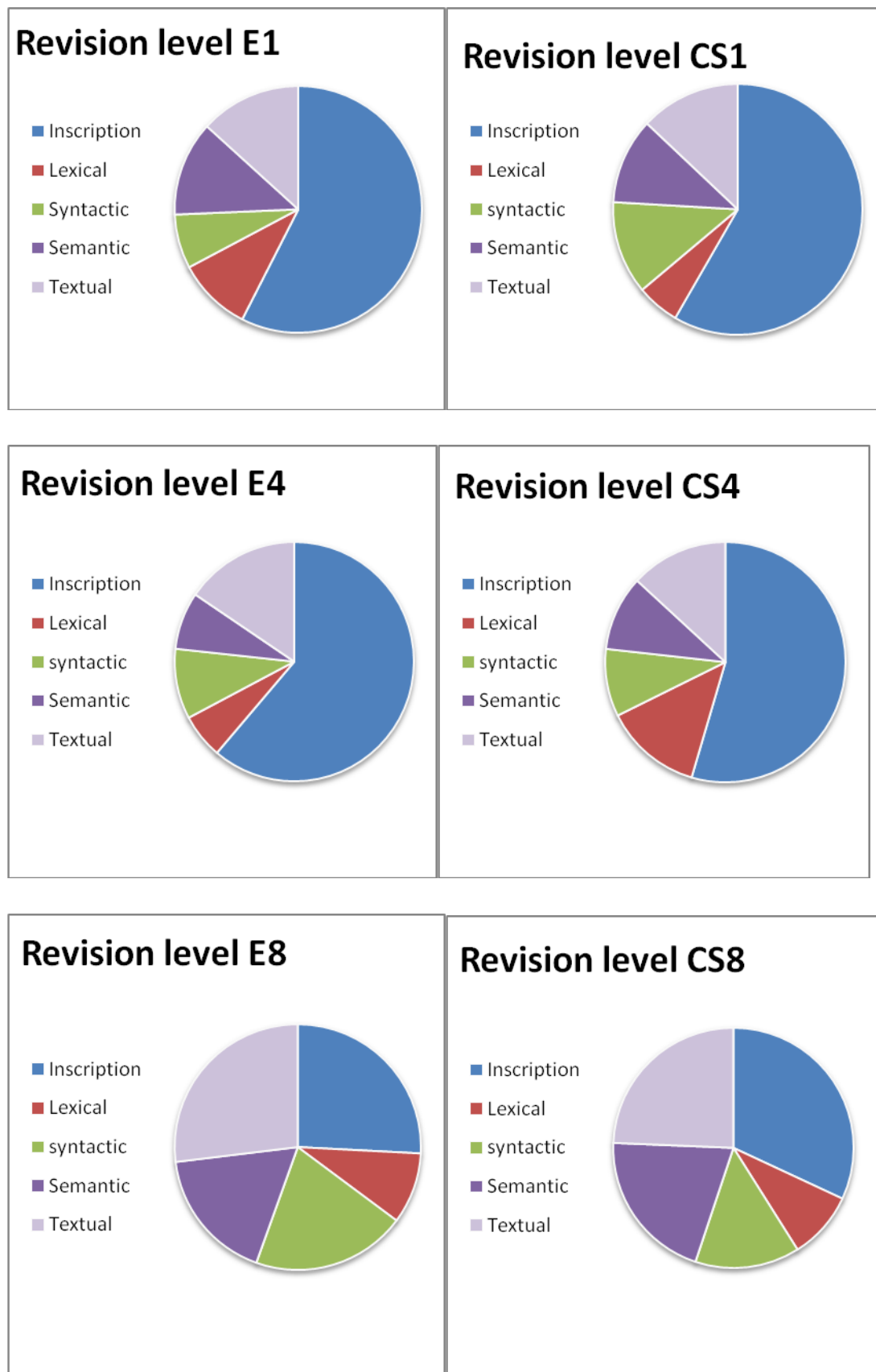
Figure 5.11 Relative distribution of revision levels in each group

5.4 Conclusion

This chapter has reported on the findings of the analysis of writers' keystroke behaviour. It presented quantitative evidence for development of fluency, and it demonstrated and exemplified revision analysis and coding at different dimensions.

As was expected, the English group has demonstrated a systematic pattern of maturation in terms of fluency of production. The average amount of produced text and the rate of production have more than doubled; and text span mean length has increased sevenfold. It seems that, in their final semester, English majors have achieved a considerable improvement in their ability to access and process larger chunks of language structures.

The Computer Science group has also shown differences along the levels, but these have not followed systematic patterns. For example, the rate of production in CS4 exceeds that of CS8, and the text span length is not considerably higher at the eighth level.

CS4 seems to deviate from this general developmental trend in all measures of fluency; on average CS4 participants have exceeded both CS8 and E4. But E8 remained the superior group, which lends support to the assumed benefits of intentional language learning experience that English majors go through.

The multidimensional analysis of revisions resulted in somewhat similar findings. It was assumed that participants of both majors will differ in the proportion of attention to form and content but the English group will be less concerned with form as they advance up the college levels because they should have quicker and more automatic access to linguistic knowledge. It was not very surprising, however, to find out that both groups at all levels demonstrated a strikingly higher attention to form than content with almost all of them (except CS4) recording a form revision proportion of over 70%. This result echoes a much acknowledged attribute of L2 writers: focusing on form at the expense of content. This is because L2 writers are often "unable to step back from the written text and test its adequacy against their pragmatic objectives" (Matsuhashi, 1987, p.404). In other words, being occupied by the surface structure hinders high-level revisions.

Frequency of revision has shown systematic development which meant a notable decrease in revisions as we go up the academic levels. This decrease is more apparent in the English group. This decrease in the frequency of revisions in all the groups fits into the developmental model that has been hypothesized in this study. However, there are no notable differences between the groups in terms of locations of the revisions. The particularly high proportion of immediate revisions amongst all the groups suggests either that L2 writers realize their mistakes immediately, perhaps because they are too conscious about correctness, or that they perceive writing as a linear activity and fail to exploit the writing mode as a recursive and a modifiable one. This supports other claims (e.g. Thorson, 2000) that foreign language writers lack enough interaction with their writing as to move around text and make revisions to distant parts from the immediate point of composing.

 Revision level analysis revealed systematic shifts in the level of knowledge that activates and/or facilitates revisions. These shifts signal maturation (although a relative one) in the trade-off between attention to form and attention to concept; and between local and global concerns. For one thing, there is a notable diminution in attention to spelling in the senior writers of both subject areas; and an increase in syntactic and/or semantic concerns. In addition, as we go up the academic levels, we see relatively more balanced distribution of revision processing.

Chapter Six: Writers' Immediate Recall and Text Assessment

6.1 Introduction

Chapter Five has laid out the analyses of the quantitative data on fluency measures (including pause) and revision behaviour (frequency, location, level and effect), and presented the quantitative findings. These have been obtained mainly from the log files for each writing activity as well as from a thorough examination of the writing sessions as they unfolded in the playback scenarios.

This chapter will present data from two more data sources. The first data source to deal with in this chapter is participants' own perceptions of their writing strategies and concerns. After they had completed their writing, all participants answered a set of questions, which aimed to encourage immediate recall of some of the writing strategies they had employed in their writing and to test their awareness of other aspects of the process. Data from the Questions for Immediate Recall (QIR) were compiled to test planning, involvement with task and audience, and priorities writers gave to linguistic, textual and contextual concerns of writing.

As well as the immediate recall accounts (QIR), the chapter will present data from another source; that is of text assessment. All 93 texts were assessed by two experienced ESL/EFL raters who have had a sound experience in rating texts written by learners of English as a second/foreign language. Results of their assessment of five text features were quantified and correlated with measures from keystroke analysis as well as with measures reported in QIR.

In the third section of the chapter, quantitative data of the three sources will be correlated to find out possible relationships amongst the writing process, writers' awareness and assessors' judgment on textual features (i.e. text quality).

6.2 Writing strategies reported in QIR

Data from QIR will answer parts of the research questions that are mainly concerned with writers' awareness and concerns. This includes five research variables: general

planning pattern, involvement with task, awareness of audience, a writer's role, and attention to linguistic, textual and contextual aspects of the writing activity. Two research sub-questions have been considered for this purpose[6].

RQ1c Does writing in English as a foreign language of university students majoring in English Language and Literature and in Computer Science demonstrate an identifiable developmental pattern along university levels, in terms of writers' awareness of their composing strategies, their linguistic, conceptual and contextual concerns, and their perception of their role as writers?

RQ2c Does writing in English as a foreign language of university students of the two majors develop differently along university levels in terms of writer's awareness and concerns?

Two hypotheses were formulated to guide the discussion of the data and the analysis:

H1c It is predicted that writers of both subject areas (English and Computer Science) will demonstrate development at different levels of tertiary education in terms of their awareness of their composing strategies, their linguistic, conceptual and contextual concerns, and their perception of their role as writers.

H2c It is predicted that writers of the two different subject areas will develop differently along the levels in terms of their perception of their composing strategies, their linguistic, conceptual and contextual concerns, and their perception of their role as writers.

6.2.1 Writers' reports on planning

The first few questions in QIR were aimed at eliciting responses from participants on the way they perceive their writing strategies to be in terms of broad meta-cognitive skills: planning, focus on task and audience awareness. Planning was measured on a four-level rank order scale that ranged from zero (if writers reported no planning at all) to three (if they reported initial global planning). Between these are sentence and paragraph planning, scored as 1 and 2 respectively. This is to show whether or not writers carry out their writing task with a global view of the text as a whole.

The following graphs show proportions of writers who reported each planning strategy in English-major groups (Figure 6.1) and Computer Science groups (Figure

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[6] Within RQs 1&2 the four main variables were numbered as **a** (for fluency), **b** (for revision strategies), **c** (for writers' reported awareness and concerns), and **d** (for text quality). Only variables relevant to the discussion in the different sections will be stated in RQs.)

6.2). Generally, no systematic patterns have been observed in planning strategies, except where Computer Science groups demonstrate a remarkable and systematic decrease in 'Sentence planning' and a systematic increase in 'No planning' strategies as we go up the levels. In the latter measure the proportion of Computer Science writers who reported 'No planning at all' displays a dramatic increase from 0% in semester 1, to 5.6 % in semester 4, and 47.4% in semester 8. This stands in contrast to what one would assume about students developing a sense of how the text will be structured as they advance in academic levels. Moreover, reporting 'Whole text planning' was very uncommon in Computer Science groups with only 5.6% of writers from one group (CS4) reporting such planning. To further demonstrate a non-developmental trend in planning strategies within the population of the study, E1 participants reported the highest rate of 'Whole-text planning' while E8 group reported 'Sentence planning' at a notably high proportion, which is second only to that of CS1. This cannot be easily explained in developmental terms.
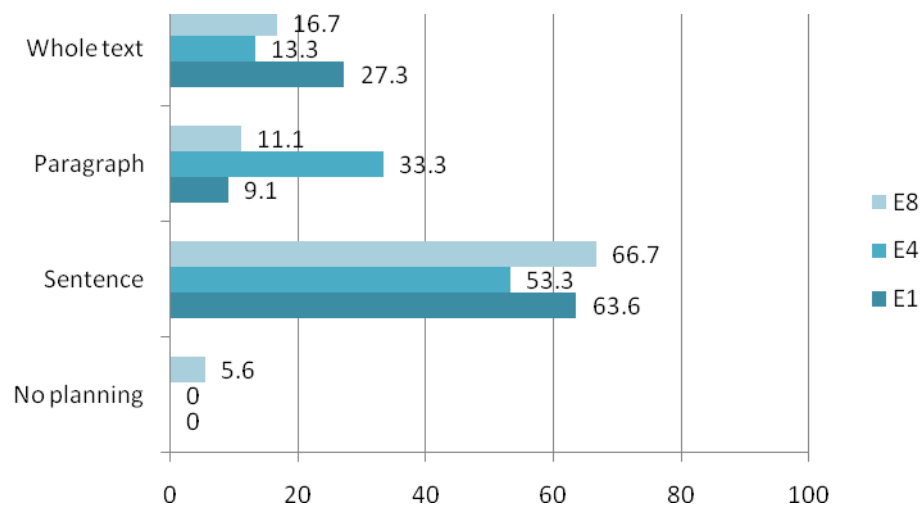

Figure 6.1 Planning strategies as reported by English participants (%)

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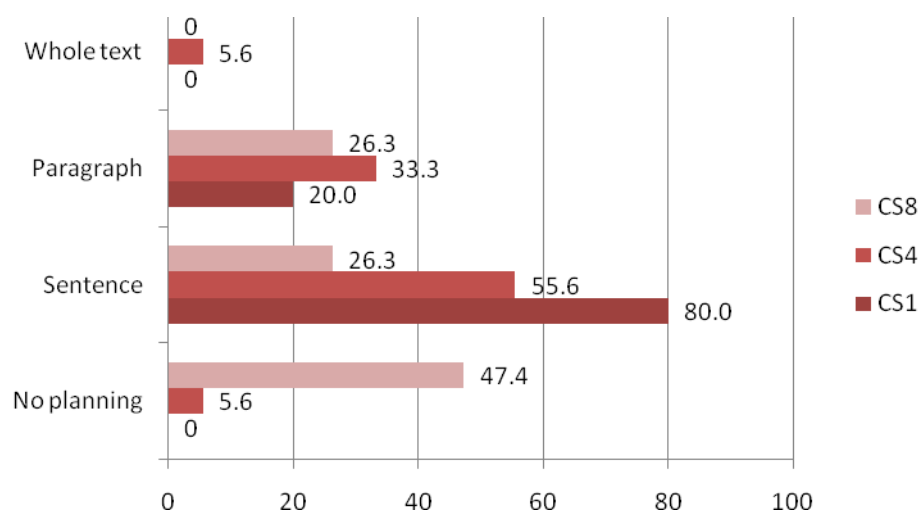
Figure 6.2 Planning strategies as reported by Computer Science participants (%)

6.2.2 Writers' reports on focus on purpose and audience

Focus on propose of writing was tested by two measures in the QIR. First participants were asked about how often they had referred to the writing prompt during the session. They chose between 'Only once before starting,' 'One or two more times during writing,' or 'Frequently during writing'. The second measure was writers' accounts on how much attention they had given to the task. Responses to this measure were meant to vary from 'Losing focus on task from the start' to 'Focusing on task all the time,' with 'Focusing on task at the beginning only' in between. Proportions of participants in both measures are shown in Tables 6.1 and 6.2.

Table 6.1 Participants' reports on frequency of reading the task prompt (%)

	Once		Twice or three times		Frequently	
	E	**CS**	**E**	**CS**	**E**	**CS**
Level 1	9.1	20	63.6	20	27.3	60
Level 4	33.3	11.1	33.3	72.2	33.3	16.7
Level 8	5.3	15	63.2	30	26.3	50

Table 6.2 Participants' reports on focus on the writing task (%)

	Focused on task all the time		Focused on task at the beginning only		Lost focus on task from the start	
	E	**CS**	**E**	**CS**	**E**	**CS**
Level 1	36.4	50	54.5	40	9.1	10
Level 4	73.3	50	13.3	50	13.3	0
Level 8	50	70	27.8	15	21.1	10

Figures in the tables above suggest no systematic patterns of change along levels or across subject areas on how often writers referred to the task prompt or how much attention they gave to the writing task. However, differences between the groups can be detected. For example the highest proportions of participants who reported 'Focus on task all the time' are found in groups E4 and CS8. In addition, 'Losing focus on task from the start' was minimally reported by all groups, with no report what so ever of such a plot in group CS4.

Similarly, accounts of attention to audience (results shown in Table 6.3 below) revealed no developmental patterns in either the English groups or the Computer Science groups. On the contrary, the highest incidence of 'Constant audience awareness' was found in the first-semester Computer Science majors.

Table 6.3 Participants' reports on considering audience (%)

	No audience awareness		Occasional consideration of audience		Constant audience awareness	
	E	**CS**	**E**	**CS**	**E**	**CS**
Level 1	27.3	10	63.6	40	9.1	50
Level 4	26.7	44.4	53.3	44.4	20	5.6
Level 8	52.6	30	42.1	45	0	20

6.2.3 Concern for linguistic, textual and contextual aspects of writing

Students varied in terms of ordering their concern for the linguistic, textual and contextual aspects of writing. An overview of the order of importance that students gave to the different aspects is presented in Table 6.4.

Table 6.4 Groups' order of priorities in writing as reported in QIR

E1	CS1
Lexis	Task
Content	Syntax
Task	Content
Syntax; Text structure	Lexis
Audience	Text structure; Audience
----------	------------

E4	CS4
Text structure	Task
Task	Audience
	Content
Syntax	Lexis
Lexis	Text Structure
	Syntax
Content; Audience	

E8	CS8
Text structure; Task	Task
Syntax	Lexis
Audience	Text structure
Lexis	Content
Content	Audience
-----------	Syntax

Concerns of all the groups have shifted in varying degrees along the academic levels. A developmental pattern can be detected in some of the variables. In particular, attention to text structure, as opposed to sentence structure, has gained higher priority by E8 and E4 groups. However worrying over the language structure of sentences remains high in both groups. English-major students might have been consistently reminded of issues of correctness through instruction in the English Language Department, and this was reflected in promoting worries over the grammaticality of sentences. Contrary to this, Computer Science majors start with more concern over syntax but as we go up the academic ladder, they seem to lose interest in that to the benefit of audience and lexis. This was not surprising, especially in the absence of instructional emphasis on form correctness in the foreign language. Addressing the

task continues to be the first priority for Computer Science students of all levels. It also gains a similar status with level-eight English majors.

6.2.4 Writers' role

The final variable in participants' immediate report (QIR) was their perception of their role as writers. They were asked to choose amongst three roles which are restated here:

1. Because the writing task was set for a research purpose in English language, my main concern was finding the correct structure and appropriate words (to reflect my English language skills).
2. My main concern was to present the information that I know about the topic by means of what I know about my field of study.
3. My first concern was to convince the reader of the extent to which the given situation is untrue (or true).

According to the knowledge-telling/knowledge-transforming developmental paradigm adopted in Chapter Three (3.2.3.2), the second and third choices correspond to the roles of a *knowledge-teller* and a *knowledge-transformer* respectively. For the purpose of this study, the Knowledge-transformer role will be labelled as 'Communicator' because this role implies a great deal of emphasis on audience awareness (Scardamalia and Bereiter, 1987). The role represented in the first choice was specially proposed for the context of the study to probe for an assumed foreign language learners' perspective of the act of writing. Writers from the general population, of which samples of the study have been obtained, have been observed as handling the act of writing in the foreign language as a language exercise, i.e. as an opportunity to display knowledge of English. Table 6.5 (below) shows changes along the academic levels in the proportions of participants who have reported such a role. The table displays a notable systematic decrease in the *Language-learner* role in English majors as we go up the university levels. This was met with systematic increases in the *Knowledge-teller* and *Communicator* roles. Computer Science majors on the other hand show a systematic increase in their perception of their role as knowledge-tellers, a salient drop in the Communicator's role in eighth semester; and an unsystematic change in their perception of their role as *Language learners*.

Table 6.5 Participants' perceptions of their role in writing (%)

	Language Learner		Knowledge teller		Communicator	
	E	CS	E	CS	E	CS
Level 1	63.64	40.00	18.18	20.00	18.18	40.00
Level 4	33.33	11.11	33.33	50.00	33.33	38.89
Level 8	5.26	25.00	36.84	60.00	52.63	10.00

The following two graphs (Figures 6.3 & 6.4) compare responses of the participants of the two majors to the question on perceived writer's role.
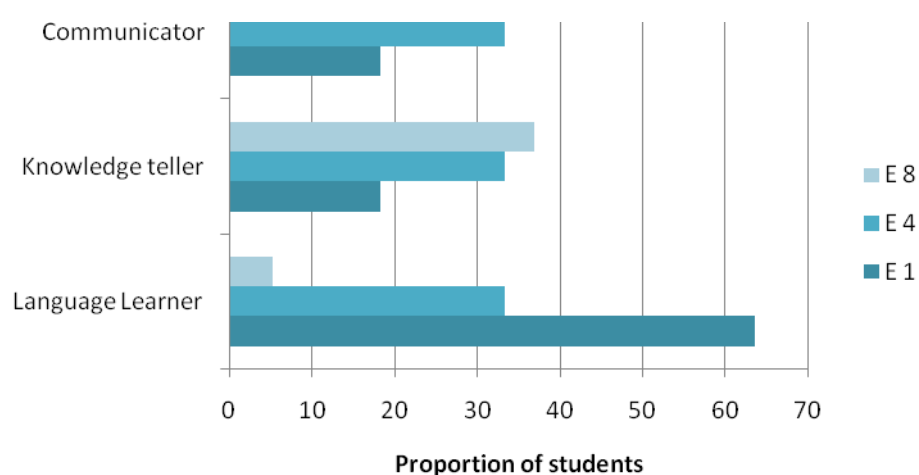
Figure 6.3 English participants' perception of their role in writing
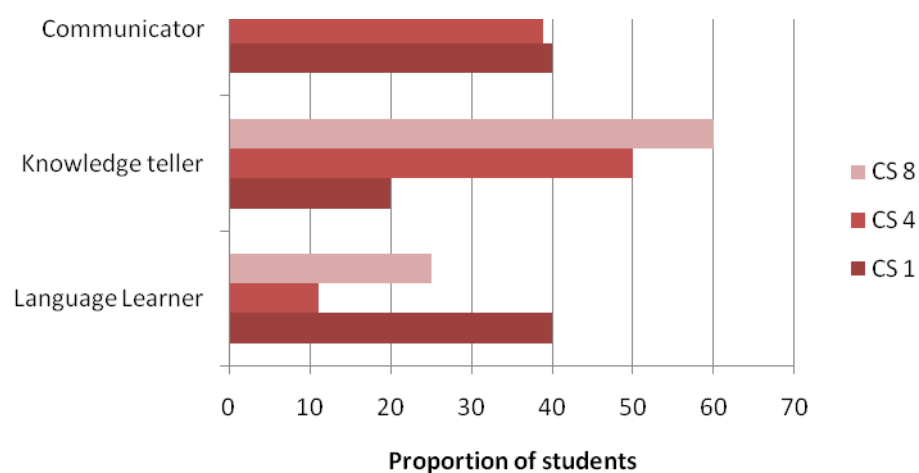
Figure 6.4 Computer Science participants' perception of their role in writing

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Since a general developmental pattern can be observed, at least in the English groups, differences between the levels and groups were tested for statistical significance. First a two-way ANOVA was run to test the influence of subject area and level of study, the combination of factors proved to have a significant effect on writers' perceptions of their role in the act of writing (p= .007)[7]. Moreover, one-way ANOVA (post hoc, LSD) was run to capture significant differences between the groups along the academic levels and across subject areas. English majors have shown developmental changes in their perception of their role as writers. As we go along the academic levels more writers see themselves as communicators and less as language learners (F=2.567, p= .007). Computer Science writers did not display statistically significant development along the levels. The graph below shows the two different patterns of change in English groups (E) and Computer Science groups (CS).
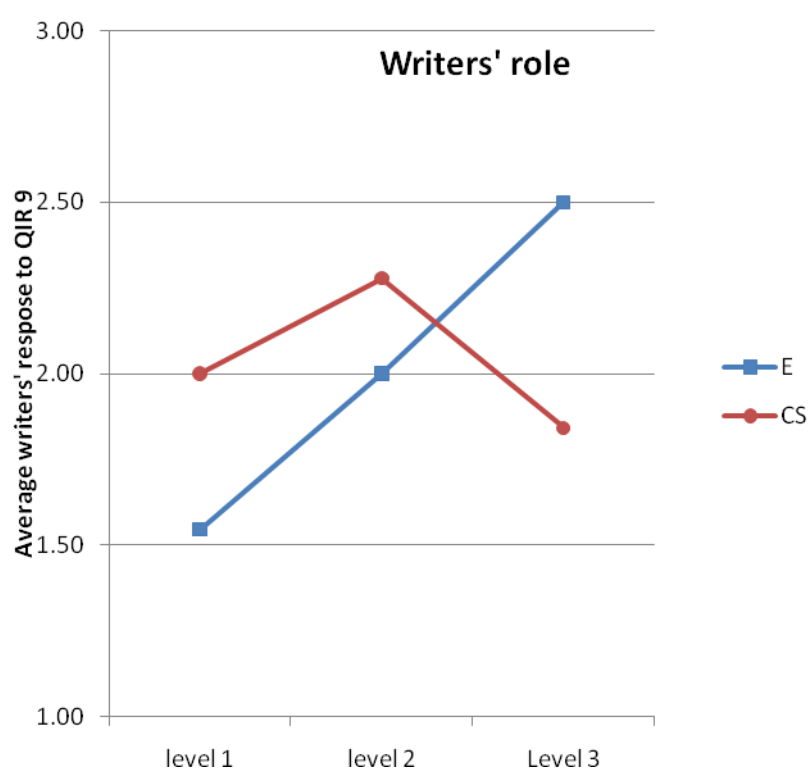
Figure 6.5 Participants' perception of their role in writing

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[7] It is important to note here that the Analysis of Variance assumes equal distances between the three points in the variable's scale of order. Since this is not necessarily the case in the 'writes' role' variable, and to avoid misleading results, sensitivity tests were run using a number of different values ... (while maintaining the ordinal nature of the variable), and they showed no differences in the significance of the results.

