UNIVERSITY OF SOUTHAMPTON

Faculty of Physical Sciences and Engineering

Electronics and Computer Science

Enhancing E-learning by Integrating Knowledge Management and Social Media

by

Edrees Alkinani

A thesis submitted for the degree of Doctor of Philosophy

August 2016

UNIVERSITY OF SOUTHAMPTON

ABSTRACT

FACULTY OF PHYSICAL SCIENCE AND ENGINEERING

Electronic and Computer Science

Doctor of Philosophy

ENHANCING E-LEARNING BY INTEGRATING KNOWLEDGE MANAGEMENT AND SOCIAL MEDIA

Edrees Alkinani

Knowledge management (KM), e-learning, and social media are three academic research fields with several concepts in common. In e-learning, a competence is what students will be able to do by the end of the course. A competence consists of, at least, a capability verb and subject matter content. Students undertaking e-learning are usually given an assignment or task that corresponds to a competence. Thus, a learning task involves a number of competences, and achieving them results in completing the task successfully. Providing students with an ontological structure of the learning task could improve their learning, and the ontological structure of the task competences is considered to be a KM technique. The ontology will be constructed from various categories of subject matter that are linked to related competences. The learning task or assignment could be achieved collaboratively through introducing additional components to a teaching and learning situation. These are called collaborative working competences, and will be developed ontologically. They serve as the capability for collaboration in a social media context. Students can study both what is required for a given task or assignment and what is required for group working, then form and manage their own groups. There will be an application using a social media tool, such as Facebook, to support collaborative working on assignments and facilitate group formation. Thus, the integration of KM and social media may be expected to enhance e-learning.

The student needs to undertake a number of activities, such as establishing the task competences, the collaborative working competences and the student skills, then selecting group members based on the available competences. Through these activities, a research conjecture is set up: *if competences, including collaborative working, are ontologically structured through a social media application, then the students would achieve better learning results*. More significantly, the research aims to contribute its Social Media Competence (SMC) application in order to provide students with ontologically structured competences to accomplish given assignments successfully. The SMC application supports better collaborative working and more professional group formation procedures by generating content from Facebook users' profiles to compare their competences. The methods of constructing ontologies for task competences and collaborative working are described, and the design and implementation of the SMC application are presented. The application is integrated with a Facebook group in order to support collaboration. Besides exploring competences, students can contribute to the knowledge base by adding their own resources to a specific competence in a structured and organised manner.

Experiments were carried out to evaluate the SMC application by asking students to answer given assignments collaboratively under two conditions: using the SMC application (app users) and using paper-based documentation (non-app users) in plain text format. In addition, students' satisfaction was measured in a number of dimensions, such as evaluating ontologically structured competences and the actual groups' collaborative working. The results revealed that the SMC application both enables groups of students to obtain higher results in given assignments and supports better collaborative working among them. In addition, the groups of

students who used the SMC application were positively satisfied with its content. The ontologically structured competences were applied to teaching in order to improve teaching performance. The opinions of instructors were measured. The results showed that instructors would teach better by using ontologically structured competences in their teaching. Furthermore, the teaching and learning environment was investigated by using Facebook Groups. The opinions of instructors were measured in order to confirm whether it could enhance the teaching and learning environment through creating groups for module activities. The results revealed that instructors' opinions positively confirmed that doing so would enhance the teaching and learning environment.

This research contributes to the tasks of both learning and collaboration competences that are ontologically structured. The ontological design for learning tasks was based on subject matter categories, and enables students to achieve better learning results in a given assignment. This reflects the effective design of the ontology in terms of structuring classes, and analysing the competences and subject matter to be fitted into the ontology in an appropriate presentation. In addition, the research contributes ontologically structured competences for collaborative working. The ontology design for collaborative working was based on commonly available social skills, with related roles of performing each skill. It enables students to conduct their group work or a given assignment more effectively when using Facebook as a social media tool. Moreover, the research contributes to better group formation by reading the social information, such as professional skills, from students' Facebook profiles in order to compare their competences in both the learning task and group work. Furthermore, the research contributes to teaching by applying ontologically structured competences to improve teaching performance. Finally, the research contributes to enhancing the teaching and learning environment by setting up Facebook groups for module activities.

Table of contents

List of Tables

List of Figures

DECLARATION OF AUTHORSHIP

I, **Edrees Alkinani**,

Declare that this thesis and the work presented in it are my own and have been generated by me as the result of my own original research.

ENHANCING E-LEARNING BY INTEGRATING KNOWLEDGE MANAGEMENT AND SOCIAL MEDIA

I confirm the following:

- 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:

Acknowledgements

In the name of Allah, the Most Gracious and the Most Merciful Alhamdulillah; all praises to Allah for the strength and His blessing to complete this thesis.

First and foremost, I should like to express my utmost gratitude to Assoc. Prof. (the greatest) Lester Gilbert and Assoc. Prof. Dr Richard Crowder, my first and second supervisors, for their supervision, valuable advice and immense patience. From Lester and Richard, I have learnt much about how to perform academic research. The production of this research would not have been successful without their kind supervision.

I am hugely grateful to my parents, Abdu and Athba, who always energised me with their indispensable love, prayers, continuous support and encouragement, both before and during my PhD studies. I also would like to thank my brothers, Mohammed, Ali, Faisal, Ayoup and Abdullah, and my sisters, Amna, Amra, Halima and Typa, for their continuous support and prayers.

I am very grateful to my uncle, Dr Mohammed Alkinani, for his continuous support and