6.3 Text assessment

Texts that participants produced were assessed by two independent raters. The assessment scale (which ranged from 1 as a lowest possible score to 6 as a highest possible score) was adapted from three scoring guides: 'Test of Written English (TWE), NWREL, and Nevada's Writing Assessment Scoring Guide. Nevada's Writing Assessment Scoring Guide was particularly useful in defining levels within the measures. One of the main characteristics of the scale is its discriminative power in measuring maturation in writing across academic levels. Accordingly, the wording of the traits was maintained at a close resemblance to Nevada's scoring guide. Text features that have been assessed are:

- Fulfilment of the Writing Task (FT).
- Development and Organization (D&O).
- Audience Awareness (AA).
- Variety of Structure and Diction (S&D).
- English Grammar and Usage (G&U)

The degree of agreement between raters was fairly strong (Cronbach's alpha): .76 in Task Fulfilment; .77 in Development and Organization; .64 in Audience Awareness; .96 in Variety of Structure and Diction; .81 in English Grammar and Usage; and .78 in the overall Average Quality of Text (all significant at the 0.01 level, $p < .001$). An average score for the two raters' evaluations was calculated for each criteria and for the overall quality average. Data from assessment have answered the following sub-questions:

RQ 1d Does the quality of texts written by university students majoring in English Language and Literature and in Computer Science improve along university levels?

RQ 2d Does the quality of texts written by university students of the two majors display different patterns of improvement?

Hypothesis 1d

The quality of texts written by university students majoring in English Language and Literature and in Computer Science may improve along university levels.

Hypothesis 2d

The quality of texts written by university students of the two majors may display different patterns of improvement.

The results of the assessment of all text features and the overall text quality are shown in Table 6.6 below.

Table 6.6 Assessment of average quality of text features in all groups (out of 6)

	Task fulfilment		Development & organization		Audience awareness		Structure and diction		Grammar and usage		Average text quality	
	E	CS	E	CS	E	CS	E	CS	E	CS	E	CS
L 1	2.38	2.8	2.14	2.65	1.68	2.55	1.68	2.5	1.82	2.7	2.51	2.79
L 4	2.33	1.83	2.43	1.58	3	2.14	3	1.94	3.27	2.28	2.81	1.96
L 8	3.02	2.73	3.08	2.48	3.55	2.8	3.5	2.75	3.47	2.7	3.20	2.53

A general reading of the table above identifies English majors at their eighth level as superior to all the other groups in all assessment measures. Compared to the freshmen of the same major, they have improved by 26.9% in task fulfilment (T-test statistics= 2.476, p=.02), 43.93% in development and organization (T-test statistics= 3.56, p=.001), 90.66% in Grammar and usage (T-test statistics= 5.714, p<.001), and their scores both in audience awareness and in variety of language structure and diction have increased by more than two-fold (108.33%) (T-test statistics= 5.904 & 6.527 respectively, p< .001 for both measures).

Moreover, eighth-semester English majors have also outperformed their peers in Computer Science by at least 27.27% in all measures except in the aspect of Task Fulfilment whereby they have achieved a score that is only 10.62% higher. In fact task fulfilment proved to be the easiest to achieve of all the quality criteria, with a total average of 2.55 out of six for all groups.

The following graph (Figure 6.6) shows the relative position of the groups in the quality scale as well as the relationships between the scores in the five assessment criteria. The graph shows vividly an absolute lead of the senior English majors in all quality measures. This is followed by the other groups showing some degradable levels but exchanging positions in some of the measures.
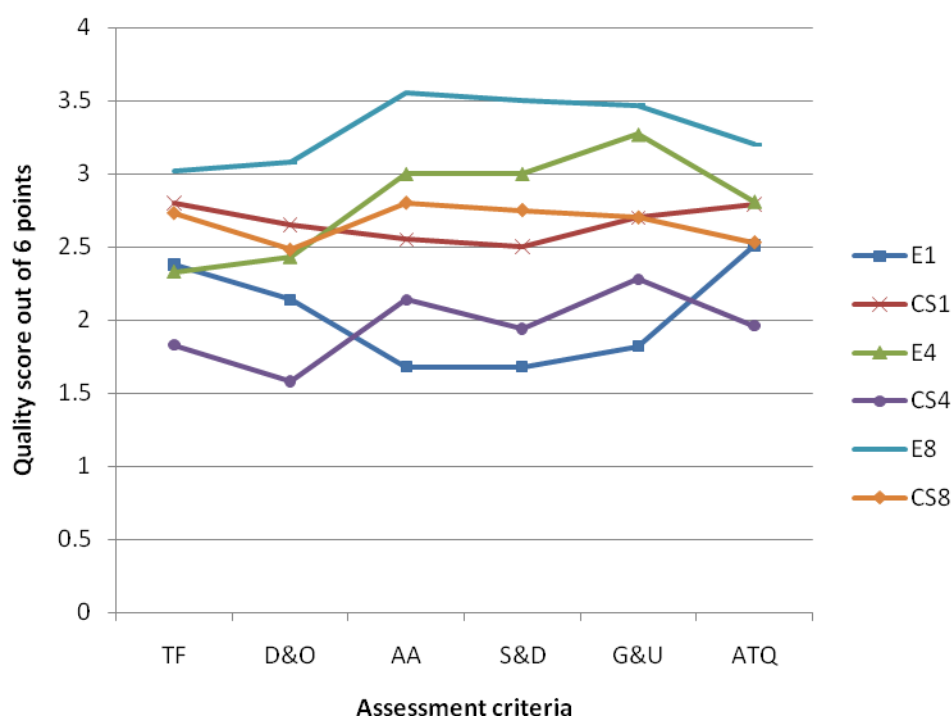
Figure 6.6 Group results in Text assessment of all measures

TF (Task Fulfilment), **D&O** (Development and Organization), **AA** (Audience Awareness), **S&D** (variety of Structure and Diction), **G&U** (Grammar and Usage), and **ATQ** (Average Text Quality)

Table 6.7 below presents average scores (out of possible six points) for each group in every measure of quality ordered according to the level of achievement in each quality trait (one is lowest and 6 is highest). Therefore, the table demonstrates a rank order of groups' achievement in the different measures of text quality.

Table 6.7 Rank order of groups' achievement in all measures (out of six)

Order	TF	D&O	AA	S&D	G&U	TQ
1	**CS4** (1.83)	**CS4** (1.58)	**E1** (1.68)	**E1** (1.68)	**E1** (1.82)	**CS4** (1.96)
2	**E4** (2.33)	**E1** (2.14)	**CS4** (2.14)	**CS4** (1.94)	**CS4** (2.28)	**E1** (2.51)
3	**E1** (2.38)	**E4** (2.43)	**CS1** (2.55)	**CS1** (2.5)	**CS1** (2.7)	**CS8** (2.53)
4	**CS8** (2.73)	**CS8** (2.48)	**CS8** (2.8)	**CS8** (2.75)	**CS8** (2.7)	**CS1** (2.79)
5	**CS1** (2.8)	**CS1** (2.65)	**E4** (3)	**E4** (3)	**E4** (3.27)	**E4** (2.81)
6	**E8** (3.02)	**E8** (3.08)	**E8** (3.55)	**E8** (3.5)	**E8** (3.47)	**E8** (3.2)

The relative position of the groups was calculated by weighing their achievement in all assessment criteria. For each group, the rank numbers they have achieved in each criterion were added up. For example, E1 achieved 3 in TF, 2 in D&O, 1 in AA, 1 in S&D, and 1 in Q&U; that is 8 in total. Accordingly, the general order of the groups

from lowest to highest came up as follows: E1(8), CS4 (8), CS1 (19), E4 (20), CS8 (20) and E8 (30). The scores achieved by the groups have placed them in a three-rank scale that comprises (1) a Superior group: English majors in their eighth semester; (2) a Medium groups: Computer Science majors of both the first and eighth semesters, and English majors in their fourth semester; and (3) a Low group: Computer Science in the fourth level and English majors in their first semester. It is not very surprising for CS1students to perform considerably better that their peers in E1. As mentioned in Chapter Four (4.2.1), this is probably because at high school Science students (as opposed to Arts students) have better motivation to learn the foreign language because of its importance in college studies and future jobs. Moreover, CS1 outperformed their seniors in CS4 and performed at a level comparable to the CS8 group.

English majors thus represent a developmental pattern by going from low to middle to superior ranks (as we go up the academic scale) in all the assessment criteria except in Task Fulfilment, where E1 and E4 swap positions by a very small difference. Computer Science groups on the other hand have unexpectedly shown a different pattern of change. CS1texts maintained higher ranks in each of the measures than did CS4 texts, starting in the third position (in Audience Awareness, variety of Structure and Diction, and Grammar and Usage), and reaching up to the forth rank in (average Text Quality) and fifth rank in (Development and Organization). CS4 texts, on the other hand remained in the lowest or second lowest ranks across all measures. The graphs in Figure 6.7 visually illustrate the systematic development of English-major writers, and the consistent drop of quality in CS4 texts in all quality measures.
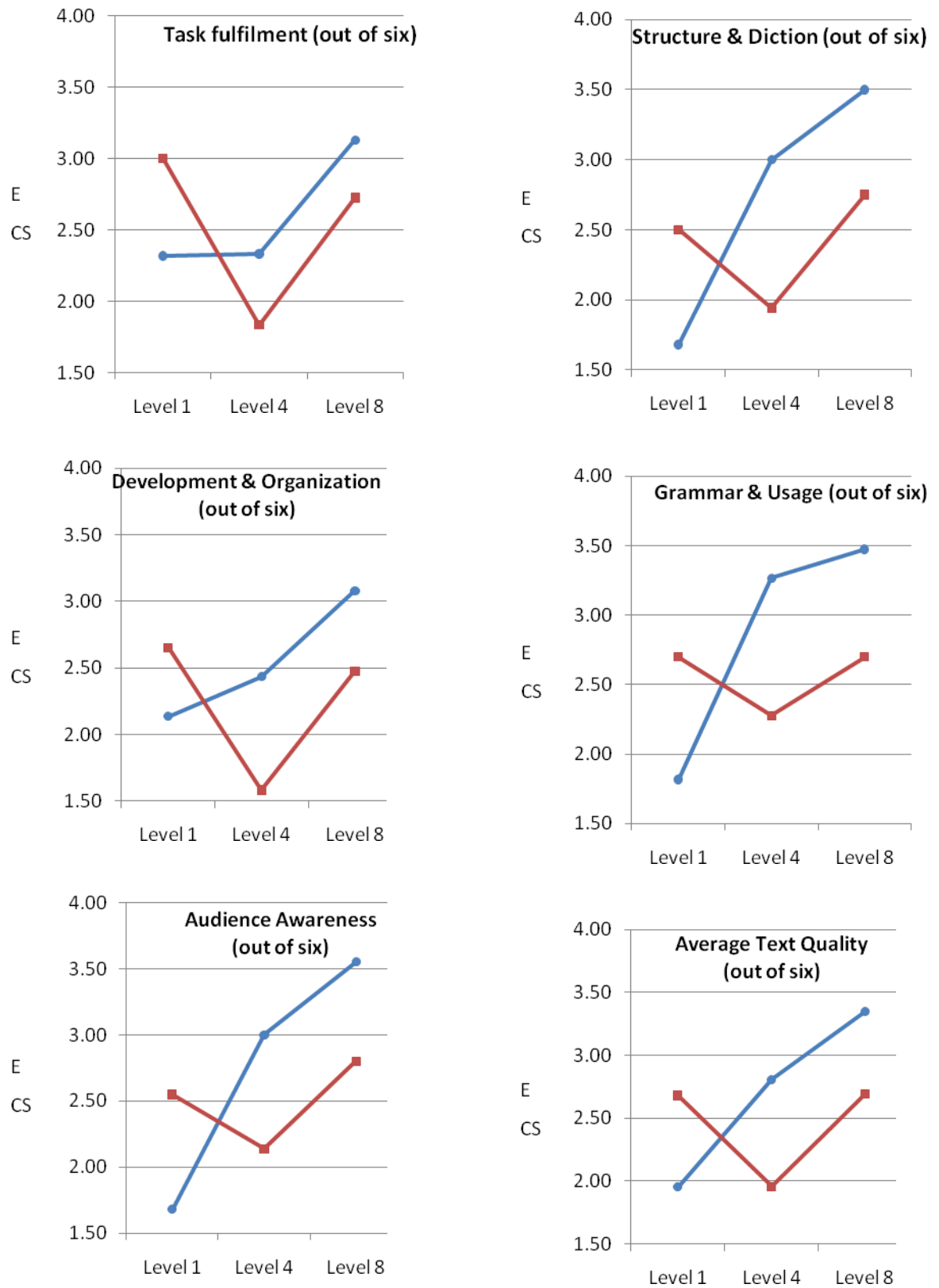
Figure 6.7 Development patterns in all text criteria

(vertical axis show average scores out of 6)

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6.4 Correlation amongst the variables

The study investigates development in student writing by means of one main inquiry (keystroke behaviour) and two secondary tools (writers' report of their own strategies and concerns, and text assessment). The following figure (adapted from Figure 4.6) depicts the three areas of quantitative inquiry, without suggesting relationships between the data elicitation tools yet.
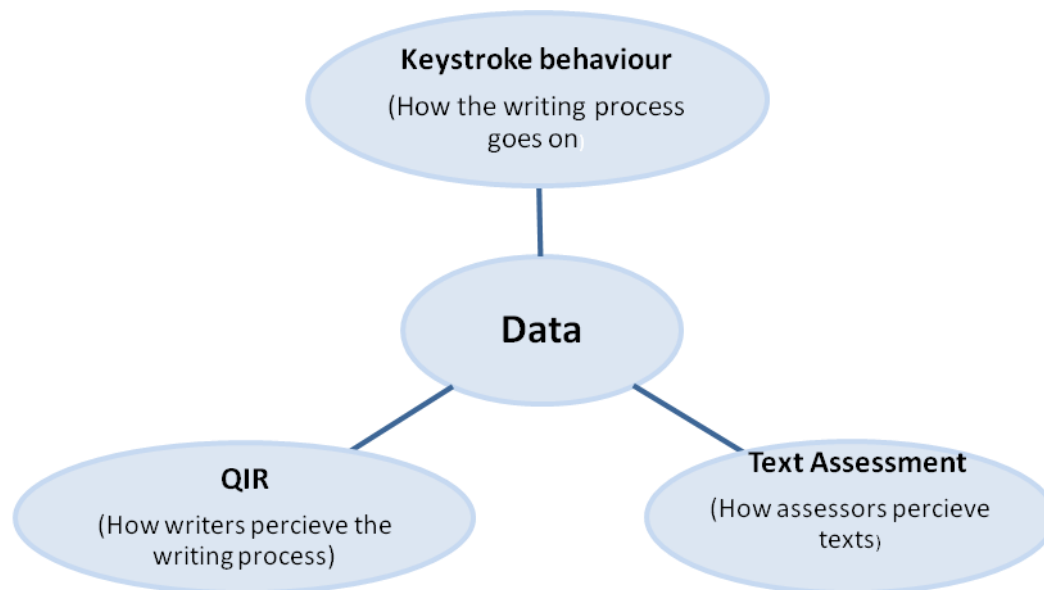
Figure 6.8 The domains of the quantitative inquiry

Correlations between pairs of related variables across the three main data resources were run to test possible relationships amongst participants' writing behaviour, their perception of their strategies and concerns and textual features as assessed by independent raters. Correlating the variables was aimed to answer Research Question 3. Two sub-questions have been driven from the original RQ3.

RQ3a Can variation in text quality be explained in terms of patterns of fluency, pause behaviour and revision strategies?

RQ3b Can variation in text quality be explained in terms of patterns of attention to linguistic, textual and contextual aspects of writing; considering writing task and audience; and the way writers' perceive their role?

Because of the exploratory nature of the relationships between variables no hypotheses were proposed in this respect.

6.4.1 Text quality and keystroke behaviour

Fluency has been acknowledged as a quality trait in writing. In the present study fluency was observed in three sets of measures. First, productivity was assessed by means of text length (TL), rate of production (PR), and mean length of text spans between pauses (TSL). Second, the proportion of accepted to candidate text was measured because of its close association with text production (FT). Third, pause behaviour was observed in terms of both initial pause duration (IPD) and proportion of pause time to total writing time (PPT).

Average text quality was found to be strongly associated with text length (Spearman's correlation coefficient is .735, significant at .01 level). Figure 6.9 shows a scatter plot of the relationship between the two variables.
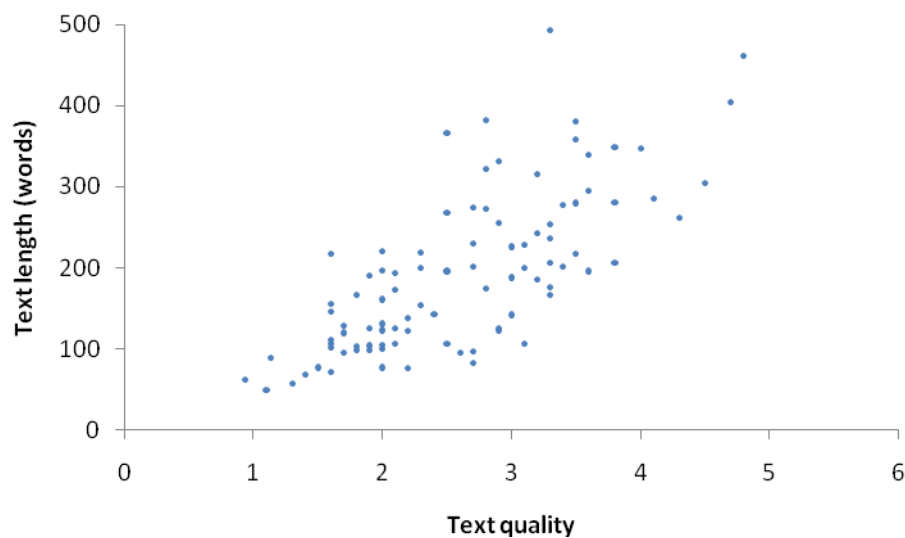
Figure 6.9 Correlation between text quality and text length

Other fluency measures were also found to correlate positively but moderately with text quality. These are rate of production, mean length of text span and initial pause duration. (Spearman's rho are .403, .424 and .381 respectively, $p < .01$). The correlation between text quality and the rate of production is plotted in Figure 6.10 below.
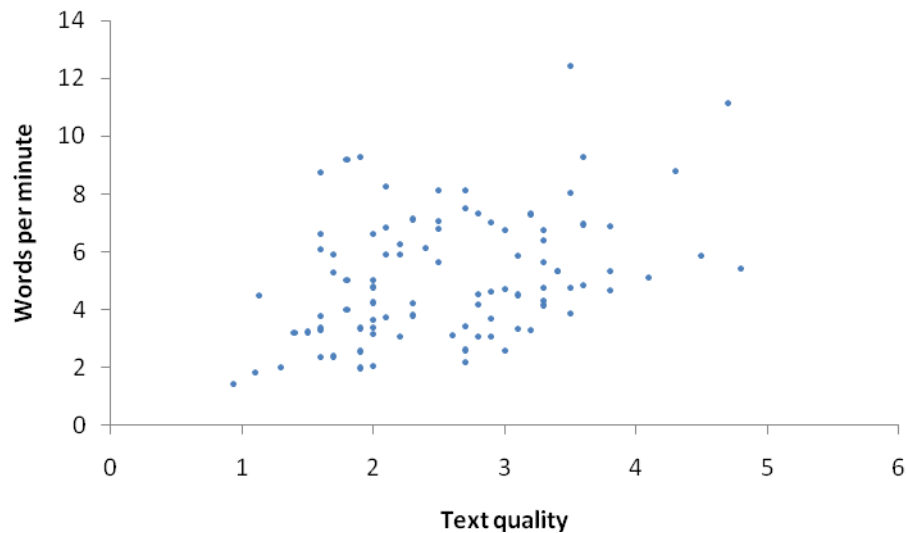
Figure 6.10 Correlation between text quality and rate of production

Moreover there was moderate negative correlation between the proportion of pause time to total time and average text quality (Spearman's rho is .384, significant at .01 level). This negative correlation is graphically plotted in Figure 6.11 below.
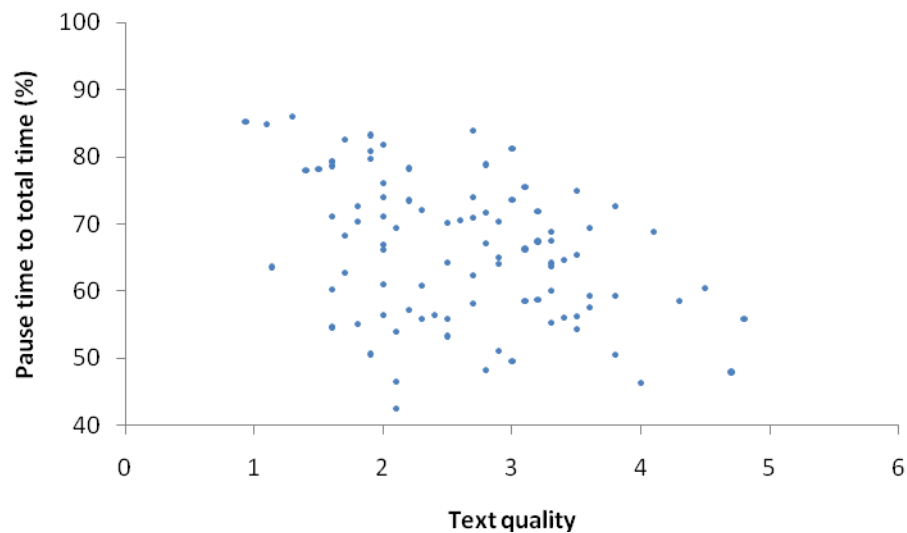
Figure 6.11 Correlation between text quality and pause time proportion

Revision behaviour, on the other hand, did not demonstrate a strong association with text quality. However, frequency of revisions per hundred words correlated negatively with average text quality (Pearson correlation coefficient is -.416, p< .05). In other words, more frequent revisions affected text quality to the worse.

When looking at location of revision no correlation was found between average text quality and the proportion of revisions in any of the three positions, immediate, proximate, or distant.

Level of revision was given a different treatment. Revisions were given value numbers that range from 1 (for the most localised formal treatment, e.g. spelling, capitalisation, etc) to 6 (for attending to content at the global level of text). Pragmatic revisions were put at the highest level of the scale as level seven, as they involve a highly demanding cognitive process of incorporating writers' goals and objectives that lie outside the immediate environment of the text. In a sense, pragmatic revisions are more global than what has been labelled global revisions of text. The order has been put as follows: Level (1), local orthography (spelling); Level (2), local meaning (lexis); Level (3), intermediate structure (syntax); Level (4), intermediate meaning (semantics); Level (5) global structure (discourse); Level (6), global meaning (textual); and level (7) pragmatic. The following table presents the erythematic calculations that were used in calculating the revision level index.

Table 6.8 Calculating revision level index according to scope and structure/meaning

	Local (×1)	Intermediate (×2)	Global (×3)
Structure (1)	Orthography (1)	Syntax+1 (3)	Discourse+2 (5)
Meaning (2)	Lexis (2)	Semantic (4)	Textual (6)

A moderate correlation was found between the revision level index and quality of texts (Pearson correlation coefficient is .484, significant at the $p < .05$ level).

The charts on Figure 6.12 (below) represent graphically the correlation between average text quality and each of frequency of revisions per hundred words and revision level index.
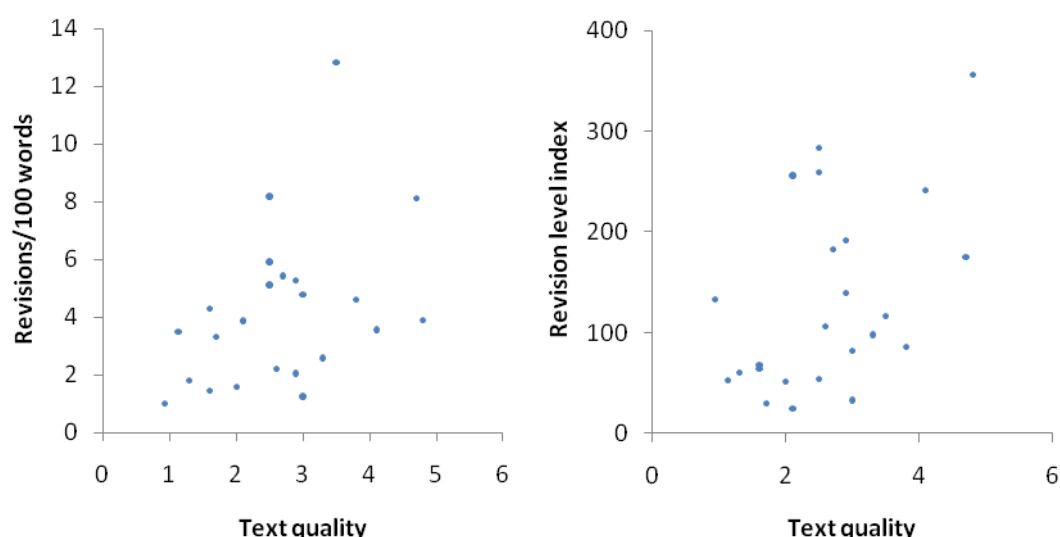
Figure 6.12 Correlations between text quality and frequency and level of revision

6.4.2 Text quality and self-reported strategies and concerns

At a global level, text quality measures of all samples were correlated with all students' reported writing strategies. As a global group, no correlation of any significance was found between students' perception of their own strategies and the assessment of features of their writing. However, when the six groups were analyzed separately, some of the groups exhibited relationships between the scores of some assessed criteria and certain reported features. In CS1 there was a significant and fairly strong correlation between writers' concern for audience and the scores they received in Development and Organization (Spearman's correlation coefficient is .69, p< 0.05). There was also a similarly significant but negative correlation between writers' judgment on the priority of overall text structure and the scores they received in English Grammar and Usage (Spearman's correlation coefficients is -.68, p< 0.05).

In both subject groups at the fourth semester, no meaningful or highly significant correlation was found between priorities writers gave to aspects of writing and criteria of text quality.

In the E8 group participants' concern for the content of the text correlated positively with assessment scores of each of Development and Organization, Audience Awareness, and Average Text Quality (Spearman's correlation coefficients are .52, .56 and .61 respectively; all significant at 0.05 level). In the same group positive correlation was also found between how participants perceived their role(s) as writers and the

scores they received in Task Fulfilment (.61, significant at 0.01 level) and Development and Organization (.54, significant at 0.05 level)

In the CS8 group concern for text structure correlated positively (though moderately) with scores participants received in each of Audience Awareness (Spearman's correlation coefficient is .48), Grammar and Usage (.52) and Average Text Quality (.47), all significant at 0.05 level. Concern for text structure correlated more strongly and more significantly with the scores writers received in the criteria of Variety of Structure and Diction (Spearman's correlation coefficient is .63, significant at the 0.01 level).

Lack of correlation between some seemingly related writers' concerns and corresponding scores carries no contradiction in the findings of the study. Participants might have been aware (or unaware) of audience; they might have (or have not), developed skills of attending to task and audience; and they might have given more (or otherwise less) consideration to global content and structure of texts; but these were not necessarily realized in the assessment of these features. Moreover, it is possible that students at the higher levels are more aware of their attention patterns. More plausible yet is the possibility that writers at higher academic levels attend more efficiently to the aspects of writing that concern them. Thus when they report attending to a particular aspect of their writing, it means they did so effectively enough as to get them a high score in a corresponding quality descriptor. This may have resulted in getting higher scores for these aspects; and therefore led to stronger correlations. The notion of effectiveness of awareness and attention may generate questions worthy of investigating in a separate thesis.

6.5 Conclusion

Participants' immediate recall has shown a picture similar to the one which was depicted through fluency and revision analysis. It asserts the hypothesis that university students develop in awareness along the academic years; and that students of English Language and Literature and those of Computer Science develop differently.

In their QIR participants from the lower-level groups showed different levels of concern to linguistic, textual and contextual aspects of the writing process. Task fulfilment came first in CS1 priorities as they write, while E1 gave the first priority to words and word

meanings. More CS1 than E1 writers saw their role in writing as that of knowledge transformers. The majority in E1 perceived their writing as a language task.

However, it is in the assessment of the quality of text features that discrepancy between patterns of development of the two subject majors demonstrates itself most remarkably. In all text criteria, Computer Science participants outperformed English majors in the first semester. In the fourth semester the performance of Computer Science declines and that of English majors improves. And in the eighth semester the quality of Computer Science texts picks up towards an increase, but fails to compete with the performance of English-major seniors, who have been maintaining a steady progress along the semesters and have come to achieve the leading position in all measures.

Text quality was found to be closely associated with fluency measures, except proportion of final to linear text. In particular text length was a strong predicator of text quality. Revision behaviour on the other hand did not show significant association with assessed quality of text, except in the frequency of revision. However when a revision index measure was developed, it correlated moderately with average text quality. This asserts the necessity of multi-dimensional perspective of revision.

The following chapter will look into the retrospective recall of participants who attended individual sessions.

Chapter Seven: Stimulated Retrospective Recall

7.1 Introduction

Chapter Five reported qualitative findings from keystroke analysis of the writing sessions. It provided data on fluency, pause and revision analysis. Chapter Six reported on writers' own perceptions of their strategies and concerns and on assessors' judgment on text features. It also proposed to answer RQ3 on possible factorial relationships amongst writer's keystroke behaviour, their perceptions and concerns, and features of their produced texts.

This chapter will present a qualitative approach to the research sample. At individual (though smaller scale) level, more detailed recall accounts were retrieved from a small number of participants who have agreed to attend individual writing sessions followed by retrospective interviews. These were facilitated by the playback feature of the logging program ScriptLog, and stimulated by the actual writing activity being replayed by the program's playback facility. These are called stimulated recall (SR) sessions and will be reported in this chapter.

7.2 Writing strategies reported in Stimulated Recall

In the following sections the performance and the stimulated recall accounts of nine participants will be closely examined in order to demonstrate if the quantitatively attested trends are manifested in individual cases. It is relevant to mention beforehand, however, that participation in the individual writing and stimulated recall sessions was obtained on voluntarily basis; these individuals may not necessarily reflect the profile of the groups. In fact, one would assume that the individuals who have willingly agreed to attend longer writing sessions and interviews are those who are fairly confident about their writing. If that is true, then these individuals will display a writing profile that is more sophisticated than that of the groups they belong to.

7.2.1 English majors

From the qualitative analysis, it was found that, over the academic years, English majors have developed writing behaviour that is more fluent and more oriented towards the global gist of the text with less emphasis on low level local linguistic issues.

Assessment of their writing has revealed superiority of E8 group both in general terms and in all specific criteria. On average E8 participants scored 3.2 while CS8, for example, only achieved a score of 2.5 in the overall average quality of their text.

In the cases that I examined, individual-English-major writers seem to reflect the general developmental model both in terms of what they recall from their writing activities and in the way they comment on the text as it develops (emerges).

I begin this detailed account of individual writing sessions by providing a quantitative profile of some of the features of the writing activities (process and product) of the involved participants in the table below (Table 7.1). Columns that show each individual's writing features are followed by columns that display the group's profile.

Table 7.1 Features of the writing process of individual participants compared with their groups

variables	measures	E1-ind.6	E1-ind.7	E1-group	E4-ind.2	E4-group	E8-ind.4	E8-ind.12	E8-group (SD)
Fluency	T Length (words)	190	125	120.82 (56.42)	201	198 (76.14)	286	404	261.37 (88.29)
	RP (words per minute)	9.29	3.09	4.66	2.6	4.54	5.06	11.15	6.97 (3.12)
attention to audience	Students' recall (priority in a 1-to-6 scale)	1	5	2.45	4	3.07	4	5	3.47
	Assessors' score (out of 6)	1.5	2.5	1.68	3	3	4	5	3.55
Focus on task	Students' recall (priority in a 1-to-6 scale)	4	6	3.82	6	4.13	6	6	3.94
	Assessors' score (out of 6)	2.5	2.5	2.38	2.5	2.33	5	5	3.02
Other assessed features	D&O (out of 6)	2.5	3		2	2.43	4	4.5	3.08
	SW (out of 6)	1.5	3		3	3	3.50	4.50	3.50
	G&U (out of 6)	1.5	3		3	3.27	3.50	4.50	3.47
	Ave. (out of 6)	1.9	2.9	2.51	2.70	2.81	4.10	4.70	3.20

As mentioned earlier in Chapter Four (4.2.1) sampling of the individual cases was that of convenience. The researcher accepted any individuals who voluntarily agreed to participate. In the E8 group, however, participation was encouraged by a course instructor, which resulted in a high number of participants. There have also been quite a few participants in groups E1 and CS1. In groups E4, CS4 and CS8, on the other hand, individual participation was minimal, with only two participants from each of E4 and CS4 groups, and only one participant from the eighth-semester group of Computer Science majors. Moreover, some individual sessions have been ruled out from the samples as a result of technical errors (e.g. sound quality, corrupted text, etc.) or for pragmatic reasons (e.g. participants who persistently resist commenting on their writing as they watch the replay, even with prompts from the interviewer). The target number of five participants per group was therefore not met. Beside elimination of samples on technical and pragmatic bases, further elimination was made on random basis to allow for equal number of participants in each group. The new target was 2 individual cases, but this could not be obtained from both E4 group (poor quality recording of the other participant) and CS8 group (wherein only one student participated at the first place).

7.2.1.1 First-semester English majors (E1)

The E1 group represents potential-English-major participants at their first semester in the Faculty of Arts and Humanities. One obvious trait of this group is the localized and narrow focus on low-level formal conventions. This has been shown in their revision analysis (5.3.6 above), wherein 67% of their revisions were made to amend spelling or mechanics. Concern for these surface features was also observed in their stimulated recall comments. In particular spelling is always commented on. The following extracts from two E1 participants' stimulated-recall interviews show a high concern for orthography that sometimes keeps coming out at different times along the course of text production. (*P*= participant, *R*= researcher; Words that were uttered in English are underlined; Participants' possible intentions as inferred by the researcher are placed in brackets, and the researcher's comments in squared brackets.)

Recall Extract.1a (E1-ind.7)

P   18:40   *... Capital and small*

                      ...

        24:50:90   *You see here, I did not know how to write "quickly".*

> *I erased it all [she replaced " more quickly" with "faster"]*
>
> *... Just to change the capital*
>
> 32:30:10 *...*
>
> *I am still looking for mistakes. Here also, I had a small letter*

Recall Extract.1b *(E1-ind.4)*

P   *Spelling. I think… I also wanted to add something.*

                ... I hesitated because of spelling

Moreover, E1 participants appear to be influenced by the instruction they had previously received on English grammar and usage. They are able to recite some rules, but knowledge of the rules does not seem to have much impact on their writing. In the following extract the participant provides a number of criteria of how a topic sentence should and should not be. But in reality she produced a topic sentence that is too broad.

Recall Extract.2 *(E1-ind.7)*

 P   *I … At the beginning there has to be a topic sentence, and*

             the topic sentence, I have learnt, has to have characteristics.

             It was difficult to find a topic sentence. There can be narrow

             topic sentence, broad topic sentence. There can be weak

             topic sentence, so I did not find topic sentence except that

             one that I wrote, so I followed it.

On the other hand, however, E1 participants, at least in the individual cases that I have interviewed, are able to draw a general picture of what they want to say. But this is often expressed in combination with concerns over their linguistic inadequacy, or, to put it in some of their own terms, inability to "formulate" the sentence.

Recall Extract.3a *(E1-ind.4)*

P   2:00   *I was thinking of ideas. Education to me is very important,*

             but why. [she explained the gist of what she wanted to say]

             I wanted to get this idea through … I don't know how to

             deliver this to the reader: that I support education; and I

             want to explain to people that women's education is strong.

             ...

Recall Extract. 3b *(E1-ind.7)*

P   21:45   *I wanted to form (formulate) the idea ... I had a story but there is no*
            good vocabulary
            ... Quality: I did not know the word in English

A closer look into two individual E1 cases reveals some variation in writing strategies within the same group. To begin with, Daniah (E1-ind.6) demonstrated writing behaviour that is fairly typical of level-one writing. She saw writing as a language exercise, and was preoccupied by spelling and grammar conventions. She did not demonstrate involvement with audience. She explained: *"all people think like me: some women need work, some don't",* so, according to her, there is no need to convince anyone. She reflects the group's general perception of their role in writing as that of displaying English language skills.

In her QIR, Daniah gave sentence structure and diction the first and second priorities respectively; concern of the reader came out the last.

Recall Extract.4 *(E1-ind.6)*

P   4:50   *I amended the spelling.*
            ... Here <u>*grammar*</u>. *When we have like three things, we only*
            put <u>*and*</u> *before the last one.*

Daniah's scores have subsequently suffered from this localized attention. A notable weakness in her essay was in the criteria of audience awareness wherein she scored 1.5 out of 6. Ironically, though, her score in English Grammar and Usage did not benefit from her form-oriented strategies. She also scored 1.5 in this as well.

Like others in the same group, Daniah considers the instruction she had received in English language and usage, but in that she refers to mechanical rules. In the following extract she talks about the instruction she had on paragraph writing, but then surprises the observer with focus on mechanical issues only.

Recall Extract.5 *(E1-ind.6)*

P   8:57   *I learnt how to write a paragraph, for example in the title*
            every word should be capitalized; after full stops (we use)
            capital letters; and we should leave a space at the beginning.
            I haven't done this. [She laughs]

R	*What else, have you learnt? Things that you find useful?*
P	*That we (should) write our names in the corner.*

Unlike Daniah, Muneerah, who is also an E1 student, demonstrated higher-level composing strategies. It appeared from the beginning of her interview that she is aware of the global content and structure of her text. She was able to explain the gist of what she wanted to say, and put forward a plan of what she wanted to do.

Recall Extract 6 *(E1-ind.7)*

P	1:20	*First I read it then I put a plan ... the main idea and the branching (secondary) ideas from it. Then I will need to organize them.*
P		*It was the most important idea; a woman should work to help her husband. Then there were some other ideas, but that was the most important idea.*

She consistently showed high attention to content organization and to the unity of the text while at the same time paying some attention to the rules of sentence structure.

Recall Extract 7 *(E1-ind.7)*

R	6.03.50	*Why did you stop here?*
P		*I have ideas in my head, but connecting them and putting them down, there is some difficulty*
		...
		Then I go back and see if the structure of the sentence is right or not.
P	9:28	*For a person who doesn't write a lot he [generic] needs to stop to adjust his sentences a little bit. Revise each sentence, to see how ... if the idea that I will write next will fit with this one.*

For Muneerah, knowledge of formal language rules seems to be more proceduralized than declared. This stands in contrast to what one would expect from first year students, who, in the past several years, have received extensive explicit instruction on grammar, and who also reported declarative knowledge of the rules. In the following example Muneerah has correctly adjusted the tense of the verb without knowing why.

Recall Extract 8 *(E1-ind.7)*

R	*Why did you change make to made?*
P	*I wanted to see (think about) the difference between the two, I did not know what to choose exactly*

Audience awareness was not spontaneously commented on in Muneerah's stimulated recall protocol. This came as no surprise given the fact that E1 group has not seen their role in their writing as one of communicating a persuasive stance to a reader, (with 63.6% of them seeing their writing as a language practice). But when prompted she showed concern about audience. However, in the course of her writing Muneerah showed consideration of the readers by engaging in several textual revisions for the sake of clarity and appropriateness of content.

Recall Extract 9 *(E1-ind.7)*

P 9:52	*I started directly, saying that <u>women SHOULD help</u>, but when I say: ok there is an immediate (economic) situation then I can say that a woman has to work to help her husband.*
	...
	Long sentence that I can cut down. I want to say that everything is expensive and the salary is low. Even "the salary is low" I don't know how to put it
P 15.11.10	*I erased that because I was afraid that I repeated the same point. Even this one I erased because I did not want to repeat.*

7.2.1.2 Fourth-semester English majors (E4)

The E4 group demonstrated development both in the fluency measures and the level of cognitive processing of their compositions. This was evident in several ways. First an increased number of participants saw their role in writing as that of communicating an argument to an audience, (33.3% as opposed to 18.2% from the E1 groups). Second there was an increase in all aspects of quality measures. Third, in their revision analysis E4 participants showed relatively less concern for surface, formal features of the writing.

Faizah (E4-ind.2) is the only fourth-semester, English-major individual case to be examined. Luckily, though, she seems to be a typical E4 case. In the text quality

assessment she scored less than Muneerah, her fellow student in E1, but as table 6.3 (above) shows, she is quantitatively more representative of her group.

Faizah is quite articulate about her content generating and organization strategies. She seems to have developed a sense of global content of text, awareness of audience and concern for appropriateness. In the following extract she shows alertness to the writing task requirements and commitment to the topic as she perceived it to be so.

Recall Extract 10 *(E4-ind.2)*

P 2.14 *After I read it, I knew you want to know my opinion on people who criticize the degree course, and prefer language centers. I wanted to start by saying that I don't agree. You have asked for my opinion. My opinion. So I write that I don't agree with this. So I wrote the idea and I wrote reasons.*

R *Have you planned the whole text in your mind in advance?*

P *I've divided it. I like to start in order. At the beginning I said she wants my opinion, so let me put my opinion. Then I looked at the other thing that you want, which is the importance of studying it (the English Language).*

...

All my focus was on my opinion. How to deliver to you or to the reader in general ...

I had ideas that I couldn't deliver appropriately

The following extract indicates modification of content according to the writer's own perception of order of importance of information.

Recall Extract 11 *(E4-ind.2)*

R *Here you wrote "in your life" then you added "the most important thing in your life".*

P *When I thought about it, <u>understanding people</u>, then <u>read</u> are not that important.*

You will see, I will cut things and reorganize them.

Faizah stated "being able to read in English" as a reason for the importance of learning English, but as she was going to put a third reason she realized that the idea needed more explanation. Accordingly, she added the following sentence.

Text Extract 6.1

"*nowadays, almost everything is written in English and you need to know what they are talking*".

Faizah is well aware of the global structure of the text, she indicated this several times. In the following extract she reports an elaboration procedure and content organization strategies, before she provides an explanation to one of the points and a summary of the text.

Recall Extract 12 *(E4-ind.2)*

P	59:24	*No, I am adding to the second.*
		…
		I am changing the position of things, cut and paste.
		…
		I will put this idea after Islam.
		First of all Islam. It is important to (be able to) explain that Islam is not terror. You know, especially after September 11. Then English is important at work; in your life.
		…
P	01.01.30	*I summarized it that (you need English) in Islam; in life; to understand; and read.*

She shows high attention to organization for the sake of clarity, which indicates an awareness of readers' need to understand. Her text scored 3 out of 6 on Audience Awareness, (average score for all the groups was 2.75).

Recall Extract 13 *(E4-ind.2)*

P	13:50	*Because it wouldn't fit with what I want to say next …*
		I reread to see if what I wrote is organized, can be understood, or I am just writing nonsense.

Faizah's concern about her English is almost always about limitations in lexis, and she occasionally mentions spelling. She hardly ever discusses grammar, except when she said that she has "some problems with grammar."

In summary, Faizah's writing proficiency appears to fit in a developmental scale, somewhere in the middle between managing writing in a second language and

processing a text. On one hand she is influenced by a freshly learnt abundant load of instruction on essay writing. This directs both language processing and content development strategies. On the other hand, she does not seem to take much authority over the act of writing. She is restricted by, for example, the three topic essay cliché. Her eagerness to generate three topics has distracted her from the original task, (i.e. explaining why specialized study is better than short term courses), to justifying why one would need to learn English. However she gave much thought to the rhetorical requirement of the text: "your opinion" and "details and examples". Within her new perception of topic, she showed a great deal of commitment.

7.2.1.3 Eighth-semester English Majors (E8)

Senior English majors demonstrated development in all aspects of the writing activity. Their texts were scored significantly higher than their junior English department fellows. And their revisions showed moving away from surface level amendment to modifications of text structure and content.

In their stimulated recall, the individual cases reported writing strategies and concerns that reflect the general developmental trend of the group as a whole. This is particularly true in integral generating strategies, global control of text structure and organization, and revisions that reflect more than localized worries over spelling and grammar. Two individual cases have been examined, Mona and Sawsan.

The first thing that strikes attention in Mona's account of stimulated recall is the consistent degree of awareness of her content generating strategies; and one of her most prominent concerns is content and content organization. When looking at her immediate recall questionnaire, she saw content as having the first priority over six other aspects of the writing activity. In the following extracts, Mona reports her struggle with content generating, and her usage of socio-academic sources for content.

Recall Extract 14 *(E8-ind.4)*

P   30:09.00   *Yes. I was thinking about the plays that we took, what the*
elements of drama are.
I put a comma, wanted to add another thing, but couldn't
remember.
...

P   31.10.04   *And I am also thinking about the other elements (of*

drama)… In particular, I was remembering a recent play we took "The Way of the World", you know it? I was remembering things. I remembered one of my classmates I was studying with, and she was telling (me) what elements the course instructor wanted us to know. I was trying to remember that.

In contrast to Daniah (E1), who saw no importance in addressing the audience, Mona shows not only an awareness of the presence of a reader, but she has also been sensitive to what the reader might think of her.

Recall Extract 15 *(E8-ind.4)*

R 17:43 *Why have you erased perfect?*

P *I felt I was … If someone reads it, he will say she is very confident about her opinion, to the point of arrogance. I did not want to give this impression, so I erased it, so that he (the reader) becomes convinced with what I say, not that I …*

See "My opinion…" I changed it.

Sawsan, who is also a senior English major, has displayed a similar level of awareness of readers, but with completely different pragmatic approach. Like Mona, she is also aware of the power of what she is saying in manipulating readers' thinking. However, while Mona tried a tone of humility, Sawsan downgraded the intellectuality of the reader and derived power from what she has learnt about English literature. In the following extract, she admits using discipline-specific knowledge to intimidate the reader.

Recall Extract 16 *(E8-ind.12)*

P 27:30 *How to convince him. If the reader supports this idea, that you don't need to study (English Literature). When he reads this, he will think: what does novella mean? What does sonnet mean? She is a (English) major; She must know better; One must study (English Literature) to be able to know that. I wanted to make him feel that it is important (to study English Literature).*
I was thinking of the spelling. So I changed it to modern literature. I wanted to say Elizabethan Literature. I also named it Renascence, but

		also couldn't figure out the spelling
R		*But modern is more recent than renascence or Elizabethan.*
P	28:15	*The unspecialized reader will not understand the difference. They will not even know some of the words.*
	30:50	*Now I will give an example about Shakespeare. I am sure when people read <u>Mocking bird</u>, and because the poem is all about spring, the ordinary reader will take it for a bird. But when you read it more than once you know that <u>mocking bird</u>, in the <u>Elizabethan age</u>, it meant betrayal, from a wife in particular to her husband. Also the mocking bird is being scornful of the man. Ordinary people will not understand it like the ones who are specialized.*
		Here I was thinking of the reader, to show him that we've recognized it but you haven't.
		... Here I will explain what it means.

This consideration of audience resulted in Sawsan being one of only three writers to achieve the highest score in audience awareness (5/6).

Sawsan maintained balanced attention to all aspects of writing, yet giving more thought to content and content organization. She explicitly expressed her effort in sentence structure and grammar, but she also attended to individual words. Occasionally, she seems to lack lexical variety and/or retrieval strategies, but she was more often troubled by too many choices from her own diction than the lack of it.

Sawsan is influenced by many semesters' experience of instruction. In the course of her study in the English department she has both acquired rules and developed her own tactics. This influence is most evident in the view she maintained throughout that what she was writing was a first draft (**Recall Extract 17**). Drafting is a professional writing approach that induces dynamicity and evolution into an otherwise static and rigid text. In the following extract she explains her strategy in generating and organizing ideas.

Recall Extract 17 *(E8-ind.12)*

P	7:35	*While I am going on. But I will erase things several times and ... This is how I write. First I put down everything that comes to my mind. Then, later on at home, I rearrange them. I cut and paste; cut and paste in several places until I see what goes with what of what I write, then I see what is irrelevant and erase it.*

Even when Sawsan comments on language form she usually addresses higher order linguistic and pragmatic issues.

Recall Extract 18 *(E8-ind.12)*

P   *Yes, originally I wanted to put this sentence in the upper (first) part, where I mentioned* <u>poet</u> *and* <u>poem</u>*. I wanted to take it there but then I thought I will do so if I am to make a second draft. As long as this is a first draft I will write what comes to my mind. Then I bring more examples or make an introduction paragraph.*
This is just the first draft, what comes to my mind, then I won't take it as one paragraph I will split it into ideas (topics). Then see what is relevant and what is not.
To me it was a draft so I felt that I don't have to organize it much.

P   36:29   *Because I decided not to move this up, I thought I will say that I've mentioned it previously; that this an example of something mentioned earlier. It is also easier for me when I write the second draft to know that I've mentioned that previously.*

Unlike participants from the first level, when Sawsan faces a lexical difficulty, she does not linger over the situation, struggling to dig something out of the memory and complaining from her inadequacy. Instead she takes authority and expresses the meaning in a different way, applying what is known as circumlocution strategy. Then she moves on.

Recall Extract 19 *(E8-ind.12)*

28:50   *Here I wanted to write "figurative language", but it did not come to my mind, I did not know what it is (in English). So I wrote "a word that has another meaning."*

The striking feature in Sawsan's writing activity as a whole is in handling the topic and juggling the writing process at different levels. Her writing activity displays fluency, interaction with audience, restructuring, reorganizing and perfecting the language. What she perceived as a first draft turned out to be one of the three most highly assessed essays: the highest in Audience Awareness, second highest in Development and Organization (shared with two others), and second highest in overall quality.

7.2.2 Computer Science majors

It was found from the quantitative inquiry (Ch. 5) that Computer Science majors have by the eighth semester shown development in some measures of writing, but at the lower levels values of quantitative measures were somehow paradoxical. CS4s did not seem to have achieved a level of writing maturation that is significantly different from CS1s. It is hoped that a clearer picture of what actually happens to the writing proficiency of Computer Science majors over the years in college will be depicted by looking at individual writing sessions in details, and particularly examining what the students have reported about their writing in stimulated recall sessions. The following table (7.2) shows some aspects of the quantitative profile of the writing of Computer Science participants in the stimulated recall session, placed against the profiles of the groups they belong to.

Table 7.2 Features of the writing process of individual participants compared with their groups

variables	measures	CS1-ind.4	CS1 group (SD)	CS4-ind.1	CS4-ind.2	CS4 group (SD)	CS8-ind.4	CS8 group (SD)
Fluency	Text length (words)	218	145.2 (70.29)	256	221	138.61 (53.3)	268	240.7 (119.30)
	Rate of production (words per minute)	4.75	4.30 (1.20)	7.02	3.37	5.73 (1.20)	5.66	4.70 (1.76)
attention to audience	Students' recall (priority in a 1-to-6 scale)	6	2.7	1	6	3.89	--	3.00
	Assessors' score (out of 6)	3.5	2.55	2.5	3	2.14	2	2.8
focus on the writing task	Students' recall (priority in a 1-to-6 scale)	5	4.80	6	3	4.72	--	4.53
	Assessors' score (out of 6)	4	2.8	3.5	1.5	1.83	2.5	2.73
General text quality	Assessors' score (out of 6)	3.5	2.79	2.9	2	1.96	2.5	2.53

SD standard deviation.

7.2.2.1 First-semester Computer Science majors (CS1)

At their first semester in the university Science majors demonstrated writing behaviour that is unexpectedly different from their Arts and Humanities' counterparts and probably more sophisticated than semester-four Computer Science students. It is relevant to restate that in the quantitative analysis they outperformed both their three-semester seniors and their peers in the Arts and Humanities, in terms of fluency, RP and mean length of text span.

In their QIR, moreover, level one Science majors have reported a lesser concern for syntactic accuracy and more concern for content than their English-major peers.

When it comes to what they say in the stimulated recall sessions, however, the concern for language once again prevails, at least in one of the cases that I have looked into. In the following extract, for example, Manal's recall suddenly shifts from expressing ideas that formed the main topic to expressing worries over spelling.

Recall Extract 20 *(CS1-ind.4)*

P	*It should be that I start with identifying what the thing I am writing about is. ...*
R	*Which is <u>work?</u>*
P	*Yah, and its importance, and the like, then I start to talk about woman's work (...) of course there is a lot of spelling mistakes but it is according to how I pronounce the word.*

Although such remarks were quite often in Manal's recall protocol, she has also demonstrated concern for higher level aspects of the writing activity. Occasionally she would remark on content and content organization:

Recall Extract 21a *(CS1-ind.4)*

P	*I am repeating the same talk, I don't know how to organize sentences.*

And on another occasion she commented:

Recall Extract 21b *(CS1-ind.4)*

P	*Yes I wanted to organize my ideas.*

Manal's perception of the reader seems to be centred on the teacher, who is a female.

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Recall Extract 22*(CS1-ind.4)*

P *… So I wrote for her [?] that a women is a mother, a*
daughter and a sister, so she has to (be able to) work
because sometimes she has no one (to support her) …

Expressions like "*I wrote for her, I gave her two answers (in an exam), etc*" are not uncommon in the everyday student rhetoric within the socio-academic context of this study. The pronoun refers to the teacher, and this reference reflects a concern with teachers' requests, opinions, and authority.

However, other than an underlying perception of the audience being a female reader, who is most probably the teacher, concern for audience remains minimal in Manal's retrospective protocol. The main concern appears to be about linguistic inadequacy. In the following extract, even with an effort to elicit possible audience awareness, the participant goes on reflecting on her inability to express her ideas the way she wants.

Recall Extract 23*(CS1-ind.4)*

R *So you wanted to convince someone.*
P *Yah, and because I don't have many words in English, so I*
tried to take at least the ones that are close to them

Agonizing over lexical inadequacy kept coming up in Manal's retrospective recall, often with explaining the intended meaning in Arabic, and complaining that she could not put it in English. In the extract below are three examples. Words uttered in English are underlined.

Recall Extract 24 *(CS1-ind.4)*

P 1:46 *Girl (daughter) as in my girl (my daughter), I did not know it so I*
wrote it <u>girl</u>, what else … development
development of a society. I didn't know it, so I wrote it <u>grow</u>
…
Because I wanted to write: it is important in our lives. And I did not
know how to write: for improving living standards.

7.2.2.2 Fourth-semester Computer Science majors (CS4)

The two individual cases I have examined in CS4, Norah and Nadiah, did not show a great deal of form-oriented concern in the way they recalled details of their writing activity.

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For Norah, spelling remains a major concern. In the following three examples she first complains of a "spelling complex"; and in the second one, despite mentioning "linking", she perceived spelling to be her main problem. She explicitly expressed this perception in the third example, wherein she also equated perfect language to correct spelling.

Recall Extract 25a (CS4-ind.1)

R	2:38	*So, Dec is short for doctorate!*
P		*Yes, I wrote it in short hand because I was afraid I would misspell it. I have a spelling complex.*

Recall Extract 25b (CS4-ind.1)

P	4:01	*I went back and read; one would want to link the text.*
R		*What was it that you wanted to say: <u>without</u> ...?*
P		*I had a problem with <u>special</u>, the spelling*
R		*So you knew what you were going to say, it was just the spelling that you wanted to be sure about.*
P		*Yes, I have a problem with spelling, generally.*

Recall Extract 25c (CS4-ind.1)

P	17:52	*The biggest obstacle I have is spelling. I don't like to write wrong spelling, although it is sort of annoying me. Even when I know the spelling of a word, I hesitate about it. In exams for example, even if it is correct I get uncertain about it. I don't know why?*
		...
P	18:05	*It is because when it comes to language I like to be perfect. So even when I write something right, I hesitate. Sometimes I go back and rewrite it wrong. I feel I have written it wrong.*

This over concern with spelling and lexis does not seem to have slowed down the writing process or affected the writing product. Norah wrote at a high text production rate that is almost twice as much as that of the average rate of the CS4 group (Table 6.4 above). She scored 3.5 as an overall text quality assessment (group mean 1.96).

Norah has also recognized problems in formulating, i.e. putting ideas into written language, although she has not reported this as frequently as reporting her concern for spelling.

Recall Extract 26 *(CS4-ind.1)*

P	*This sentence I thought about it several times, I wanted to formulate it. It confused me.*
	...
R	*And do you remember why did you stop here?*
P	*It is this same sentence I wanted to formulate it neatly (in a more organized way)*

Unlike Norah, Nadiah, who is also a fourth-semester Computer Science student, did not seem to worry much about spelling. Instead she insisted that spelling is not important at all and that any concern about it is against simplicity.

Recall Extract 27 *(CS4-ind.2)*

P	*14:02*	*I wrote and wrote then I thought it's enough, so I went back and started to amend.*
R		*What have you amended? ... Spelling for example.*
P		*No, I am not concerned about spelling. I don't care about spelling because, basically, they don't care about it abroad. ... Only when they write research they care about spelling. I wanted to put it simply, to convince the reader, after all I am saying my point of view, that of a student, it won't matter much. So I said I will talk about it simply, no need to care about spelling, I thought I might even give the reader something to giggle about, I might get to the reader through my spelling mistakes.*

This awareness of the reader emerged right from the beginning (the extract below) and reappeared several times during the interview. Such an effort in addressing the reader has resulted in a relatively high score in the audience awareness scale. Nadiah was given 3 out of 6, a score that is above the CS4 group average (2.14), the academic level average (2.57) and all participants' average (2.76).

Recall Extract 28 *(CS4-ind.2)*

    P   1.25   *I wanted to start with an introduction. My intention was to convince the reader.*

    R   *Who is the reader to you?*

    P   *Whoever is going to read, a specialist or a non-specialist.*

Sensitivity to the reader's need to understand has not been a recurring issue in the stimulated recall reports elsewhere; and it often entails paying attention to other aspects of the text. In the case of Nadiah she paid attention to organization and stated that it is for the sake of making it clear to the reader.

Recall Extract 29 *(CS4-ind.2)*

P   *Where I stop, I read.*

R   *And what do you do when you read?*

P   10.50   *I look at ... If what I say is ... The most important thing is organizing the talk (discourse).*
I want to convince myself and the reader.
It is important ... When the talk (discourse) is organized it will be understood, not when it is fragmented.

7.2.2.3 Eighth-semester Computer Science majors (CS8)

Daniah, the only Computer Science student who participated in an individual writing session, demonstrated a more sophisticated approach to the writing task than the individual participants in CS1 and CS4. Throughout her writing session she was engaged in higher level content generating and organizing process paying less attention to surface amendments and more attention to informativity and accuracy of content.

Like Mona (the E8 participant) Daniah utilized sources from the immediate socio-academic context to generate content, and tackled the topic from an insider point of view.

Recall Extract 30 *(CS8-ind.1)*

P   00:23   *First I was reading the writing task*
Then I thought it isn't a new topic for me. My friends and I had discussions about whether a person needs short courses or specialized study at college.
But I was trying to remember what the basis of the discussion was, and what we have disagreed about.

		So I put together a number of sentences at the beginning saying that I am familiar with this argument.
R		*Have you had a plan at the beginning?*
P		*As soon as I read the prompt I had in mind what I have just said, so I started with an example, that there is a controversy. Then I started to*
	1:09	*think about training institutes: what they could offer to us. Is it a particular course? What sort of subject material could a student get? Is there a focus on a certain thing in the institutes? Etc.*
R		*The content*
P		*Yes the very content*
R		*Have you thought about paragraphing, where you will put information, what sort of starting, ending?*
P		*As soon as I got the idea, I put it down. I did not say I will start with an introduction about specialties and the like, no.*
		I felt it is closer to me in reality, so I started expressing that.

Although, initially, Daniah did not acknowledge having a mental representation of a reader, throughout her writing she showed involvement with an audience in more than one occasion.

Recall Extract 31 *(CS8-ind.1)*

R		*Have you thought of whom you are addressing what you're saying to?*
P	*2.06*	*At the beginning, no. I was just writing, but then in the middle of the talk (discourse) it occurred to me if what I am saying is going to be useful (informative) or not.*

Awareness of the reader is evident not only in what she explicitly reported *(Recall Extract 31a)* but also in her persistent efforts to evaluate the quality of information she is giving (Recall Extract 32a&b).

Recall Extract 32a *(CS8-ind.1)*

P	*12:45*	*(I thought of it) in terms of convincing; a strong evidence. As a point of view, I am representing my thought but whoever is reading this after me might not feel that it is strong evidence, not an example that you could follow.*

Recall Extract 32b *(CS8-ind.1)*

P		*I am giving evidence. I've heard from one of my friends, whose father works in a big company, that they take those with diplomas first, and place the files of KAU graduates next. So I said this is an example.*

But then I thought of other cases in the big companies where

specialized people are welcome.

It is, therefore not a strong evidence,

Daniah is aware of the text structure at a global level, with a conscious command on the distribution of information. While she was generating an idea, for example, she felt that the gist of the idea fitted somewhere else. She then readjusted the global plans: moved the argument up to a previous paragraph and decided to dedicate the new paragraph to a different aspect of the argument.

Recall Extract 33*(CS8-ind.1)*

P   6:01   *I was going to start a new paragraph, I suppose, to say that: if*

            everyone goes to these institutes, we will abandon specialized studies. I

            left this and went back to here [P points to the screen] to elaborate:

            that we do cover these details in our study. The others don't.

R   *Will you go back and finish the bit that you've started here?*

P   *I felt the idea fits better there. I will choose different meanings*

            (different content).

            No I will not write it again; I've expressed it; I've summarized it (in

            the previous paragraph); that should be enough.

            I wanted to be coherent: they miss these information and we cover

            them in our study.

            I suppose the new paragraph, then, will be about our study.

In fact, she is one of very few students who are aware of paragraphing as a tool of punctuating the main ideas.

Recall Extract 34a *(CS8-ind.4)*

P   26:38   *[as she sees the next paragraph unfolds]: As I told you I was going to*

            go back and write about our study.

Recall Extract 34b *(CS8-ind.4)*

P   54:25   *My idea is to clarify that knowledge of the details improves the*

  (+18:42)   *science itself. This entire paragraph is about this. In this paragraph*

            the idea was clear, but which sentence comes before which?

As she gives priority to ideas and idea sequencing, Daniah often delays attending to the language structure of the text (Recall Extract 35a). But she does go back to solve

language problems after she puts the ideas down. And occasionally she shows multiple-level processing of content and language (Recall Extract 35b&c).

Recall Extract 35a (CS8-ind.4)

P   5:40   *Here, the linguistic structure of the sentence.*

Recall Extract 35b (CS8-ind.4)

P   *When I read I look at the sequencing of ideas. Sometimes I correct spelling.*
               Sometimes I feel I need to elaborate, add a word or two.
               Sometimes, but maybe the least, I look at the structure of the sentence itself, the
               grammar, past tense, present
               Like here, for example, you are correcting said to say.
               When I run out of ideas I go back and check, like this, but not much in the grammar.
               That is because I go back and read, and in my reading I include al;, this and this
               and this ...

Recall Extract 35c (CS8-ind.4)

   21:18   *Here I suppose I went back to read, I will adjust spelling.*
               After I put my ideas down, I go back and read. I try to find another
               sequence. Sometimes I read from the beginning.

Daniah's attention to spelling was very minimal. She only occasionally commented on spelling. In the following two extracts she either downgraded the significance of attending to spelling (36.a) or laughed at it (36.b).

Recall Extract 36a (CS8-ind.4)

P   *Sometimes I stop for spelling only. Or thinking of a word.*

Recall Extract 36b (CS8-ind.4)

P   4.06   *Here I was thinking of the spelling of institute. [She laughs.]*

In her revisions Daniah seems to break away from the extensive local worries that characterized the writing of most participants. In the following recall extract there is reference to a revision episode (a number of related revisions) that is scattered over a large chunk of the text, all the changes are serving one objective: to add an idea and emphasize it.

Recall Extract 37 *(CS8-ind.4)*

P   27:30   *Yes. You might have noticed, there is coherence. Here, I am saying*
             that we study everything in details, then I went back to the institutes
             (' bit) and clarify that ... I scattered the idea over.

Daniah seems to have employed writing strategies that showed maturation, according to the development hypothesis, but as luck would have it, she did not receive high scores. This indicates that even when they take a global approach to their writing, with an awareness and focus on a central message and control over the flow and organization of their text, L2 writers may still fall short of achieving highly assessed written communication.

7.3 Conclusion

Participants' retrospective recalls yield a considerable support to the quantitative accounts on fluency, revision analysis and writers' awareness and concerns. The general picture drawn from individual recall of their writing supports the hypothesized development of university students along the academic years; and that students of English Language and Literature and those of Computer Science developed differently.

In the stimulated recall sessions first semester participants of both groups expressed more concern about lower-order linguistic and orthographic concerns. Quite often, they expressed worries over either spelling or lexical inadequacies, but one of their occasional complaints was from their inability to put ideas in writing.

As they move up the academic scale, participants from the two different majors progress differently. English majors at their fourth level seem to be influenced by the instruction they get on essay writing in a way different to how high school instruction influences E1 writing. The latter group reported awareness of the rules at the sentence level, while those in the fourth semester reported concerns over conventions of paragraphing and organizing main ideas, and tactics for generating content. Fourth level English majors seem to have gained more authority over their texts over time.

At their fourth semester, Computer Science students cease to talk about instructions or rules. In the cases examined above two different trends were tracked. That of a fourth level Computer Science writer who still perceives writing as a language practice and works on perfecting the text at the surface level; and another trend displayed by a

participant at the same level who was so involved with the purpose and audience that she dismissed other concerns.

Both E8 and CS8 groups have demonstrated an ability to refer to (and to use) resources made available to them through their knowledge of their subject areas. Mona, for example, utilized her knowledge of Drama in generating content. She also consulted the opinions of those who share the socio-academic context with her. In other words, subject related knowledge has contributed to a vital process in the writing activity, i.e. content generating.

Moreover, level 8 writers of both disciplines take authority over their text. They move information around, change content and manipulate structure. And they deliberately work against ambiguity and test the truthfulness of what they say. All these indicate that senior students are moving away from concerns over surface structure of the text towards a more global and conceptual approach to writing.

In addition, data from the stimulated recall sessions displayed evidence of development in university students from a different perspective. Writers' ability to talk about their writing and express their concerns varied along the academic levels. At their eighth level, participants of both groups are fairly articulate about their writing processes, goals, and problems. They were able to comment on their writing as it took place online. In particular, English majors at the fourth and eighth levels are quite articulate about their content- generating and content-organizing strategies. The stimulated recall of the lower groups, on the other hand, included frequent instances of complaint and justifications more than an objective account of what had happened.

Part 3: Discussion and Conclusions

- Chapter 8: Discussion of Findings

- Chapter 9: Conclusions

Chapter Eight: Discussion of the Findings

8.1 Introduction

This chapter draws together the findings of chapters five, six, and seven. It summarizes the measures of writing development as found by the data analysis and presents the developmental models that have been found through data analysis, by bringing together the observed patterns, relationships and tendencies while discussing at the same time exceptions to these generalizations. Throughout the discussion, the outcome of the present study is evaluated against previous work.

8.2 A word on data sources

The multidimensional nature of the present inquiry in the development of writing proficiency has necessitated multiple data-elicitation methods to capture aspects of writing at different levels of processing: linguistic, cognitive and socio-cognitive. First, keystroke logging has addressed the need for accurate and unobtrusive recording of what writers do as they write, thus avoiding any possible negative effect the traditional think aloud method (TA) might have on the writing process (for a critique of TA see Levy & Olive, 2001; and Levy, Marek & Lea, 1996). Data from log files have informed the study on temporal and spatial characteristics of the process (pause, fluency, linearity, etc) and on change actions (i.e. revisions). The playback facility has provided an extensive tracking of the actions of the writing activity as they take place online. Following the actions in this manner was at times the only way to uncover a process or understand a strategy that could extend over a longer stretch of text than the immediate unit. Needless to say that the playback facility has in addition provided a vivid stimulus for retrospective recall that is second to none.

In addition, computer logging (observation and analysis) has empowered the capacity of the study to handle a large number of participants and samples. As mentioned earlier, other tools of observation and analysis have limited the number of participants and samples that could be handled in each single study.

Second, questions for immediate recall (QIR) elicited responses from participants on relevant aspects of their writing process: consideration of and involvement with the demands of the writing task, involvement with audience, attention they paid to linguistic and contextual concerns of their writing, and their perception of their role as writers. This provided invaluable, immediate insights into the practices and priorities writers were engaged in during writing. Pragmatically, QIR challenged the limitation of time in group writing sessions and provided data that could have otherwise been ruled out from the analysis.

Third, one or two individuals from each group attended Stimulated Recall sessions (Gass & Mackey, 2000) wherein they reported extensively on what they did and considered in their writing while watching their texts emerging on the screen. Their stimulated recall protocols did not only contribute to testing the trends that were quantitatively found, but they also offered more detailed insights into writers' roles in the process of writing and their interactions with their texts and with the world outside.

Finally the produced manuscripts were assessed by two experienced independent raters according to five criteria: Task Fulfilment, Development and Organization, Audience Awareness, Variety of Structure and Diction, and English Language Grammar and Usage. The purpose of this was to gain textual evidence of contextual, textual and linguistic attainment of writers, as well as to get an average measure of text quality, against which other tendencies in the writing process were tested.

Triangulation of data eliciting methods served the study in two significant ways. First, since the measures of development have been informed by a wide scope of research with a wide range of objectives, tools, and data sources, and since these measures were synthesised in a way unique to the present inquiry, a single method would not have been able to elicit all the required data. For example, data on writers' awareness could not have been elicited from keystroke logging. Second, multiple data sources have shed light on areas that may otherwise remain in the shadow of other variables. It would have been misleading, for instance, to measure audience awareness only from what writers reported on the degree of consideration of a reader. It was important to seek an assessment of the extent to which 'a piece of writing communicates purposefully to a reader' from a reader's point of view. Both measures can be interpreted as different insights into writing, and so it was not necessary to find a correlation between the two.

This was crucial in differentiating between writers' concepts and readers' perceptions of the text. Finally, triangulation of data sources was considered for validation of some of the measures.

For most of the data, there appears a great deal of consistency between the variables measured by different methods. However, an apparent discrepancy between writers' self reports in the QIR and the assessed quality of their texts has raised a number of interesting points. It has been found that at lower academic levels writers' own perceived concerns did not predicate better performance in the corresponding criteria. Participants' report of their degree of attention to audience, for example, did not correlate with assessors' judgments of the level of audience awareness as evident in the written scripts. On the other hand, at the eighth level, some relationship was detected between what writers think of their awareness and strategies and what they achieved in the final texts. Two explanations are possible. It could be that more mature writers are better able to evaluate their skills and strategies (i.e. know their points of strength or weakness), or that when advanced writers address a certain concern, they do it effectively enough as to appear in the finally produced text. In either case development in awareness seems to have been achieved during advancing up the tertiary academic scale.

8.3 Development of writing along university levels

The study aimed to answer three research questions, which are restated under relevant sections in this chapter. The first of these asks if student writing develops over the course of university experience.

RQ1. Does the writing process and writing strategies of university students majoring in English Language and Literature and in Computer Science develop along university levels in terms of fluency, revision strategies, writers' awareness and concerns, and text quality?

The discussion of the findings provided in this section is divided into two sub-sections. The first one (8.3.1) addresses RQ1by finding development along university levels in the writing of English majors. The second (8.3.2) addresses RQ1 by looking at development in the writing of Computer Science majors.

8.3.1 Development in English majors

8.3.1.1 Fluency

Fluency has been operationalized in three measures: text length (TL), rate of production (PR) and length of text spans between pauses of 5 seconds or longer (TSL). A fourth measure, the proportion of final text to linear text, has also been associated with fluency, but because of the unclear findings this measure yielded it was kept as a possible contributing factor to fluency. The following sub-hypothesis presents the assumption that underlies analysing fluency measures for the English groups.

> **H1a.1** It is predicted that English-major writers will demonstrate development at
> different levels of tertiary education in terms of fluency of production.

The quantitative analysis has shown improvement in all fluency measures in the writing activity of English majors, providing thus a positive answer to RQ1 (in regards to the English groups and fluency measures). By looking at differences between E1 and E8, there has been enough evidence to accept the hypothesis (H1a.1). However, the insignificant change in fluency in fourth-semester English majors may indicate that development in fluency over the years is ultimate but unsystematic. A detailed look at the English-major participants is provided in the following discussion.

At the first level, the English group produced texts of only 79.8 words (on average) at a rather slow production rate of 2.74 words per minute. Their mean length of text spans between pauses of five seconds or more was 2.65 words. These were the lowest fluency values in all the groups including those of their peers in CS1, although because of individual variation differences between E1 and CS1 did not prove to be statistically significant. One possible explanation of the low fluency in first-semester English majors can be found in their pause behaviour. Their non-fluency time comprises 67.83% of their total writing time, which is the highest proportion in all the English-major groups. Moreover, the time they spent before writing anything at all was on average 1.17 minutes.

English majors in their fourth semester displayed improvement in all but one fluency measure (i.e. text span length). To begin with, E4 participants produced texts that are almost double the average length of those of E1 group, with a much higher rate of production. This came as no surprise as English majors are expected to gain much

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knowledge of the English language over the first few semesters through intense instruction and exposure to English course materials. This increase in knowledge facilitates the writing process and probably reduces the time it takes to decide on a certain word or structure. The increase of fluency is also accounted for by a decrease in deletions (i.e. accepting more of the proposed text in the final text, 80.79% compared to 75.54% in semester one), as well as a decrease in the proportion of pause time to total time.

On the other hand, E4 writers' average length of text spans between pauses of more than five seconds decreased, though insignificantly. This can be attributed to the intensity of form and discourse instructions at this phase of college experience. In their fourth semester, English majors will probably become much more aware of the correctness of their text. This awareness might have slowed down the process of writing, but it seems to have yielded more accurate language structures, no wonder then why, when it came to assessment, they scored best in English Grammar and Usage.

The fact that E4 writers spent more time on initial pauses despite a decrease in the proportion of pause time to total time could mean that longer initial pause lengths indicate maturity in writing. This however could not be explained in terms of planning strategies as the majority of E4 participants reported planning at sentence level. In fact, since there had been no correlation between initial pause time and planning strategies it could be that initial pause time has been wrongly associated with planning (e.g. Bereiter & Scardamalia, 1987; and Sasaki 2000).

English-major writers at the eighth semester exhibited the most fluent composing process of all the English groups in all fluency measures. The average length of their texts is more than three times that of E1 group, with a production rate of 7.11 words per minutes. Moreover, improvement in the ability of fluent production in English majors over the semesters was manifested in the length of text spans that writers could process as chunks of text between pauses of five seconds or more. E8 writers were able to produce an average of 7.61 words between pauses longer than 5 seconds, which is the highest rate of all groups. This corresponds to Chenoweth and Hayes (2001), Lindgren et al. (2008), and Spelman Miller et al. (2008) who found improvement in burst length along the years of L2 experience.

Pause time echoes other fluency measures. Senior English participants are less halting than all the other English groups. Although they spent around 60% of their time pausing, it remains the lowest proportion of pause time to total time of all the groups. Total pause time was found to decrease as experience with L2 increases (e.g. Lindgren et al, 2008; Spelman Miller et al, 2008). Moreover, more than 10% of E8 writer s' pause time was spent as an initial pause.

Improvement in fluency can be explained in terms of the concept of automatization, proposed by Schmidt (1992), and examined by Chenoweth and Hayes (2001). According to the hypothesis, automatic, rather than controlled, processing of language occurs when the working memory is free from worrying about formal linguistic adjustments. In the present case the higher level groups were aided by better diction and familiarity with the structure of the foreign language. This has resulted in more fluent production as well as improvement of the written product.

Increased fluency along the academic levels of L2 writers has been reported in other research (e.g. Sasaki, 2000, Chenoweth & Hayes, 2001, Lindgren et al, 2008; Spelman Miller et al, 2008). Chenoweth and Hayes have reported improvement in the number of words per minute, burst length and ratio of accepted text to candidate text as experience with L2 increases.

Besides automatization, improvement in fluency along university levels and variation in the outcome of fluency measures between the two subject-area groups can also be explained in terms of the inhibition hypothesis. Preoccupation with attention to formal aspects of writing has been constantly acknowledged in both less skilled L1writers (Rose, 1980; Sommers, 1980; Faigley & Witte 1981) and L2 writers (Stevenson et al. 2006). It has been reported that such preoccupation affects fluency (Chenoweth & Hayes, 2001) as well as higher level processes (McCutchen, 1996; Stevenson et al, 2006). The following section shows how aspects of formal and conceptual processing are demonstrated in the revision behaviour of writers. Other dimensions of revision will also be discussed.

8.3.1.2 Revision

It was assumed (Chapter Three) that observing revision behaviour will yield evidence for the cognitive processes and meta-cognitive awareness that underlie writers' strategies. Frequency of revision can affect fluency. Yet it is also strongly associated

with automatization as familiarity with language and ease of retrieval of relevant linguistic knowledge are thought to facilitate writing and reduce the need for revising.

 Location of revision to the point of inscription reflects the linearity or otherwise of the writing process (Thorson 2000). In the present study this has been used as an evidence of meta-cognitive recognition of the capacity of writing as opposed to speech. Increase in revisions in distant locations indicates a developmental pattern that fits into the paradigm of speech-to-writing proposed in Chapter Three. On the other hand, writers who linger over localized adjustments, and move mainly forward, seem to have wrongly subscribed to a concept of irreversibility of writing. They do not seem to take advantage of the recursive nature of writing. In other words they are influenced by the nature of the spoken mode of language.

Observing the scope of revision may also provide similar insight as to whether or not writers are taking advantage of the potential of dealing with larger units of text as opposed to revising within structurally small parts of it. This facility is not offered in a speech event. Finally, studying the level of revision provided data input that can be interpreted according to what concerns writers as they revise. Revisions to spelling and mechanics were taken as clues of writers'concern for basic inscription problems; syntax revisions indicated concern over clause and sentence structure; and discourse revisions indicated attention being paid to higher-order structure and linking of text. Similarly, revisions to lexical items showed concern for meaning at word level; semantic revisions reflected awareness of propositions of individual utterances; and textual revisions indicated awareness of the gist of the text or awareness of the information. Assumptions about development in revision patterns of English majors are provided in Hypothesis H1b.1

> **H1b.1** It is predicted that English-major writers will demonstrate development at different levels of tertiary education in their revision behaviour.

Revision behaviour of potential English majors in their first semester exhibits a severe preoccupation with localized surface –level concerns. To begin with they conducted 40.62 revisions on average for every hundred words they wrote, of which 80.68% were formal changes. This came as no surprise since 63% of the participants in this group reported (in QIR) that they had perceived the writing activity as an opportunity to display their command of the English language. But what level of formal processing

have they been engaged in? E1 participants seem to have put most of their revising efforts in spelling and mechanics which made up 57.52% of the total number of revisions (with 43% revisions in spelling alone). Revisions to syntactic structures made up 7.08% of the total number of revisions, and to lexical items 9.73%. Higher level processing of text structure was 6.19% and of content and content structure was 7.08%. There was no significant difference between the four categories.

Their localised attention is also evident in the scope of the structural unit they tend to revise within. Most of the time, they seem to be working within word and phrase units, wherein 67% of their revisions were carried out. Their revisions to clauses and T-units comprised 17.7% of the total number of revisions; and only 5.3% of their revisions were carried out at the text level. It seems that not only have first semester English participants perceived writing as an English language practice, but they also confined their treatment of the foreign language to a localized and superficial level. This might reflect inability to act at higher structural units.

As far as location of revision is concerned, excessive immediate revisions (65.83% of all revisions) were observed in the writing of potential English majors in their first semester at college. This means that participants at this level process their writing locally and in a linear manner. As they go on slowly in their writing, they stop to revise in the very immediate surroundings of the point of inscription. Most of the time, it seems, they become unaware of the text written so far before this point.

At E4, revision behaviour of writers in the English department changes in different ways. Most notably there was an abrupt decrease in the frequency of revisions by at least 40% from that of first-semester students. This is not an uncommon phenomenon. Previous studies showed that frequency of revision decreases as skill in or experience with writing increases (e.g. Thorson 2000, Stevenson et al 2006). However, immediate revisions increased, indicating that writers at E4 are probably still confined to a linear style.

In their levels of revising (i.e. processing at linguistic, textual, or contextual levels), E4 English majors have not displayed a noticeable variation from their first-semester fellows. Focus on spelling and mechanics remain prevalent, but word choice (lexis) and meaning (semantics) revisions have slightly decreased. This gives an indication that at this level students are still much engaged with the formal aspect of writing. Their

recently learnt rules of grammar and discourse structure have resulted in an increase, however slight, in revisions to the syntax.

At a macro level E4 writers once again showed more concern only to the structural aspect of text (i.e. discourse). Content reorganization and modifications beyond the T-unit (i.e. textual revisions) have even dropped in proportion to record its lowest in all the groups. This supports earlier research on the limited capacity of the working memory of early writers (Scardamalia and Bereiter 1987, Kellogg 1994, McCutchen 1996 & 2000).

It has become clear that English majors in their fourth semester are more oriented to the structural aspects of their writing. Revisions to mechanics, syntax and discourse show concern for structure at different hierarchical levels. Unlike their juniors in level-one who seemed to be severely confined within word-level, E4 are now able to formally build up a text at relatively higher linguistic levels. But this, at least in their revisions, has come at the expense of content.

Being subject to systematic learning, the fourth semester English majors have shown an increase in awareness of the structural aspects of language at the intermediate level. They act mostly at clause and T-unit levels and they make more revisions to the structure of these units than to content.

At the eighth level we see automatization at work. Occurrences of revisions in the writing of senior English majors demonstrate a drop to almost a third of the number of revisions performed by E1. This asserts the developmental nature of revision frequency. E8 participants are assumed to have acquired a sufficient knowledge of the language as to automatize their production. Automatic production of language according to Schmidt (1992) is quicker and less controlled. Having less control over the production process will mean that a writer could go on writing not even realizing mistakes, if any. The concept of automatization offers yet other interpretations. It seems that writing has been kept progressing by two related factors: (a) writers in the advanced levels struggle less over lexical and structural choices; and (b) they are making fewer mistakes. In both cases there is less need to halt and revise during the act of writing. As a result English majors at the most advanced level of college experience are comparatively freed from lower-level linguistic concerns and more able to consider content of their text, develop pragmatic goals, and attend to them. Unfortunately, although the study provides robust

evidence for a decrease in revision frequency as experience with L2 increases, relevant research does not provide support to that. In fact a recent study (Spelman Miller et al, 2008) found no significant decrease in revisions in L2 writing along three secondary academic levels, but a decrease in form revisions, in particular, was reported in Lindgren et al (2008). However, a number of studies coincide with the present one in finding decrease in revision frequency a developmental measure, not across levels of L2 experience but within L1 (e.g. Faigley & Witte, 1981) or between L1 and L2 (e.g. Thorson, 2000, Chenoweth & Hayes 2001).

Location of revision in the E8 group shows evidence of development from E4, but the fact that E4 participants have shown a decrease in the number of immediate revisions from E1 could only mean that what is happening in E8 is in part a correction to the decrease in E4 revision strategies. There was in fact a decrease in the number of immediate revisions, but this decrease is too insignificant to conclude that writers have at last abandoned their linear mode of writing and are now dealing with the text at a global level. Neither does the (significant) increase in the number of distant revisions, from 8.7 revisions per hundred words in E4 to 14.57 revisions in E8 indicate an overall progress along college years since in E1 revisions to distant location were even more frequent than in E8 (19.17 revisions per a hundred words).

In addition, senior English majors' revisions were focused on the language units of clause and T-unit. With a dramatic drop in word-level revisions and a remarkable increase of revisions at the domains of clause (increased by almost three-fold) and T-unit (increase by more than double), it is feasible to conclude that E8 writers' scope of treatment of structural units became more distributed. However revisions to larger chunks remained minimal.

In broader terms, English majors demonstrated a drop in the proportion of formal revisions at the advantage of conceptual revisions which increased from 17.74% in the first semester to 35% in the eighth semester. Faigley and Witte (1981) also reported similar differences in meaning revisions among students, advanced students and adult writers. The drop in conceptual revisions in the fourth-level students (to 11.56%) below that of first level can be attributed to the focus on linguistic form during the second year in the English department. Decrease in formal revision (which is met by increase in conceptual revisions) has been reported to characterize L1 writing when compared with L2 (Lindgren & Sullivan, 2006).

Because of the varying patterns of change in the different aspects of revision behaviour, it is difficult to provide a simple judgement in regards to the hypothesis H1b.1 (stated at the beginning of this section).

8.3.1.3 Writers' awareness and concerns

Writers' awareness of purpose and audience and their concerns about linguistic, textual and socio-contextual aspects of their writing have been evaluated through eliciting their 'immediate recall' responses to a set of questions. Much insight into how writers perceive their own act of writing was gained from the data. The following hypothesis had been proposed.

> **H1c.1** It is predicted that English-major writers will demonstrate development at different levels of tertiary education in their awareness and concerns.

Being so busy with localized inscription and encoding, the majority of E1 writers did not show a great focus on the writing task, as the majority of them (54.5%) of them reported focus on task at the beginning only. They, moreover, put task fulfilment as a third of six priorities that included structure, diction, content, text structure and audience awareness.

Beside focus on task, focus on audience also suffered from E1's localized, surface level formal processes. There was a minimal concern for Audience: first, only 9.1% of writers reported 'I thought a lot of who is going to read the essay, and tried to adopt an appropriate way of addressing the reader'*;* and second, in reporting 'Content is convincing to the reader*'* as having the least priority among a list of six linguistic, textual and contextual aspects of writing.

Similarly, the order of priority E4 writers gave to text structure and syntax indicates a tendency similar to the one indicated by revision behaviour. They reported giving higher priority to text structure and syntax, and lower concern for content and audience.

Perhaps a general picture of fourth-semester English majors can be seen in their report of their roles as writers. In the previously discussed measures they showed varying degrees of fluency, content-form processing, concerns, etc. In their answers to the last QIR they have indeed reported the three roles in equal proportions. One third of them saw themselves as language learners, striving to perfect language. Another third perceived their role as that of a knowledge-teller; yes, content is important but with

minimum manipulation, and minimum consideration of audience. The third part reported seeing themselves as communicators for whom conveying a message to an audience is the primary concern in their writing. It is so supportive to the claims of the present study to see that the effect of continuous systematic learning of the English language is starting to induce more skilful writing strategies and mature socio-cognitive awareness. It is particularly interesting to see this development in some (not all) writers, in some (not all) aspects of writing and to some (not an ultimate) degree in semester-four English majors; as the ultimate overall development will probably be demonstrated, as the study has hypothesised, by E8 writers.

The discussion of eighth-semester English group's awareness and concerns would better begin from where the discussion on the fourth-semester group ended, that is from writers' reported roles in the act of writing. In E8 more than half the participants perceived their role in writing as communicating a message to an audience. This is a clearly high-order developmental role according to the developmental paradigms that were theoretically embraced by this study. Whether this role can be described as *knowledge-transforming* (Scardamalia and Bereiter 1987) *writer-based prose* (Flower 1977), *transactional writing* (Britton et al 1975) or simply *communicative writing* (Bereiter 1980), it obviously indicates that writers, from the perspective of this study, have ceased to act as language learners and started to consider authentic purposes in their writing, however unauthentic the writing task might sound to them.

The order of priority E8 gave to linguistic, textual and contextual concerns of their writing process provides evidence for a global view of writing. Awareness of the importance of focus on task reflects both the influence of apprenticeship in the English language department and socio-cognitive maturation of writers. According to the developmental paradigms (proposed in Chapter Three) focus on task derives from socio-cognitive awareness of the purpose of writing as opposed to private speech that does not normally occur as a response to a task.

Moreover senior English majors' reported frequent consolidation of task affirms that they have actually developed a sense of the overall gist of what they are writing, and that their representation of gist demands referring back to the written representation of the writing task, i.e. the prompt. Therefore, it was not surprising to find out that task was also given a first priority, sharing the position with text structure.

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In stimulated recall sessions, English majors have shown development in their perception of writing and awareness of purpose and audience. Their responses range from a severe preoccupation with localized, low-level issues in writing (mostly spelling), in semester one, to a high-level transformation of content and structure to interact with, convince and/or intimidate the reader, in the eighth semester (see Chapter Seven for examples and discussion).

8.3.1.4 Text quality

H1d.1 It is predicted that English-major writers will demonstrate development at different levels of tertiary education in the assessed quality of their texts.

English majors have shown a systematic and steady progress in all the assessment criteria as they go up the academic scale except in Task Fulfilment, where E1 and E4 swap positions by a very small difference. In particular, E8 have demonstrated a remarkable improvement in Audience awareness, Structure and Diction, and Grammar and Usage. Improvement in vocabulary and language use that is associated with L2 experience was reported in Sasaki (2000), and in the overall quality of the produced texts was reported by Lindgren et al (2008).

It is interesting though to observe that much of the improvement in the assessed text quality happened between the first and fourth semester, around which time most of the learning is focused on language issues. This contrasts with the study's other findings on fluency and writer's awareness, wherein much of the improvement happens between the fourth and the eighth semesters. Once again, focus on accuracy and variety of structure (in the sophomore year in the English Department) is probably playing a major role here.

In short, there is enough evidence as to accept Hypothesis H1d.1, that there has been a systematic improvement along university levels in the quality of texts written by English majors.

8.3.2 Development in Computer Science majors

8.3.2.1 Fluency

The following hypothesis on development of fluency in Computer Science majors has been proposed.

H1a.2 It is predicted that Computer Science majors will demonstrate development at different levels of tertiary education in terms of fluency of production.

In their first semester Computer Science potential majors displayed a relatively fluent writing behaviour. On average they produced texts of 155.2 words, at an average production rate of 5.03 words per minutes. Their average length of continuous text span between long pauses (of five seconds or more) was 3.22 words per minute. More than three quarters of what they wrote was kept in their final text.

CS1 pause records show that on average they waited for less than one minute before starting their writing and paused for about 69.78% of their total writing time.

Contradictory fluency measures were found in fourth-semester Computer Science majors. The average length of their texts was shorter than that of first-semester students, but they wrote with a higher rate of production, (the difference in the rate of production, however, did not prove to be statistically significant). Moreover, their mean length of text span was the highest in all Computer Science groups at the three levels.

However, CS4 participants' fluent performance, it seems, could only mean that they wrote their texts quickly without paying due care to the demands of the writing task. This conjecture is supported by the fact that they did not seem to have negotiated the content of their text much. They kept in their final texts 85.6% of what they wrote, and their frequency of revision was relatively low.

At the eighth semester, Computer Science participants showed a remarkable improvement in some fluency measures. They produced texts that are significantly longer than both CS1 and CS2. However, their rate of text production (PR) has not improved significantly, and the decrease in text span length (TSL) indicates an unsystematic change. On one hand, they have demonstrated significant improvement from CS1 in the amount of text they are able to process and produce in one time span (TSL). This could indicate a high level of automaticity and ease of retrieval. On the other hand, the fact that TSL in CS8 is lower than that of CS4 can be explained by three alternative reasons: (1) TSL might not be a valid developmental measure; (2) CS4 writing's improved TSL indicates an increased capacity of processing in the working memory; (3) It is possible that due to concerns over content CS8 writers' ability in language processing has decreased.

Although **H1a.2** can be confirmed on the basis that development has happened in the fluency measures. It is important to note that with the exception of CS4, high standard

deviations in text length and PR suggest considerable variation between Computer Science individuals.

8.3.2.2 Revision

The following hypothesis addresses revision behaviour in Computer Science groups.

> **H1b.2** It is predicted that Computer Science majors will demonstrate development at different levels of tertiary education in terms of revision behaviour.

In their first semester Computer Science potential majors made 23.74 revisions for every 100 words they wrote, with 85% of them in the immediate surroundings of the point of inscription. Revisions at distant locations were very uncommon as they accounted for only 1.65% of the total number of revisions. Moreover, 55% of the revisions by this group were carried out at word or phrase levels. Revisions to structural syntactic units (i.e. clause and T-unit) amounted to 29% and, 16% were done at a text level.

In terms of level of processing, revisions to the conceptual content of CS1 participants' texts are severely lacking. The majority of changes (72.68%) were done at a formal linguistic level; with spelling getting a good 46.85% of these; mechanics and syntax sharing between them one fifth; only one incidence of discourse structure revision was detected in this group.

In their fourth-semester Computer Science majors revised much less frequently than their peers in CS1. This infrequency of revision has contributed to a fluent production. Writers at this level do not seem to have let any concerns for correctness and/or appropriateness hold back their progress in the writing activity. When they stopped, they probably did so briefly, and attended mostly to word-level concerns (50% of their revisions were at word level).

Fourth-semester Computer Science majors have clearly focused on formal linguistic issues when they revised. Only 27.32% of their revisions were done to the conceptual content of what they wrote. Even in their formal revisions, they have mainly been concerned with lower level inscription conventions of spelling and mechanics which amounted to 62.95% of their revisions. Syntactic structure was a minor concern and structure at a discourse-level was barely an issue. In their treatment to meaning they seem to have given equal treatment to meaning at both utterance and text levels, and

slightly more attention to word meaning and word choices. In short, E4 in their revision behaviour represent a typical view of L2 writers whose focus is mainly on surface-level.

Moreover, students at this level have not yet recognized the potential of writing (as opposed to speech). And in the absence of instruction they maintained a linear style of writing without revisiting distant locations of their texts.

In the eighth semester, Computer Science majors do not seem to exhibit much improvement in their revision behaviour. They continue to linger over or around the point of inscription without much backward revisions; and their proportion of conceptual revisions has only slightly increased. The change has been statistically proved to be insignificant. Moreover, their scope of revision has not significantly differed from other groups except at text level, wherein more than one quarter of their revisions were done to text chunks.

8.3.2.3 Writers' awareness and concerns

> **H1c.2** It is predicted that Computer Science majors will demonstrate development at different levels of tertiary education in terms of writers' awareness and concerns.

Computer Science majors at the first level showed great attention to the task. 60% of CS1 participants reported consulting the writing prompt several times during composing and half of them reported considering the writing task constantly. They also placed *Focus on task* as having a first priority amongst six other issues to consider when writing. Consideration of task and task prompt can be attributed to a tradition formal instruction that places a great deal of emphasis on comprehending and following what the task prompt asks for. Next to *Task* CS1 students have collectively reported *Syntax* as a second important issue in writing followed by *Content* and then word and word meaning. *Structure* of text shared the lowest position with *Audience*. This is a very typical picture of pre-college situation except that content was given a higher status than one might have expected. It nevertheless explains the high proportion of freshman Science majors who perceived their role in writing as knowledge-teller.

In their fourth semester Computer Science majors continue to prioritize *Task* and *Content* issues, but *Audience* have become more considered. However, linguistic structure both at sentence and text levels gets minimal focus. This is very much in

harmony with revision behaviour. CS4 writers seem to have lost attention to formal structure perhaps because of lack of systematic input in the foreign language during the sophomore year. In their QIR, it is clear that they do not perceive their writing as a language practice.

Computer Science seniors have not displayed a notable developmental shift in their awareness and attitude. Their order of priorities does not reflect an increased focus in issues related to their text as a global unit, nor does it reflect better attention to audience. As the majority of them have reported, it seems that these writers are adapting the role of a knowledge-teller in their composing process. They displayed the content according to the demands of the task, but without much transforming for the sake of the reader.

In stimulated recall sessions, Computer Science participants showed a developmental pattern. In their first year most of their SR accounts were concerned with spelling and lexical inadequacy. They have also expressed much concern about their inability to formulate what they want to say. The senior Computer Science student who participated in the SR session has occasionally been found to be held in an internal, intellectual dialogue to question the content of her text and to test the usefulness and the truth-value of what she has put on paper. It is clearly an instance of knowledge-transforming (Bereiter and Scardamalia, 1981; Flower, 1979).

8.3.2.4 Text quality

The following hypothesis has been formulated to address the issue of assumed improvement in the quality of texts produced by Computer Science students.

> **H1d.2** It is predicted that Computer Science majors will demonstrate development at different levels of tertiary education in terms of text quality.

Assessment of texts written by Computer Science groups has shown a different mode of change along the university levels than that of English groups. Students in their first semester (CS1) have outperformed those in the fourth semester in all measures. Moreover, they have even outperformed their eighth-semester seniors in Task Fulfilment, and Development and Organization. It is tempting to attribute the drop in CS4 quality of writing to lack of formal study of the English language after the second semester. However, it is important to note here some context-specific details about new college candidates. At high school, although both Science and Arts students study the

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same English curriculum and go through identical testing procedure, the emphasis on the importance of English is greater in the Science section. As a result, it is often observed that Science students (e.g. potential Computer Science majors) have a better command of the foreign language when they start college.

Looking at the difference between Computer Science groups in their first and eighth semesters, enough evidence can be drawn to support the hypothesis presented at the start of this section. Statistical tests have shown significant changes in the overall text quality across the groups, but with an unsystematic pattern of change. In other words, the change does not reflect a progressive improvement in writing in the foreign language of writers from the Computer Science department over the course of university years.

8.4 Differences in the development of the two subject groups

This second section of the discussion on findings looks into differences in the way the groups of the two subject areas develop. It addresses the following research question.

RQ2. Do the writing process and writing strategies of university students of the two majors (English language and Literature and Computer Science) develop differently along the academic levels?

8.4.1 Fluency

The following hypothesis addresses possible variation in the development of fluency measures during college experience.

> **H2a** It is predicted that writers of the two different subject areas will develop differently along the levels in terms of fluency of production with English majors showing more improvement.

The two subject groups have demonstrated differences at all the three levels in fluency measures. At the first level CS1 students outperform E1s in text length, rate of production (PR) and text span length (TSL). At the fourth level Computer Science students produced shorter texts than their English counterparts, but with greater production rate and greater fluency between significant pauses (i.e. TSL).

At the eighth semester, the participants of the present study showed a remarkable improvement in all fluency measures, but again this aspect highlights differences between achievements of English and Computer Science majors. In their eighth

semester the English group produced texts that are more than two times (200%) longer and with a 33% increase in the rate of production from those in their first semester. The Computer Science majors, however, showed an increase in their text length by only 42% and did not achieve systematic improvement in the rate of production. RQ2 is accordingly answered with an affirmation of differences in the way the two groups develop in regards to fluency.

8.4.2 Revision

H2.b It is predicted that writers of the two different subject areas will develop differently along the levels in terms of strategies of revision, with English majors showing more improvement.

Based on the understanding of the automatization paradigm (Chapter Three), it can be assumed that development in revision strategies will first and foremost be indicated by a decrease in revision frequency during the writing activity. It is well established that increase in linguistic and/or writing experience will yield fluent writing with less interruptions (Chenoweth & Hayes, 2001; Thorson 2000). Some of the seemingly contradictory findings (e.g. Hirose & Sasaki, 1994; Faigley & Witte, 1981) provide a sense of relativity to the relationship between frequency of revision and writing proficiency. To put it briefly, excessive revisions may indicate less writing proficiency, but too little (according to Faigley and Witte) is also an indication of lack of skill in writing.

The revision frequency variable in the present study proved to have a discriminating potential amongst subject and level groups. At the first level, as with fluency, Science students showed a better revising skill, simply by revising much less than potential English majors. In the fourth semester there was a remarkable decrease in both subject groups. In the eighth semester the two groups showed a different pattern of change. While English majors showed more progress by making 40% less revisions, CS8 writers' revisions have increased in frequency to a level that is comparable to their juniors in the first semester.

Proportion of formal and conceptual revisions was found to be another discriminating variable, yet with no claims for a systematic improvement in the English groups. In the first semester the two subject groups showed seemingly different proportions. Potential English majors showed more formal processing than their Science peers. Then in the

fourth semester Computer Science maintained the same proportion of formal and conceptual revisions, but English majors demonstrated an increase in the formal and a corresponding decrease in the conceptual category. Although this is taken as a decline in the skill of revising, it can be attributed to E4 participants' mode of learning. The specialised study in English formal structure, during the sophomore year, could have resulted in more concern of the formal aspects of the writing activity. In the eighth semester both subject groups achieved an observed decrease in formal revisions and an increase in conceptual revisions. However, the only development that was proved to be significant is that of English majors along the whole span of 8 semesters. In other words E8 demonstrated a considerable decrease in the proportion of formal revision to the advantage of conceptual revisions. Automatization, it seems, has at last paid off and students now are relatively more focused on the content of their composition.

A closer look at the distribution of the level of mental processing of revisions reveals even more discrepancies between the groups. At a global level, Computer Science writers carried out fewer revisions to the formal structure of text, i.e. discourse, than did their English fellows in all the academic levels. However, at a global conceptual level Computer Science writers of all levels manipulated and rearranged content, in textual revisions, more often than the English students. This was unexpected as findings have so far proved that English students develop skilful revising strategies as they go up the tertiary levels. Yet again, when taken together textual and discourse measures provide an indication of global attention to text in which English majors once again demonstrate more development.

Revising meaning, both at a word level and propositions level, has not shown a systematic pattern in both groups, but a notable ultimate progress in the semantic revision was found to be significant in both groups. On the other hand, revisions to structure at sentence level show differences between the two subject groups. CS1 conducted more revisions to the syntax in the first semester, but in later semesters English majors have shown a systematic increase in revisions to syntax. All these increases were met with a decrease in the proportions of revisions to spelling and mechanics. In particular, proportions of revisions to spelling have dropped systematically in both subject groups over the course of university years, with more notable decrease in English majors.

In summary, evidence from all revision measures, i.e. frequency, scope and level, supports the hypothesis stated above (H2.b) that revision behaviour of the two subject groups develop differently, and that by the eighth semester English majors show more improvement in their revision strategies.

8.4.3 Writers' awareness and concerns

> **H2.c** It is predicted that writers of the two different subject areas will develop differently along the levels in their awareness and concerns, with English majors showing more concern for linguistic and textual aspects of writing.

According to the hypothesis no differences are expected to be found between participants of the two subject areas in relation to contextual concerns. In reality, although writers from the two subject groups have demonstrated variation in their focus on task and audience, no significant differences were found between the groups in regards to focus on task.

The two subject groups have nevertheless demonstrated significant variance in their reported concern for audience. In particular, the proportion of E1 writers who reported 'Constant audience awareness' was considerably higher than that of CS1 writers. In semester four, however, E4 participants did not record improvement from first-semester participants, but the CS4 group showed a remarkable significant increase in reporting such '*constant*' awareness of audience. On the other hand, the percentage of Computer Science writers who reported 'no consideration of the reader' of their text fell sharply from 50% in semester one to 5.6% in semester four. However, in semester eight both subject groups took opposite directions to the so far established trends, excluding level-four groups of both subject areas. By the eighth semester, English majors have shown development in considering audience by a significant increase in the number of writers who reported considering an audience constantly, and an absolute disappearance of reporting 'no consideration of the reader'.

Variation between English and Computer Science writers in their ordering of priorities can be summarised in three points. First, in both subject groups at all levels concern for task has been given a high priority, but slightly less so in E1 and E4. Second, *structure* at both sentence (T-unit) and text levels gains more consideration as we go up the academic ladder in English majors at the expense of *audience* and *content*. Third, there

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does not seem to be any pattern of variance along the Computer Science majors or between groups of the same level.

Writers' awareness of their role in the writing process showed differences, though not statistically significant, across the subject groups in the first and fourth semesters. By the eighth semester, statistically significant differences appeared. The general trend was that as English majors progress along the academic years, they perceived themselves less as knowledge-tellers, much lesser as language-learners, and more as communicators. In other words they worry less about language issues and focus more on getting a message through to the reader. On the other hand, Computer Science writers, in their first semester, show a lesser concern about language than their English-major peers and much more concern for communicating a message. At the fourth semester, they start to develop a knowledge-telling role, which by the eighth semester have become their major perceived role in writing. In stimulated recall sessions, the CS8 student demonstrated much concern about the quality and accuracy of content.

8.4.4 Text quality

> **H2d** It is predicted that writers of the two different subject areas will develop differently along the levels in terms of text quality, with English majors showing more improvement.

As with measures of fluency, first-semester Computer Science participants have demonstrated superiority in text quality over their peers in the English department. It is arguably possible to associate that with circumstances in the socio-academic context prior to joining the university (more detail in 8.3.2.4 above).

In the present study, text assessment findings suggest that not only are CS1 participants better than those in E1, but also they can sometimes be better than both English majors in their fourth semester (i.e. in Task Fulfilment, and Development and Organization), and their Computer Science seniors in the fourth semester. The decrease in the latter group is probably due to the lack of systematic learning of the foreign language in the two semesters that preceded data collection. If that is the case then it is plausible to conclude that formal instruction affects the writing process positively.

Text assessment, to put it briefly, placed the groups in three levels of text quality with one noticeably superior group, one low group and four groups in between, exchanging positions in the different measures: (1) Superior group: English majors in their eighth

semester; (2) Intermediate groups: Computer Science in their first and fourth semester, and English majors in their fourth semester; and (3) Low group: Computer Science in the fourth level and English majors in their first major. On the other hand, other measures of process, strategies and attention have clustered the groups into slightly different developmental categories (discussed in 8.6 below). However, even in the broader categorization E8 maintained their leading position and E1 and CS4 remained in the basic level of the scale.

In short, the hypothesis (H2d) is confirmed. Both subject groups have one way or another demonstrated development in text quality. English majors, moreover, have demonstrated more improvement in text quality over the course of their study, and a pattern of development that is steadily progressive, i.e. with no decrease at any point.

8.5 Text quality, writing process and writers' reports

The last research question addresses the issue of text quality from a different angle. In particular, it asks if variation in text quality is related to the other hypothesised developmental measures.

RQ3. Can variation in text quality be explained in terms of fluency, revision behaviour and writers' awareness and concerns?

As mentioned in Chapter Six, no hypotheses have been put forward in addressing RQ3. This is because of the exploratory nature of the question, and because of the large number of variables involved in testing relationship between the main constructs. In the following sections relationships between text quality and both writing behaviour and writers' awareness are explored.

8.5.1 Text quality and the writing process

8.5.1.1 Text quality and fluency
The issue of text quality and fluency is a complicated one, yet it is further complicated by the multi-measure approach in this study. Text quality has been defined in five criteria, and a sixth one was represented as the average score of all the criteria. Moreover fluency has been defined by four measures; and because of the lack of correlation between some of them, one would assume that each measure will contribute differently to text quality. The first correlation test was run between text length and average text quality. Holistically tested, a strong correlation has been found between the

two. However, when individual groups were tested for relationship between this fluency measure and text quality, there appeared variation in the findings. The strongest correlation between the amount of text and average text quality was found in senior Computer Science students. In CS4 and E8 groups, on the other hand, no correlation was found between the amount of text writers produce and the score they get in text assessment.

Average length of text span, another measure of fluency, has also holistically correlated with average text quality, but individual groups have not shown significant correlation. Moreover, text quality correlated positively with the production rate in two groups, CS1 and CS8; and correlated negatively, though mildly, with the proportion of pause time to total time. Contrary to expectations, initial pause length did not correlate with text quality at any level or with any subject group.

8.5.1.2 Text quality and revision

It has been found that there is a moderate association between frequency of revision and the assessed quality of the final texts. The fewer revisions writers made the better quality achieved. The relationship between the two can be recursive and bidirectional. First, it has been established that fluency (which can mean less pause time and fewer revisions as well as productivity) develops as experience with language increases, and so does knowledge of language. Development in language knowledge deems revision less necessary and therefore causes a reduction in the frequency of revision. On the other hand, it could be that a text that is less interrupted by revision comes out with a coherent flow of ideas and support as to affect its quality for the better.

An index of revision level was improvised to account for the two developmental dimensions of scope and level of processing. It has been proposed that the more skilful a writer is, the wider the scope of treatment in revisions. Similarly it has been assumed that skilful writers will attend more to content and less to form. Accordingly, levels were put in a developmental scale that runs from one to seven where values reflect the scope of treatment and level of processing. Statistically, a significant moderate correlation was found between text quality and values in the revision-level index (Pearson correlation coefficient is .484, $p < .05$).

8.5.2 Text quality and writers' awareness and concerns

When association was attempted between how writers perceive their writing strategies and concerns and what they actually produced, some interesting details appeared. In general terms, there has been very little agreement between what writers think of their writing process and the judgment of text raters. However, individual groups showed variation in the relationship between the two perspectives of writing. Computer Science potential majors in their first semester displayed some association between the degree of concern for audience and the score they achieved in Development and Organization of text. The more concern they gave to audience, it seems, the more they attended to developing and organizing their ideas and, thus, the better they scored. In addition, they reported a lesser concern for the formal structure of text, and that resulted in a reduced quality of Grammar and Usage. Potential English majors in their first semester and participants of both subject-areas in the fourth semester did not show significant relatedness between reported awareness and concerns on one hand and assessed quality of relevant textual features on the other.

Although in quantitative research practice (e.g. Connolly 2007) it has been warned that correlations could be misleading and that observed related changes in any two variables could have been induced by a third factor, some particular findings have been strikingly meaningful. It has been very informative to know that the association between writers' perceptions and raters' judgements on textual criteria becomes stronger as experience with language increases. Whether writers at higher levels of skill are more rightly aware of their strategies in writing or their awareness reflects effectively in the final product could open up a debate in L2 writing research.

8.6 Developmental clusters

Despite variation in some of the measures within the research constructs, an overall progressive tendency can easily be tracked along the academic scale in almost all the variables that were put to test. Data analyses have revealed certain groups were associated with growth in what have been established as developmental measures. However, the analysis did more than just identify the groups with the developmental features, or degrees of the features, they display. It resulted in clustering the six groups into three categories representing three levels of maturity in writing behaviour, awareness and text quality. Each of the clusters has spontaneously, but not arbitrarily,

included two groups. The clustering did not correspond to academic levels except on the highest level. The lowest-level cluster comprises participants from first-semester English and fourth-semester Computer Science. The writing performance of this group was characterised by scant initial planning, low word count, and extensive immediate revisions at surface level. It seems from their responses to the QIRs that they were preoccupied by linguistic concerns and they prioritized issues of syntax and lexis over discourse and contextual aspects of their writing.

The middle-level encompassed E4 and CS1participants. (It has been explained earlier that the superiority of CS1 over their seniors in the fourth semester can be attributed to the recent influence of high school instruction.) Writers from this cluster displayed more initial planning, sectional planning and improved fluency. They reported giving priority to content and text structure. In their stimulated recall sessions, the individuals from the two groups reported inconsistent accounts of how they went about their writing activities, and showed different degrees of development. The similarity between the two groups seems to have arisen from a so-far similar formality, though different intensity and diversity, of foreign language instruction. It is therefore plausible to assume that, the similarity could have been the product of an unspoken belief in the importance of accuracy and well-formedness in the foreign language.

The groups that show highest level of writing proficiency, i.e. E8 and CS8, make up the superior cluster in this taxonomy. They displayed a remarkably higher degree of fluency, significantly longer initial pauses, and higher capacity of dealing with the text as a global unit. In their immediate retrospective accounts they reported giving priority to contextual and discourse aspects of the writing. And when retrospective recall was stimulated by the playback facility of the logging program they commented on their writing events in a way that indicates conscious awareness of their writing process, showing less concern with language and more concern with the message of what they say. They constantly referred to the gist of their text, or parts of it, and its organization. Seeing their text as a global unit and being able to deal with it at distant as well as immediate approximations to the point of inscription provide evidence of development according to the speech-to-text paradigm of development, proposed earlier in Chapter Three. It shows distinction from first semester students, none of whom commented on the overall gist of what they wrote.

It must be noted, though, that college experience for non English majors has by the eighth semester resulted in a significant degree of development both in features related to language proficiency and in areas that have been reported to be independent from English language proficiency (areas that are not language specific, e.g. development of content, awareness of audience, and writers' authority). For one thing they have acquired a good deal of skill, patience and interest to keep them writing longer stretches of text, paying due care to how clear and organized their text is (as to be understood by readers), and taking a global approach in treating the content of their text. And while they seem to have continued to adapt knowledge-telling strategy for most of the cases, they seem to be more occupied by concerns for content than form. This echoes what Scardamalia and Bereiter (1987) described:

> *Differences in the quality of written compositions can be attributed to the differences in the two knowledge stores that form part of the knowledge-telling model: content knowledge and discourse knowledge. P. 347*

8.7 Summary

Development in fluency, pause, and revision behaviour of the participants of this study corresponds to the principles of the *capacity* hypothesis (McCutchen, 1996 & 2000). Freeing the working memory from surface linguistic concerns allows for more focus on content development and organization. This was demonstrated by higher percentage of content (textual and discourse) revisions in level 8 groups of both subject areas. The English majors, in particular, showed a remarkable decline in revisions made to spelling, which comprise 61% of the overall count of revisions in the first semester and only 20% in the eighth semester. This decrease is met with a proportional increase in revisions at text and discourse levels in the eighth semester group. However, while RQ1 is answered with another 'yes' for development in revision behaviour, the general trend amongst the participants of all groups and levels remains form-oriented. Lack of substantial conceptual revisions in student/basic writing has been reported in both L1 (Emig 1967, Flower and Hayes 1981) and L2 (Stevenson et al 2006, Van Gelderen,& Oostdam, 2004) contexts.

Location of revisions as approximation to the point of inscription reveals linearity, or otherwise, of the writing activity. Distant revisions, for instance, were seen by Thorson

(2000) as indicating a recursive writing process. Within the speaking-to-writing development paradigm (discussed in 3.2.2 above), perceiving text as a wide-scale unit of different spatial points enables writers to control text at a global level. Contrary to the assumptions, however, no significant decrease in immediate revisions has been detected along college levels or across subject areas. Immediate revision location remained the most common in all groups with a minimum of 60% revisions in immediate location (in CS8).

In addition, moving around the text and making revisions to distal locations shows that writers are aware of and concerned with the gist of what they write rather than with individual linguistic units. As would be expected, E8 made twice as many revisions in the distant category as E1 writers did. However, it is writers in the fourth-semester who made the largest proportions of distant revisions in both groups. Other than that, no significant differences were found between the groups or the academic levels in terms of location of revision, i.e. no developmental pattern was detected.

Some of the variables were difficult to explain in the light of previous research. The treatment of text span, for, example, differed from similar research. Chenoweth and Hayes (2001), for example, calculated length of burst between pauses and revisions. In this study average text span between significant pauses was considered based on the assumption that the working memory has a limited capacity that increases with language experience (Chenoweth & Hayes, 2001; McCutchen, 1996). Text span length was thus taken as developmental measure, and it has been found to be so.

Writers' awareness of purpose and audience has increased along the three academic levels. One of the areas participants improved in is awareness of the world outside self, i.e. awareness of the presence and needs of the recipient(s) of what they write. The notion of audience awareness is very much related to text autonomy (Flower 1979). The shift from expressing self to addressing the others is one of the developmental paradigms that informed and shaped the present inquiry. This was guided by an assumption that is best described in Flower's words:

> *... effective writers do not simply express thought but transform it in certain complex but describable way for the needs of a reader. Writer-based prose ... is a description of this undertransformed mode of verbal expression. It reflects the associative narrative path of the*

writer's own confrontation with her subject ...   In contrast, Reader-based prose is a deliberate attempt to communicate something to a reader. To do that it creates a shared language and shared context between writer and reader. It also offers the reader an issue-centered rhetorical structure rather than a reply of the writer's discovery process (1979, p.19&21)

An *"issue-centered"* structure was spotted in the stimulated recall of Dania, the CS8 participant, who made a persistent effort to arrange the information in a way that is not only clear to the reader but also as to avoid repetition. She was controlling her *"private"* flow of thought and rearranging it according to the needs of the recipient. Very little evidence of such *"transformation"* was found elsewhere in the stimulated recall protocols.

In their first levels, it seems, writers perceived writing as language practice with 52% of them reporting their role in writing as that of displaying language skills (compared to 15.4% in the eighth semester), and 10 out of 20 considering audience as the least of six other linguistic and contextual priorities.

Students' evaluation of what concerned them most during the writing sessions revealed another developmental but unsystematic trend, with differences between English and Computer Science majors. The general trend, however, indicates giving higher priority to task and audience in the more advanced groups.

It seems that dwelling in the tertiary academic context with or without systematic learning experience of the target foreign language (English) resulted in development in writers' awareness of both the contextual environment and the global message of what they say. In their stimulated recall accounts participants in the eighth semester, both English and Computer Science, showed a relatively high degree of audience awareness and made deliberate attempts to inform, convince and (at least in one occasion) intimidate the reader. Moreover, they demonstrated greater concern for content and content organization. In particular they utilized knowledge from their subject-area and from their socio-academic experience to enhance the content. Sometimes they reorganized the content to make more sense of it.

However, lack of systematic learning of the foreign language has by the fourth semester affected text quality in Computer Science students. Paradoxically, though, fluency has increased. This increase in fluency in CS4 can be seen from a different point of view

than that of E4. While E4 writers' more fluent production has been attributed to automatization, CS4 participants' performance gave the impression that their increased fluency was due to a sort of 'we should get this done quickly' attitude. This attitude is evident in the amount of time participants allowed for their writing. As with all other groups they have been allowed 40 minutes to write their essays. On average they only spent about half of that time (19.91 minutes) in writing. Moreover, CS4 writers conducted fewer revisions than any of the other groups (except E8), and they kept 85% of their proposed text. It is also evident in the relative infrequency of revision which indicates a reluctance to stop for reviewing what they have written so far or diagnosing a problem with the text. And finally their reported infrequency in reading the writing prompt can also mean that CS4 were in a hurry to finish their essays.

The findings of this study suggest that a great deal of writing behaviour of most of the participants can be described as *performative* writing (Bereiter, 1980). In other words writers were often engaged in applying a set of learned rules to generated content. In fact *Language learners* is the term that best describes the majority of participants in this study. One of the students represented this attitude in her essay in the following remark. Ironically the extract also displays a much observed linguistic inaccuracy in the population of the study.

Text extract 8.1

> *In my opinion the Englishe language it's very simple language but it need for deep study for grammer, speling and how to make a good sentinces without any mistakes. (E4-4)*

Using Chenoweth and Hayes' (2001) terms, the translator (which is assumed to be responsible for processing the conceptual content into a linguistic form) seems to have a double function in L2 writing. It is either that, or there is a fifth processor that is responsible for L2 writers' processes of finding structures and words in the target language, to express thought. Although empirical evidence is necessary to be able to claim that there is a processor that works interdependently with the established processors, it is useful at this point to envisage the position of such processor in the domain of working memory or "Internal Process Level", as referred to in Chenoweth and Hayes (2001). The processor will be called the *encoder.* The following figure (8.1) suggests a visual position and function of L2 encoder within the processing level of Chenoweth and Hayes' model.
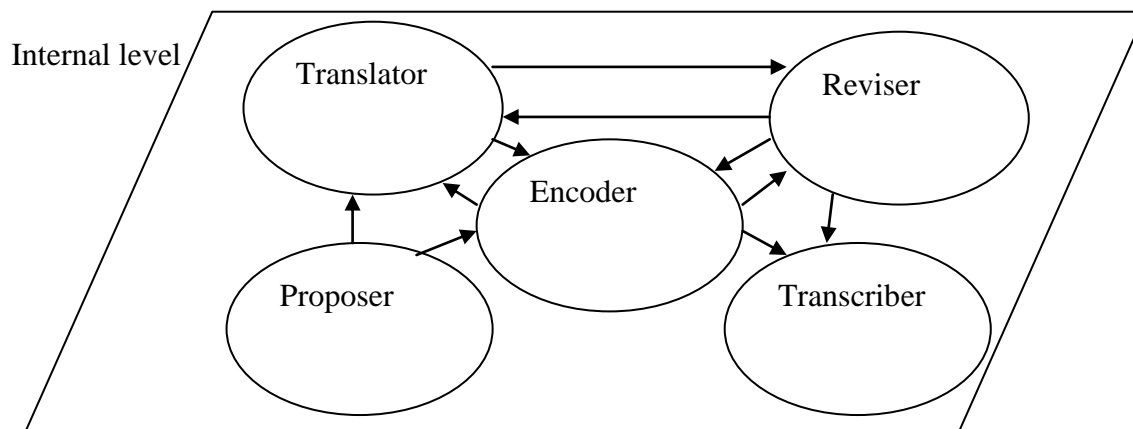
Figure 8.1 A depiction of the proposed proximity of the encoder to other internal processes in Chenoweth and Hayes' model

What Chenoweth and Hayes call *the transcriber* is kept busy doing all the proposed revisions, most of which are as basic as amending spelling. The findings of the present study suggest that *the trascriber* is limited by the capacity of the *encoder* to encode meaning into the structure and diction of the target language. This explains participants' repeated complaints of not being able to "formulate" their ideas. This limitation is in a way similar to what Chenoweth and Hayes (2001) describe as the limitation of *the trasncriber*. As we had come to believe that putting thought into language is an identifiable process; I have come to believe that putting thought into a second language is yet another identifiable process. Not much acknowledgement of that was found in the relevant literature.

Have the students developed in writing in English over the course of their college experience? On one hand, there is a notable development in every studied aspect of writing performance, writer's awareness and the written product; and yes the two subject-area groups followed different paths in their progressive experience with the foreign language. On the other, findings of this study, however, suggest that in all the developmental paradigms laid out in chapter 3, L2 writing of all proficiency levels (at least within the population of this study) fits into the lower-stages of writing development. Less processing of content, localised and immediate focus, lack of fluency, excessive revisions, etc, all seem to characterise the majority of writers in English as a foreign language within the context of the study.

Chapter Nine: Conclusions

The study has proposed that the distinction between conceptual and linguistic processing implied in Chenoweth and Hayes' (2001) model (see Chapter Two for details) is useful in providing theoretical grounds for understanding the cognitive processing of L2, and investigating development in L2 writing. While being informed by this distinction, the present study has brought in a different perspective on cognitive processes in writing in a foreign language. The perspective has come out as a result of observing fluency and analysing revision behaviour.

First, it has been established that fluency can be hindered by excessive formal amendments, particularly at word and phrase levels. According to Chenoweth and Hayes model, the *transcriber* is to be blamed. When the *transcriber* gets forms wrong (i.e. not in accordance with what the *proposer* or the *translator* had wanted them to be), the reviser attempts to amend, thus slowing down the process of writing and limiting production. In the findings of the study, in fact, there has been found a negative influence of frequency of revisions on fluency. However, evidence from the stimulated recall (SR) accounts suggests that, beside the *transcriber*, the *translator* (the processor that puts thought into language) represents a common source of inadequacy in L2 composing at the tertiary level. Although translating (i.e. putting thought into language) is considered by many as a natural first stage in writing (e.g. Flower, 1979; and Bereiter, 1986), when it comes to L2 writers it represents a challenge. Research seems to have overlooked that particular distinction between L1 and L2. In any case, when both the *translator* and the *transcriber* get busy with L2 language production, fluency suffers the most.

Second, in treating L2 revision as fundamentally different from L1's, the study sought to uncover the underlying knowledge that either triggers or otherwise facilitates revision actions. Unlike previous taxonomies (e.g. Faigley & Witte 1981, Whalen & Menard 1995; Stevenson et al 2006; Lindgren &Sullivan 2006), this study has considered the L2 mental processing dimension in revision analysis. Based on findings from observing writers' behaviour, and from simulated recall remarks, the study has come to assert that there exists a mental facility that is responsible for L2 encoding, and that works interdependently with other processors during the act of writing. The *encoder* is the

term the study has proposed to label such a processor. The role of the encoder changes with experience and becomes more automated as more linguistic knowledge is acquired. The concept of the encoder is only partially touched on in the present study, but it could provoke a vast amount of further investigation.

Moreover, the study has found that the mental processing of L2 is an integral process of writing in the foreign language, which intervenes at every level and in every stage of writing. Formal learning matters; it influences the writing process in ways that reflect its orientation. Focus on clause and sentence structures during the sophomore year, for example, has led English majors in their fourth semester to attend to these intermediate structures in their revisions more often than to either word-level or textual units.

In addition to realizing the L2-specific cognitive nature of the composing process, the present research provides a new understanding of development in writing in English as a foreign language along university levels. The cognitive basis for problems in writing, adopted from Flower (1979), provided both a framework for investigation and a feasible explanation to the changes in the performance of foreign language writers in the tertiary academic context. Writers at the low academic levels showed self-based writing without much manipulation of content for the sake of an audience. In that sense, L2 writing, at least in the first stages of development, shares some characteristics with egocentric speech. This can be explained in the light of the working memory capacity theory (McCutchen 1996). While Flower hypothesises that writers ignore audience to free enough space in the working memory to handle content generating, the present study suggests that the burden of L2 processing leaves little space in the working memory to attend to audience or effectively address the purpose of the writing task. As this burden eases out in the senior level, evidence of audience awareness was found in writers' strategies, awareness, texts and stimulated recall accounts.

Moreover, the explanation of the speech-writing relationship was expanded, in a considerably different way than was in previous hypotheses, to include another aspect of resemblance between speech (in general) and L2 writing performance. It was found that even this self-based writing was often accompanied by reluctance to move around the text or to consider manipulation of content after it has been put down. The present study suggests that this could be due to a relative unfamiliarity with using the written mode of language (both L1 and L2) for expression and communication within the Saudi

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student population in particular. This assumption has come from the author's firsthand acquaintance with the social and socio-academic culture in Saudi Arabia. Perhaps an investigation into literacy practices of representative samples from this population will provide much needed evidence on this matter.

In addition, some specific findings were of a great significance to our understanding of foreign language writers in general. The unmistakable excessive attention to form found in the participants of this study reflects their attitude and perception of writing as language practice. The fact that this attention eases out in the higher levels supports two more developmental views of L2 writing: the automatization hypothesis (Schmidt 1992) and the Knowledge-telling/knowledge transforming parameter (Bereiter and Scardamalia, 1987).

In line with the automatiztion concept, findings of the study have established that university students develop in certain aspects as they progress in the academic levels. There is enough evidence as to suggest that better familiarity with the foreign language (whether through systematic instruction or continued exposure) has eventually resulted in more automatic and quicker access to the linguistic knowledge. The resulting automatic processing of L2 (Schmidt 1992) has affected both fluency of production and revision behaviour to the better. It accounts for fluent production through quick activation of required information on language and discourse; and it increases focus on content (meaning and global content), rather than form (words and local structures) by lessening the linguistic load on the working memory and allowing it to process content instead of surface-level processing. This is in line with the working-memory capacity paradigm (McCutchen 1996, 2000). Moreover, the study has also shown that writers at higher tertiary levels demonstrate engagement with the text at a global level. This is signalled by an increase in distant revisions, and an increase in the proportions of text and discourse revisions. Students in the higher university levels seem to have become more familiar with the written mode of the foreign language as to realize the potential of modifying and manipulating text. Yet development in this respect remains proportional.

Changes in writers' roles and their interaction with the writing process have also been identified in the course of this research. The qualitative approach to the data revealed some crucial aspects of writers' role and levels of involvement with the writing task. Together with quantitative findings, stimulated recall accounts have been very

instrumental in distinguishing two groups of writers with the two profiles that Bereiter and Scardamalia (1987) proposed: knowledge-tellers and knowledge-transformers. Yet another group has emerged from SR data analysis in this study; a group that has been given the label 'language learners'. This category includes writers who were found to be encompassed in an L2 shell that seemed to both restrict their expression and direct their attention towards surface linguistic concerns. Their main worry was to perfect language, and when they were unable to do so, they complained from linguistic inadequacy. Distinctions between the three groups were also captured from the other resources of data as well as from the stimulated recall accounts.

Perhaps, one of the most significant findings of this study, in this respect, is seeing writers at higher levels of academic experience break away from this language-learner's shell and aspire for authentic goals in communication, by considering the demands of the writing task and consolidating the needs of the audience. In particular, there has been strong evidence of the influence of formal learning and of continued linguistic and meta-linguistic facilitation of writing on the development of fluency, a trait that indicates relative freedom from linguistic worries and focus on the effectiveness of content.

However, the details of the transformation L2 writers could undergo, from language-learners to knowledge-tellers and knowledge-transformers, have not been identified in the present study. One would hope that the realization achieved by this study of the basic role that some language-learners adopt in writing, and of the usefulness of the stimulated recall technique in uncovering the thinking behind it, will encourage researchers to consider larger data for qualitative inquiry. In-depth looking at more individual cases will probably reveal more tendencies and patterns, which may be veiled by the quantitative presentation of the writing behaviour.

Besides proposing a developmental framework within which we can understand development in writing, the study has provided a perspective of how two distinct academic experiences influence students' performance in and awareness of the writing mode in the foreign language, not only in terms of the characteristics of what they produce and how they go about in producing it, but also in the ways they perceive their writing practice and their roles as writers. Participants from the English Language and Literature Department and from the Computer Science Department demonstrated

different patterns of development in writing proficiency along the three tertiary academic levels. It has been found that systematic formal learning yields systematic improvement in fluency measures, revision behaviour and text quality. In particular, the quality of the produced texts improves better and earlier when writers go through systematic learning. Moreover, specialized study of the foreign language raises awareness of writers' role in a way the ordinary academic exposure to the language does not achieve. Computer Science seniors have mainly maintained their role as knowledge-tellers while the majority of their English-major peers have perceived their role in writing as communicators.

However, although a systematic developmental trend in terms of fluency, revision behaviour and text quality was evident only in the groups that received formal instruction all the way up the academic levels, i.e. the English majors, evidence of gradual improvement in socio-cognitive competence was detected in both English and Computer Science. This was obvious from the way writers handled their texts and from the individuals' reports of their writing process. Writers from senior academic levels of both disciplines demonstrated more involvement with the writing task and greater awareness of audience. In their stimulated recall accounts, they appeared more focused and interactive in communicating the content of their text, and they displayed attempts to enhance the clarity of text, thus taking their writing from egocentric-speech-like string of words towards autonomous texts, achieving in a way what Flower describes as

> *Their composing processes, unlike that of less effective writers, is marked by constant re-examination of their growing product and an attempt to refine, elaborate, or test its relationships, plus an attempt to anticipate the response of a reader. (1979, p.36)*

Although the study's limited capacity did not allow for handling the debate on subject-related vs. general English writing instruction, one particular lesson this research offers in that matter is too obvious to ignore. Writers on subject-related areas do need recurring (remedial) intervention to help them fulfil the writing demands of their discipline areas. To be able to write in the foreign language they need linguistic tools. Exposure to the foreign academic language alone does not seem to be a sufficient aid to the development of writing proficiency. In fact, lack of instruction in the Computer Science group has not only hindered development but by the fourth semester it has also brought writing quality to a decline. The quantitative findings, in particular, assert the

usefulness of continued formal facilitation of L2 and call for remedial intervention to improve the writing practices of the subject-related majors.

On the other hand, instruction should emphasise that writing is not all about language. It has been found that writers who are more aware of the socio-cognitive process perform better in writing. The findings of the study support what Scardamalia and Bereiter (1987) call "fostering the development of intentional cognition." Writers should be made aware that there is much more to writing than language; that communicating a message to an audience cannot be achieved by assembling words together alone. Writing practices at the higher education should therefore be facilitated with meta-linguistic tools. Deliberate focus on task, consideration of audience and effective revision strategies should be promoted in L2 writers.

Relevant to the issues of the linguistic and meta-linguistic tools is the issue of content. Stimulated recall sessions have shown how having access to content gave students something to talk about, and ideas to negotiate. This took their minds off form, and made them focus on the usefulness or the convincing power of their message. In this respect, it is important to recognize that in order to promote L2 writing in university students, they should be provided with a great deal of content or access/links to content. In other words, writers need to have something to talk about. In general writing instruction, fostering writing from resources, or reading for writing purposes will probably help. In the more basic EFL writing classes, this could be achieved through self-content-generating strategies, e.g. brainstorming, planning and outlining, etc. the idea is for writers to have enough material to talk about before they start writing. This will not only lessen the load on the working memory as Kellogg (1994) advocates, it will facilitate writing in a way similar to what an authentic writing task does. In academic and professional contexts, writing is facilitated by content from resources, e.g. books, articles, results, etc. In everyday life, writers are not likely to be asked to write their opinion about something without having enough knowledge (or access to knowledge) or background. In more general terms they would, for example, comment on news, or review a book or a product; or they could argue for or against a state of affair with a huge amount of details about the situation, the circumstances and their own motivations and emotions. It is relevant to acknowledge here, that the comparative nature of the present study demanded eliciting writing responses through similar writing prompts in order to avoid possible effects of variation in the writing tasks. However, it

would be useful in future research to consider writers' responses to different writing tasks. In particular, studies are needed for dealing with genre-specific and/or subject-related writing, wherein participants have more access to content.

Despite this study and other relevant efforts, there remain unclear areas in our understanding of what knowledge writers need and what knowledge they acquire in the course of their tertiary academic experience and how they put this knowledge to work when faced with a writing task. Because writing entails more than acquiring language skills it is difficult to isolate the different variables. This study has attempted to track development in writing along the higher education academic path and to track development in writing and to find out if continuing formal learning yields systematic improvement in writing. However, while probing for the influence of formal instruction in the foreign language, three fundamentally related, though seemingly paradoxical, insights have emerged. (1) Those who underwent formal learning have shown steady development throughout the college levels, whereas it took eight semesters for the unsystematic learning to yield some development. (2) It appeared that the mere dwelling in the tertiary academic context and gaining more content knowledge have in general strengthened writers' ability of communicating an argument to an audience and gain control over what they write. Whether this results from intellectual, biological (age-related), or socio-academic maturation, the topic needs to be addressed in future research. (3) In regard to the general level of all participants, it appears, there is still a lot to achieve in making students take authority and a global view of what they write instead of worrying over language and lingering over localized issues.

Moreover, because the study is not concerned with causal relationships between the different external and internal elements of the writing process, definite explanations of the sources of problems in college-level writing were not sought. Factors from pre-college academic experience, for example, were not considered. Therefore, it would be of great enrichment to our knowledge of writing at the tertiary level if other research could track writing development from earlier stages. That is from the time learners start to face L2 wring demands. Even better, it would be useful if future research could look at students' practices and proficiencies in writing in the native language as well, i.e. in Arabic.

In the present study, although English majors have displayed development in socio-cognitive skills along the academic levels, linguistic concerns have continued to preoccupy their writing process to a considerable degree. On one hand, they have demonstrated detachment from self and awareness of the others (reader awareness), knowledge transforming (rather than knowledge telling), and global concern for their texts. On the other hand, however, their increased proportion of proximate revisions, their report on sentence structure concerns and their increased frequency of revisions at the syntactic as well as the lexical levels all assert a pattern of attention to T-unit structure and lexical choices. This suggests that priorities of vocabulary and grammar that were once established in secondary schools continued to either explicitly affect instruction in the foreign language or implicitly influence students' concerns at the tertiary level.

To further complicate matters, the study has also yielded some interesting details about the limited writing proficiency of those who have been undertaking English Language and Literature as a major in the foreign context of the Saudi university. Evidence of development over the semester and of their advantage over their Computer Science peers should not mask the reality of the quality of their writing as evaluated by independent and experienced L2 raters. It has been confounding to find that the majority of them (52%) have achieved less than 60% of the average top score (that is less than 3.6/6), and that about 79% have achieved less than 3.6 in English Grammar and Usage alone, an area which one would expect senior English majors to need the least effort to excel in.

The view seems paradoxical. However, the paradox asserts the multi-dimensionality of the issue of writing in English as a foreign language. As the term denotes, *writing in a foreign language* includes both the aspect of writing and the aspect of learning in a foreign language. On one hand, learners should be supplied with enough L2 knowledge as to automatize their production and let them focus on content and communication. And on the other hand, L2 educators should be careful not to drag learners into a language-learning shell that could cut them off from the real world and limit their authority over their texts to the level of perfecting language only.

Finally one of the strengths of this study lies in a reasonable uniformity of the educational and cultural background of the participants. Studies that dealt with learners

of English as a second language tend to deal with writers of diverse backgrounds without giving enough consideration to the effect this might have on the findings. This study thus has the potential of comparability with other studies that deal with homogeneous groups within other EFL contexts. In particular it would be very useful to know if university students in the Saudi context are comparable to similar groups from different populations of different L1s, or with those who study English as a second language within the target language's native context.

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Appendices

Appendix 1: Call for participation (in Arabic and English)

بسم الله الرحمن الرحيم

عزيزتي الطالبة

السلام عليكم ورحمة الله وبركاته

أقوم حاليا باجراء بحث للتحضير لدرجة الدكتوراة في اللغويات التطبيقية في جامعة ساوثهامبتون ببريطانيا. وموضوع دراستي هو التطور في العمليات المعرفية أثناء الكتابة باللغة الإنجليزية كلغة ثانية. أشكر لك تعاونك والوقت الذي ستقضينه للمساهمة في هذه الدراسة.

سبب اختياري لك ولزميلاتك في الفصل هو أنكن تمثلن عينة مهمة لأهداف الدراسة التي أقوم بها، وذلك من حيث تخصصكن والمستوى الذي أنتن فيه حاليا.

هنالك متطلبان لابد من توفرهما: (1) موافقتك على المساهمة في هذا البحث والذي في اعتقادي انه سيساهم في معرفة الصعوبات والمتطلبات وتطوير الكتابة باللغة الإنجليزية، وهذا سيشمل ترحيبك بكتابة مقال قصير باللغة الإنجليزية. (2) مهارة معقولة في السرعة والراحة في الطباعة باللغة الإنجليزية. ليس شرط أن تكوني سريعة جدا في الطباعة.

إذا وافقت في المساهمة في هذاالبحث، فستقومين بالكتابة باللغة الإنجليزية لمدة تتراوح بين 35 إلى 45 دقيقة. ستحضرين بعدها مباشرة مقابلة شخصية لأهداف البحث. لن يتجاوز الوقت الإجمالي للكتابة والمقابلة أكثر من ساعة ونصف، بل ربما يستغرق أقل من ذلك.

مواضيع كتابتك وكذلك المقابلة الشخصية ستكون بأسماء مبهمة وستكون سرية. فقط الباحثة ستكون على دراية بمن قامت بكتابة الموضوع والمعلومات التي ذكرتها اثناء المقابلة الشخصية. وبالتالي فإن جميع المعلومات سترمز وسيتم مسح جميع الأسماء.

أرغب أن أقوم بهذه الدراسة خلال الفترة من 11 صفر إلى 10 جمادى الآخر. عند موافقتك على المشاركة في الدراسة، آمل إرسال رسالة على بريدي الألكتروني (--------------------) لكي اضيفك إلى مجموعة المساهمات في البحث. وبالتالي فإنني سأرسل دعوة للمجموعة لتقوم كل واحدة بحجز الوقت المناسب لها للكتابة والمقابلة الشخصية. يسعدني مقابلتك في أي وقت من ايام الأسبوع من السبت إلى الأربعاء (من الساعة 8:00 صباحاً إلى الساعة 4:00 مساءً). أو يمكن بطريقة أخرى أن تذكري الأوقات المناسبة لك خلال الأسبوع وسأقوم بإضافة إسمك في الجدول.

شكراً جزيلاً لك على تعاونك.

الباحثة

Dear students,

I am writing to you in connection with some research I am conducting for a doctorate program in the field of Applied Linguistics in the University of Southampton, UK. The research is on writing in English as a foreign language. I would indeed appreciate your cooperation and the time you take to participate in the study.

The reason why I chose you is that you and your classmates represent a sample that is of a particular importance to my research objectives in terms of your major and the academic level you are in.

The only two requisites you need to have are (1) a willingness to participate in a research that will probably contribute to our understanding of the difficulties, demands, and development of writing in English, this includes a willingness to write a short essay in English; and (2) a reasonable degree of speed and comfort in typing in English. You don't have to be a very fast typist.

If you agree to participate, you will attend a writing session of about 35 to 45 minutes. After that, you will be interviewed for research purposes and/or answer a set of questions about your writing. It should not take more than an hour and a half, altogether; it could take less than that.

Your written texts, as well as your responses to the interview will be anonymous and strictly confidential. Only the researcher will initially know who did or said what, then everything will be coded and your names omitted.

I need to conduct the study during the following four months (11th Safar – 10th Jumada-Akhir). If you agree to participate, please send me an email (-----------) to add you to my Yahoo group. Then you will get an invitation to the group so that you can log on to book your session. (I can meet with you Saturday to Wednesday any time from 8:00 am to 4:00 pm.) Alternatively, you can indicate, in your email, your preferred times and I will put your name in the table.

Thank you very much for your co-operation.

The researcher

Appendix 2: Questions for Immediate Recall (QIR)

Arabic (original) version

1. هل قرأت مهمة الكتابة باللغة العربية أو باللغة الإنجليزية؟

☐ اللغة العربية.

☐ اللغة الإنجليزية.

☐ كلتا اللغتين.

2. كيف تناولتي موضوع الكتابة وكيف فكرتي فيه في البداية؟

----

3. هل وضعتي خطط لكتابة النص؟

نعم ☐   لا ☐

4. إذا كانت الإجابة بنعم، فما هو طبيعة التخطيط الذي قمتي به؟

☐ خططت كامل المقال في البداية.

☐ خططت كل جزء (Paragraph) على حدة.

☐ خططت لكل جملة في وقتها دون تفكير في باقي النص.

5. هل أتبعتي خططك الأولية؟

نعم ☐   لا ☐

6. كم مرة أعدتي قراءة مهمة الكتابة؟

☐ قرأتها قبل البدء في الكتابة ثم لم انظر إليها أبدأ.

☐ أعدت قراءة مهمة الكتابة مرة أو مرتين أثناء الكتابة.

☐ كنت أعاود قراءة مهمة الكتابة بين الحين والآخر.

7. ما مدى الاهتمام الذي أعطيتيه لكي يكون مقالك متوافقاً مع مهمة الكتابة؟

☐ كنت طوال الوقت أوجه مقالي للرد على مهمة الكتابة.

☐ فكرّت في ما هو مطلوب في البداية ولكنني بعد ذلك انشغلت بالكلمات المناسبة وقواعد اللغة.

☐ دخلت في تفاصيل وأمثلة ولم اعد أفكر في المهمة الأساسية للكتابة.

8. كم من المرات خطر في بالك من سيقرأ المقال؟

☐ لم أفكر أبداً فيمن سيقرأ المقال.

☐ خطر ذلك في بالي مرة أو مرتين.

☐ كنت طوال الوقت أفكر فيمن سيقرأ المقال وأحاول اختيار الأسلوب المناسب لمخاطبته.

9. كم من الاهتمام أعطيتي للأمور التالية (الرجاء ترقيم المربعات حسب الأولوية):

☐ أن يكون تركيب الجمل صحيحاً.

☐ أن يكون تركيب النص منطقياً ومترابطاً.

☐ أن تكون معاني الكلمات المستخدمة مناسبة.

☐ أن يكون محتوى النص كافياً وفعالاً.

☐ أن يكون محتوى النص ملائم للمهمة المطلوبة.

☐ أن يكون النص مقنعاً للقارئ.

10. كيف كان دورك ككاتبة:

☐ بما أن مهمة الكتابة كانت لأغراض البحث في اللغة الإنجليزية، فقد كان اهتمامي الأول إيجاد التراكيب الصحيحة والكلمات المناسبة (لتعكس مهارتي في اللغة الإنجليزية).

☐ كان اهتمامي الأول هو عرض المعلومات التي أعرفها عن الموضوع وذلك من معرفتي في مجال تخصصي.

☐ كان اهتمامي الأول هو إقناع القارئ بمدى (أو عدم) صحة العبارة المعطاة.

Questions for immediate recall (QIR): translated to English

Have you read the writing prompt in English, Arabic or both?

English ☐   Arabic ☐   Both ☐

How have you thought about the writing task at the beginning? Did you have an overall idea of what you were going to write?

Have you thought of any plans for your essay?

Yes ☐   No ☐

If you have answered yes to (3): What sort of planning have you done?

☐ a. I planned all the essay at the beginning

☐ b. I planned every paragraph or section one after another

☐ c. I planned sentences as I wrote.

Have you followed your initial plans?   Yes ☐   NO ☐

How often have you read/reread the writing prompt?

☐ d. I read it once before I start writing then I never looked at it again.

☐ e. I reread it once or twice while I was writing

☐ f. I went back to it several times.

How much attention have you given to fulfilling the writing task (so that your essay would address the writing task accurately)

☐ g. My essay was focused on addressing the writing task all the time

☐ h. At the beginning I thought about what is required in the writing prompt, and then I got busy with grammar and finding appropriate words.

☐ i. I got involved in details and examples, and ceased to think about the main writing task.

How often have you thought of the reader of your essay?

☐ I haven't thought of who is going to read my essay

☐ I thought about the reader once or twice

☐ I thought a lot of who is going to read the essay, and tried to adopt an appropriate way of addressing the reader(s).

Which of the following did you pay the most attention to? (*Please number the boxes according to the priority of the items.*)

☐ Sentence structure is correct

☐ Text structure is logical and coherent

☐ Words and word meanings are appropriate.

☐ Content is sufficient

☐ Content is appropriate for the writing task

☐ Content is convincing to the reader

How did you perceive your role as a writer

☐ Because the writing task was set for a research purpose in English language, my main concern was finding the correct structure and appropriate words (to reflect my English language skills).

☐ My main concern was to present the information that I know about the topic by means of what I know about my field of study.

☐ My first concern was to convince the reader of the extent to which the given situation is untrue (or true).

Appendix 3: excerpts from keystroke logging data

App. 3.1 A section from a 'pause linear file': first paragraph of CS8-6 (4 lines)

START><0.55.234>In my opinion<0.02.219>, this is completely
wrong. <0.07.328>Dealing with computers is
<0.09.407><0.02.781><0.05.125><0.09.109><BACKSPACE26>There
is tow basic rules in dealing with
<0.02.547>computers<0.02.016>, the <0.04.640>ordinary user
who deal with <LEFT6>s<RIGHT6>the apps (application
programs)<0.05.297> and on the other side there is the
<0.09.438>programmer<0.06.734> who <0.03.594>know the
underling layer <BACKSPACE>s of the computer
it<BACKSPACE2>system<0.03.156> <0.05.891><MOUSE
EVENT><BACKSPACE>o<0.17.328><MOUSE EVENT>who<BACKSPACE3>is
0.0>the 3.047><BACKSPACE4>who playing the first role,
<0.03.640><MOUSE EVENT>0.>16.313><MOUSE EVENT>and
he<0.02.140><MOUSE EVENT>s <MOUSE
EVENT><0.07.703><BACKSPACE>MOUS>E
EVENT><BACKSPACE>y<0.03.422>i<0.05.390><MOUSE EVENT>.

App. 3.2 A section from a 'deletion linear file' (CS8-6)

From my point of view[147 In my opinion 147] this is completely wrong. [1 Dealing with computers is 1]T[148 h 148]ere is t[14 o 14]o basic r[4 u 4]oles in dealing with computers, the ordinary user who deals with the apps (application programs) [9 i 9]and he[7 s [6]who 7]plays [8 ing 8]he first role, and on the other side there is the computer specialist (e.g. the programmer, software [30 E 30]engineer ..) who knows the underl[10 i 10]ying layer[2   2]s of the computer [3 it 3]system .[11 These 11]Computer [13 ourse[12]s 13]courses mainly focused on the apps only[15 , 15] like MS WORD, Excel, Access....etc and they have no idea about how these [16 progra 16]application is creat or how it's running . They also guess that by [17 knowing this 17]dealing [18 th 18]with these apps they've [19 been 19]kn[20 ow 20]ow [21 the 21]what is computer system mean[23 [22]. 23], and by the way , this is what[92 [25]the idea which 92]I was bel[26 eieve 26]ieve in before I came to the university and [27 spe 27]chose Computer Science as a[93 my 93]major in bachelor [28 f 28]degree.This is [29 the 29]unfortiunually , the common [31 culture 31]thoughts about Computer studi[34 r 34]es in our socitey.According to this idea, I've noticed that some people here afraid of clicking [46 s 46]few[45 ome 45][41 w[39]i[40]eured 41]buttons, they [42 beleive 42]think that by clickin[43 h 43]g them[48 , 48][47 it 47]somethig gonna scream[44 s 44] on the[49 m 49]ir ace s!

App. 3.3 A section from a sample log file (CS8-6)

time	type	from	to	Grp1	Grp2	T Time	key
0.00.000	10	00000	00000	0		0	<START>
0.55.234	8	00000	00000	1	2	55.234	I
0.55.547	7	00001	00001	1	1	0.313	n
0.55.593	7	00002	00002	4		0.046	
0.55.765	7	00003	00003	1	1	0.172	m
0.56.000	7	00004	00004	1	1	0.235	y
0.56.062	7	00005	00005	4		0.062	
0.57.000	7	00006	00006	1	1	0.938	o
0.57.203	7	00007	00007	1	1	0.203	p
0.57.984	7	00008	00008	1	1	0.781	i
0.58.203	7	00009	00009	1	1	0.219	n
0.58.484	7	00010	00010	1	1	0.281	i
0.58.672	7	00011	00011	1	1	0.188	o
0.59.468	7	00012	00012	1	1	0.796	n
1.01.687	7	00013	00013	2	2	2.219	,
1.01.781	7	00014	00014	4		0.094	
1.01.953	7	00015	00015	1	1	0.172	t
1.02.078	7	00016	00016	1	1	0.125	h
1.02.297	7	00017	00017	1	1	0.219	i
1.02.468	7	00018	00018	1	1	0.171	s
1.02.578	7	00019	00019	4		0.110	
1.02.672	7	00020	00020	1	1	0.094	i
1.02.797	7	00021	00021	1	1	0.125	s
1.02.890	7	00022	00022	4		0.093	
1.03.468	7	00023	00023	1	1	0.578	c
1.03.672	7	00024	00024	1	1	0.204	o
1.03.922	7	00025	00025	1	1	0.250	m
1.04.297	7	00026	00026	1	1	0.375	p
1.04.531	7	00027	00027	1	1	0.234	l
1.04.781	7	00028	00028	1	1	0.250	e
1.05.015	7	00029	00029	1	1	0.234	t
1.05.156	7	00030	00030	1	1	0.141	e
1.05.593	7	00031	00031	1	1	0.437	l
1.05.953	7	00032	00032	1	1	0.360	y
1.06.015	7	00033	00033	4		0.062	
1.06.797	7	00034	00034	1	1	0.782	w
1.07.047	7	00035	00035	1	1	0.250	r
1.07.218	7	00036	00036	1	1	0.171	o
1.07.453	7	00037	00037	1	1	0.235	n
1.07.547	7	00038	00038	1	1	0.094	g
1.09.140	7	00039	00039	2	1	1.593	.

Appendix 4: Stimulated recall (sample transcription)

E8-ind.4

P= participant, *R*= researcher; Words that were uttered in English are underlined; the participant's possible intentions are placed in brackets, and the researcher's comments in squared brackets.

R	00 00.22	(I explained the procedure) I will replay the session and talk about what you have just written. What I would like you to do is to talk about what was going in your mind, during the writing session. Especially when you change something or stop writing We will start now. First, there is your first pause. Try to remember what were you doing or thinking at this time	
P	00.30	At this moment I was thinking what the sentences I was going to write are ... I was between read... I was going back to the <u>writing task</u>. I was between writing these sentences in other words arranging my ideas. I read this <u>writing task</u> more than once. This is what I often do.	Attention to task.
R		Ok, … yah	
P		It usually takes me about 15 minutes thinking	Planning
R		Ok. What about the sentences you have written? Are they summaries (of what you are going to say) or are they real sentences that you will eventually put down?	
P		No, these are the things that came up to my mind. As soon as I thought about the topic, I put them down[8].	
R		Things like, for example, …?	
P		<u>When I study English I know how I can think in critical way</u>. Really, when we study English now in <u>drama</u>, or something like that, you become <u>critical way</u>, you become an analyst.	Content (discipline-related)
R		Yah, OK.	
P		<u>need to analyze literary text is more important than have a degree</u>. (Reading from screen)	
		This came at the beginning, then I dismissed it	Content

---

[8] She wrote a small list on a separate sheet

		when I wrote.	modification
R		Yes	
P		<u>I can read any text and … significant, that can tell me what will happen next.</u> That one I actually took in <u>Drama</u>	
		<u>Some people think they are … read to have enjoy only without have knowledge</u>	Audience awareness
R		So these ideas you wanted to put them here (pointing to the text space on screen)	
P		I put them as preliminary ideas, some of them I have changed and some I haven't, but I elaborated more on them.	Content elaboration
R		All the time you were writing these things and thinking…… Do you remember the other things that you thought about?	
P	2:07	I thought about the <u>essay</u> type and found it an <u>argumentative essay</u>, I tried to recall the <u>rules</u>: <u>How to write an argumentative essay</u> I imagined that someone was in front of me and he was opposing the idea, and that I had to defend it … and … I mean (يعني) I tried to present the pros and cons in our studies… bearing in mind that I was going to talk more about pros … because I disagree with this point	Attention to rules Awareness of a reader (unprompted) Awareness of topic (this point)
R		(looking back at the replay screen) And you are still pausing	
P		Yes, I am still pausing, indeed. I usually think about everything then I start writing.	
R		Ok, have you thought about the reader at this stage	
P		Yes, of course	
R		Did you have a representation of who is going to read? Are they like a general reader who would also read newspaper, or students who would want to join the department.	
P		What came to my mind is a normal reader, general, I haven't thought about education but the most important thing is the thinking, level of thinking … I expected that <u>just read to enjoy</u> (?) So I felt that my study will improve more.	Audience awareness (prompted) Authority
R		Three minutes and you are still pausing. Perhaps I shouldn't have give you a piece of paper!	
P		Even in exams, even if I didn't have a paper. It is known (to me) 15 minutes have to go in thinking, even with time limitations in exams. For a quarter of an hour, it is impossible that I write, then when I write, I write it together.	
		[we had a chat about this. She asserted that this is the way she writes in exams]	
R		4:39 minutes and you are still pausing	

P		Can't we forward it?	
R		No we can't. Well, yes we can, but we wouldn't be able to know when you started.	
		[we talked about feedback.]	
P		My style is very good. The grammar. Although sometimes I make fragments. I extend the sentences, very much. And the spelling. I take a lot of care of spelling, although sometimes I make mistakes. However, I write short essays. They like long essays. For example, when the professor gets a three-page essay, she admires it. But when she sees my essay as one page and a half, although it has ideas and things, but it is not expanded, she would tell me to expand it and give more ideas, I like it short and concise.	
R		Do you get suggestions on how you can expand it?	
P		NO	
R		Do you get advice on organizing ideas? What you put first ...	
P		Yes, these things are there (taken care of) Yes, like introduction, how you start it and … but every professor has her own style.	Evidence of prioritizing structure
R		I am still waiting.	
P		Yah	
R		Do you remember what were you thinking at that time? If you can remember anything	
		I was also thinking about the <u>introduction</u>, how to make an introduction. But I finally I decided that I won't write a divided <u>essay</u>. I decided to write it all together.	Content structure
R		Without dividing ... yes.	
P		Without distinguishing the <u>introduction</u> from the <u>body</u>, from the <u>conclusion</u>	
R		Without it being distinguished on the page, but have you perceived the first part as introduction, the second part as …	
P		Yes, yes. Because this is the way we are used to. There has to be an introduction paragraph, a something paragraph, etc	
P		I was also reading this (the writing task) so that I could deduct from these ideas themselves an introduction. I have also realized something, I realized "details and examples"	Awareness of the task (unprompted)
R		Have you noticed this at the end	
P		In the middle, the middle of the page.	
P		After I thought I was almost finished, I looked at the writing task and found:"with examples and	Concern for the task prompt (limited)

		details." I said (to myself) I had forgotten them I did not write them. I needed to support my ideas with a lot of examples.	
P	10:10	I am still not writing, write! (instructing herself)	
R	10:25	You are starting.	
P		Here, I was writing people and I felt that the spelling is wrong [she then read quietly what was appearing on screen] Here I was looking at the sheet (writing prompt), trying to bring out the … idea, to arrange it first in my mind then write it. I think I have erased that, yes, I remember it	Attention to spelling Task
R		Why did you erase it?	
P		I felt the sentence will get longer	Discourse
R		"When we study English" … so you said "In English …"	
P		This is my fear, I really have a <u>fragments</u>' complex. I make long sentences then I find out that I must shorten them. Especially when using "<u>that</u>", it makes sentences longer. Here, I was going back and read to rearrange the idea properly. Have I made a mistake in <u>spelling</u> here?	Attention to sentence structure & style Rereading, organizing, att. to Spelling
R		No	
P		No. … Here I was thinking to write <u>"They said"</u> or to start it as normal sentence. <u>"They think …"</u> I was trying to talk about them first and then write my own sentence. … You see I erased it.	Style Att. to meaning
R		You wanted to write "<u>that</u>"?	
P		Yes. Then I went back and erased the whole sentence.	
R		Why did you erase it?	
P		Because of <u>that</u>?	
R		You wanted a sentence without <u>that</u>.	
P		Yes. Then I wrote "<u>In their opinion</u> …" then "<u>they think</u>" I was trying to make it, [laughing] I wanted to make their opinion seem less important. "<u>Their opinion</u>". You know what I mean, I wanted to make it clear that this thing I did not like, but <u>indirectly</u>.	Pragmatic choice. Awareness of audience
P	14:20	Here, I really wanted to show how their opinion is wrong. [She left the sentence "In their opinion …] I am discovering how slow I am in typing, maybe in thinking as well. And here I was concerned about spelling "<u>pleasure</u>"	Engagement with audience Spelling
R		Does your concern to spelling interrupt your thinking	
P		Sometimes when I write I would know that the sentence .. the spelling is not right, so stop for a while to correct spelling, then I continue, but I	

		don't lose the idea.	
R		Good	
P	15:53	But I care a lot about spelling. Here I was writing from the same sentence (of the prompt): "through unspecialized reading". You see, also, spelling delays me. Something will happen now, you will see. It's a surprise.	Att. to spelling
R		Here you stopped, can you remember why?	
P		I was going to write "I disagree with them" … I put it directly. Here I wrote "I don't agree with this", then I erased it, I felt the sentence became weak; with and this; they are all ambiguous. So I wrote "with what they say."	Attention to clarity of meaning
R		Good, so you felt that this won't give a clear meaning.	
P		"what they have said" erased it, "what they had" I was thinking, you see, I put said. In my opinion, here I started to put my own opinion. Here, the punctuation has delayed me. I wanted to put a comma, but I didn't, although I should have put it, right?	Att. to form Authority Att. to Mechanics
R		It's ok both ways.	
P		Here, I was going to write "the perfect way"	
R	17:43	Why have you erased perfect.	
P		I felt I was … If someone read it, he will say she is very confident about her opinion, to the point of arrogance. I did not want to give this impression, so I erased it. So that he (the reader) becomes convinced with what I say, not that I … See "My opinion…" I changed it. Here, I suppose I will erase it … we ..	Reader awareness (high degree)
R		Yes, why did you erase we?	
P	18:16	I was arranging a sentence …	Structure/syntax
R		Yes, arranging a sentence. But was the meaning of the sentence clear in your mind (to you)?	
P		Yes.	
R		In other words, you already wanted to say that the best way is to study …	
P		To study English literature Now I am thinking how to construct a sentence that would deliver (convey) the meaning that I want [reading] "in my opinion the perfect way to become a good … a good reader	Meaning; awareness of Audience
P	18.36.50	I went back to read. In front of you wrong , so I separated it.	Phrase structure
P		I was concerned with spelling, frankly.	Spelling
R		Yah.	

P		But the ideas are good, to a certain extent, right?	Content
R		Yes the ideas are very good.	
P		All of this will be the introduction, right? You see, I went back to change spelling of "analyze"	Text structure Spelling
R		You've done more than an introduction, you've started to present (one of) your ideas, and support it.	
P		I wish I did not write "you". (to avoid repetition as another *you* has ended the previous sentence)	
		[she is able to anticipate what she will write/delete/change next]	
P		I have a typing problem here.	
P		This is how I thought writers, because of works.	Coherence across sentences (discourse)
P	22.39.40 (25:00)	It should be <u>meaning significant not hidden</u>	(lexical/semantic): Word meaning and word combinations
P		I feel the sentence is too long. It is very long? Is the sentence right.	Text/style/coherence correctness
R		Yah …meaning wise it is correct … It is correct in every aspect, I think.	
P	24.34.50	I was thinking of the length of the sentence. It is too long. I usually like to be concise. When it is short you deliver the information quickly and directly. And the reader doesn't get bored.	Style audience
R		That's right.	
P		Now I am writing. The previous pause, I was trying to make it shorter.	
P		I was thinking of a distinctive feature that distinguishes the English literature students from other readers. What they do in the English (department).	Content
P	26.00.00	Until now I am arranging ideas. I like to arrange the sentence first and then write it down.	structure/content structure
P		I was thinking of what I took (in drama) … I have a problem with translation, I think about it in Arabic, then I translate it.	Subject-related content
P		I changed important to importance. When I wrote course again, I realized that the first one is wrong, I corrected it.	Grammar Spelling
	28:00:40	I was not sure about it, but I said let me finish the sentence then go back and correct it. I have a problem with vocabulary	Spelling vocabulary
P		I will go back and add 's'	grammar
R		Are you thinking about the elements of drama?	

P	30:09.00	Yes. I was thinking about the plays that we took, what the elements of drama are. I put a comma, wanted to add another thing, but couldn't remember	Content/ generating content
R		What is it that you went back to change?	
P		Importance (from important)	Lexis
R		So you read from the beginning.	
P		Not from the beginning , only this sentence.	
R		This is what I mean. But you are still busy with this sentence you haven't finished it yet.	
P		Because it is related to drama.	
P	31.10.04	Also, because my mind was busy with "importance". While I was writing I was thinking of "importance". You see I've stopped at it for long And I am also thinking about the other elements (of drama). In particular, I was remembering a recent play we took "The way of the world", you know it? I was remembering things. I remember one of my classmates I was studying with, and she was saying what elements the course instructor wants us to know. I was trying to remember that.	Occupied by grammatical categories (lexical alternatives but based on grammar not meaning) Relaying on subject related knowledge to generate content
P	32.44.10	I put a full stop. No, I did not. I remembered the sentence was not complete.	Concern for mechanics
		It should have been "significance", instead of (significant)	Grammar (categories)
	33:00:10	I was thinking how to end the sentence.	Cohesion/ Text structure
		I wanted to explain significance.	Clarity
		I wanted to use aspects but knew I won't use it well, so I erased it.	
	35.05.30	I feel it is wrong. The sentence is weak.	Stylistic, pragmatic
		Now I noticed the details and examples (from the writing prompt). So I wanted to give one, other than drama, so I considered fiction	Concern for task
	36.22 (40.05)	I was thinking about what to write about fiction. In a way it is like ...	Generating content

Appendix 5: Sample revision analysis

CS8-18

Linear text	Revision analysis
<START><1.30.234>computer science is very in<BACKSPACE>mportant mat<BACKSPACE3>majors<LEFT21>*1*	1,prox,np,sem,conc,mp
one of <RIGHT21> ,<BACKSPACE>specially*2*	2,im,cl,mech,fm
<0.12.453>in this tim<BACKSPACE7>his time where technology <0.07.625>take the high way <0.06.062>a<BACKSPACE>*3*, <0.06.453>there are	3,im,bT,T,conc
many people who learn is by them self<BACKSPACE>*4*vx<BACKSPACE2>f<BACKSPACE>vs	4,im,w,sp,fm
and they are very ee<BACKSPACE>fficient in it even in programming or	5,im,w,sp,fm
desining<BACKSPACE5>*5*gning web pages or <0.06.468><BACKSPACE3>or any other	6,im,bt,T,unid
cares<BACKSPACE>s about it<0.06.782>.<0.09.469><RETURN><MOUSE	7,im,bt,T,unid
EVENT>*6*<BACKSPACE> , so <0.07.218><BACKSPACE5>*7a*<BACKSPACE>*8*.most of	8,im,bt,T,unid
them the computer re<BACKSPACE2>*9*<LEFT9><BACKSPACE4>*1*<END>is<0	9,im,?,?,?
.34.641>	10,prox,np,gr,fm
hoo<BACKSPACE>ppy<0.06.187><LEFT5>*11*one of thir<BACKSPACE2>*12*eir <END><BACKSPACE>ies	11,prox,np,gr,conc
<0.10.203>and most of <BACKSPACE12>*13*.but in <0.08.188>all universities<LEFT19>	12,im,w,sp,fm
<LEFT>*14*it is teaches <RIGHT><END> which mean <0.05.016>hey <BACKSPACE4>they care a bout	13,im,bT,T,conc
<0.26.281><LEFT5>*15*<BACKSPACE><0.22.437><END >and	14,prox,cl,synt,fm
acua<BACKSPACE2>*16*tuall<BACKSPACE5>*16*ua<BACK SPACE2>*16*tu<BACKSPACE2>*16*ut<BACKSPACE2>*16*tua	15,im,w,sp,fm
lly <0.07.922>there are many <0.22.422>hide<BACKSPACE>*17*den	16,im,w,sp,fm
<0.13.125>concepts does not appear in <0.11.109>traning	17,im,w,sp,fm
<LEFT4>*18*n<0.05.062><RIGHT4>the computer as boop<BACKSPACE4>*19*hoobby<BACKSPACE4>bbu<BACK	18,im,w,sp,fm
SPACE>y<UP><DOWN><LEFT2><BACKSPACE2>pp<END> o<0.09.093><BACKSPACE><HOME>*20*a	19,im,w,sp,fm
<0.11.172><END>and<BACKSPACE3>*21*also	20,im,np,gr,fm
<0.11.718><BACKSPACE5>*22*or it <0.06.250>understand	21,im,bT,T,conc
false<0.17.656><BACKSPACE5>*23*wrong ><BACKSPACE>.<RETURN>in computer	22,im,bT,T,conc
sce<BACKSPACE>iecnce<0.12.797><LEFT4><RIGHT>	23,im,w,lex,conc,mp

<BACKSPACE><END> we learn <0.05.250>the principle of compue<BACKSPACE>*25*ter and the concept of the programs which any one <0.12.219> couldn't <BACKSPACE4>*26*'nt	24,im,w,sp,fm
<BACKSPACE4>n't <0.08.344>understand them by him self <0.39.141>for <BACKSPACE4>*27*for	25,im,w,sp,fm
example <0.11.484>i learn <0.48.454>data base s<BACKSPACE>*28*,<BACKSPACE>material <0.10.454>and	26,im,w,sp,fm
<0.32.360>bachelor<0.38.625><0.07.938><0.50.469>*29*<BACKSPACE39>in digital desing	27,im,pp,?,?
<BACKSPACE4>*30*gn<BACKSPACE>in	28,im,np,lex,conc,mp
<0.05.187>material <0.23.078>it coul<BACKSPACE3>*31*ann'<BACKSPACE2>*32*'t teach	29,im,TU,T,conc
in <0.29.610>work shop because the student<0.12.391> <1.11.844><BACKSPACE>*33*s	30,im,w,sp,fm
are not in high level <BACKSPACE22>*34*did	31,im,vp,gr,fm
<BACKSPACE3>*35*on't a<BACKSPACE>*36*understand	32,im,w,sp,fm
it as it	33,im,w,mrph-s,fm
<0.35.984><BACKSPACE3>*37*it<BACKSPACE5>as it shoulf=<BACKSPACE2>d be know .<RETURN>so	34,im,cl,sem,conc,mp
when you know how its work you cam<BACKSPACE>n <0.11.594>deal with it by	35,im,vp,gr,fm,ts
the thruth <BACKSPACE6>*38*ruth	
waty<BACKSPACE2>y <0.07.828>and will know	36,im,w,sp,fm
you <BACKSPACE4>how its work and what should	37,im,cl,prg,conc
you di<BACKSPACE>o if son thing <BACKSPACE8>me thing wrong	
happen.<0.15.297><RETURN>sl<BACKSPACE2>also	38,im,w,sp,fm
most of the work shop they are not specialize <BACKSPACE6>*39*alist in computer	39,im,w,gr(cat),fm
they take the work shop and be teacher which*40* <0.07.062><BACKSPACE6>so it cant	40,im,cl,syn,fm
<BACKSPACE2>*41*'t <0.14.484>give them the	
details <0.08.015>i<BACKSPACE>of the	41,im,vp,sp,fm
computer.<RETURN>so t<BACKSPACE4>*42*aso in	
work so<BACKSPACE>hp<BACKSPACE>op	42,im,S,sem,conc
<BACKSPACE14>*43*<LEFT2>*44*k<BACKSPACE>l<RIGHT	
2> we are <BACKSPACE4>*45*don't <0.16.609>learn	43,im,adp,T,fm
the same as it learned in<BACKSPACE>n work shop e.g we dont learn	44,prox,w,sp,fm
th<BACKSPACE2>*46*designing programs	45,im,vp,gr,fm
b<BACKSPACE>*47*we	
;<BACKSPACE>lear*48*<BACKSPACE7>because this	46,im,np,gr,fm
it could be learned for any one who doo<BACKSPACE>es not	47,im,bt,synt,fm
spex<BACKSPACE>ca<BACKSPACE>ial in cok<BACKSPACE>mputer	
<0.39.344>.<RETURN>s<BACKSPACE>computer	48,im,bt,T,conc
bachelor is more important	49,im,cl,syn,fm
<0.08.312>t<BACKSPACE>know at this time <0.10.656>than who take it from work shops	

Appendix 6: Sample essays

App. 6.1 CS8-6

From my point of view, this is completely wrong. There is two basic roles in dealing with computers, the ordinary user who deals with the apps (application programs) and he plays the first role, and on the other side there is the computer specialist (e.g. the programmer, software engineer ..) who knows the underlying layers of the computer system.

Computer courses mainly focused on the apps only like MS WORD, Excel, Access....etc and they have no idea about how these application is create or how it's running. They also guess that by dealing with these apps they've know what is computer system mean, and by the way , this is what I was believe in before I came to the university and chose Computer Science as a major in bachelor degree.

This is unfortunately, the common thoughts about Computer studies in our society. According to this idea, I've noticed that some people here afraid of clicking few buttons, they think that by clicking them something gonna scream on their faces!

Computer System is faaaaar way of these blabbing.

Here I'll talk about my own experience: studying Computer as a major has opened a new doors in front of me, it changes the way I'm thinking, my thoughts and the way I look to the problems, it also learns me how to think in a right way and how to take a good decision according to what i've know till this moment. Dealing with the "programming" thing means that your talking with someone doesn't speak your language and you have to try to understand him and also you must solve his problems in a reasoning manner.

The computer isn't just how you can open file and click the red "X" to close it.

It is an evolution of the recent history, completely a different new world .Using computer can solve nations problem and can destroy another one. It isn't about having fun and spending time.

Studying computer science means that you've learn a new logic (Digital Logic) and you have to make this static solid machine "the computer itself" cooperative partner to help you and other people in solving problems, making right important accurate decision, storing huge amount of informations and retrieving them in a fast way, and also you have to keep them these information as secure as you can and even more.

How can a computer scientist do all of these things? First he has to learn to be patient , learn new language, learn new logic , learn how to be reasonable and learns that this computer will do just what you have tell him to do! you are his programmer his main brain and his source of knowledge application courses let you understand and solve all these objectives?

Another last thing, when some people think that learning and dealing with computers is soooo easy (from their point of view according to their usage) it's an evidence of programmer professionalism.

Thank You..

(Participant's nickname)　（：

It's totally wrong what people actually think about our department, because to study English as a major is very different than studying it as course at any English institution. Because in English department we study English as a specialized courses that provide a lot of knowledge about English as a language so, so we are studying all the kinds of English linguistics which include Phonology, morphology, phonetics, Syntax, and semantics. These courses give us a clear cut about the features of English language specifically. These courses also teach us the right way of pronouncing English language. It also shows us the syntax and the way for analyzing sentences. We are studying English in the university as a linguistic science that give us a clear knowledge of the characteristics of English language which most of The outside English institution don't concentrate on this knowledge at all.

The department of English language and literature, not just teaching us linguistics they have other varieties for the courses like translation and literature courses. Translation courses is very important in our field because these courses show us the of the methods and the basic steps that we should follow or avoid. Literature course are the most interesting course, it's not like what others think about learning literature in the university and how we can replace it by writing and reading freely. It's totally wrong in the literature courses we are learning how to read, to criticize, how to write a very well structured essays which needs a lot of studying and practicing. We are taking a well choosed novels that are well known in the world and for different ages to know each era and which are the novels abd the writers of this era. It'd very important to know about the famous writers and novels as literary or artist.

Studying literature is a very interesting study, before I specialized in English department, I wasn't thinking critically when I watch a movie or read a novel which is very important. The literature courses in the English department evaluate and develop the sense of critical thinking. It's very important to be specialized in the English department because, it's make you get a specific knowledge that provides a clear idea about the English linguistics as a science and the literature as improving our critical thinking. Now in my graduating semester I really have clear idea about the English linguistics and all of the branches of This science, I also have a sense of critical evaluation for any thing that I read or watch. Studying English language is totally different from any other institution, and studying literature is also different from free reading and writing in our lives. As well as free reading and writing will more useful if we studied the basics of writings and the literary criticism.

Note: I have corrected most of the spelling mistakes to allow for undisturbed reading of the texts. However, I left the ones that reflect more than a spelling problem, e.g. lexical, pragmatic, etc

Appendix 7: Scoring guide

Fulfilment of the writing task

The paper …

6	demonstrates sophisticated and analytical response to the writing task.	
5	demonstrates commitment to the task in a clear and focused manner.	
4	demonstrates adequate commitment to the task.	
3	communicates a sense of commitment to the topic but lacks consistent engagement and/or development.	
2	demonstrates a sense of the task, but topic is not defined and/or not developed appropriately as a response to the task.	
1	demonstrates no engagement with the topic, although may repeat the task prompt.	

Development and organization

The paper …

6	develops and organizes ideas in a coherent, effective, and detailed manner.	
5	is well developed and well organized.	
4	is adequately developed and organized.	
3	is inadequately developed and/or organized; attempts argumentative stance but position is unclear and/or evidence is brief.	
2	lacks focus and development; may list items with little or no supporting detail	
1	fails to establish a position and/or develop persuasive view; or evidence is not apparent	

Audience awareness

The paper …

6	speaks purposefully to the audience in an appropriate, individualistic, and engaging manner.	
5	communicates purposefully to the audience.	
4	uses a voice that is appropriate to audience.	
3	attempts to connect with the audience earnestly, but ineffective and impersonal.	
2	attempts, but fails to involve the audience appropriately.	
1	does not attempt, or otherwise fails, to connect with the audience	

Structure and diction

The paper …

6	uses complex and varied sentence structure and effective diction	
5	uses varied sentence structure and a wide range of diction.	
4	uses appropriate sentence structure and diction.	
3	uses sentence structure and words that are somewhat limited, simplistic, mundane, or otherwise inappropriate.	
2	uses sentence structures and words that are highly limited and/or inappropriate.	
1	uses very limited and/or immature sentence structures and words.	

English grammar and usage

The paper …

6	commits very few, if any, errors in English grammar/usage and mechanics	
5	commits few errors in English grammar/usage and mechanics.	
4	commits some errors in English grammar/usage and mechanics that do not impede meaning; indicates basic understanding of conventions.	
3	contains flaws in Standard English rules of grammar/usage and mechanics that do not impede meaning; indicates some consistent misunderstanding of the conventions	
2	contains serious and frequent errors in Standard English rules of grammar/usage and mechanics that often impede the meaning.	
1	overwhelms the reader with serious and persistent violations of Standard English rules of grammar/usage and mechanics	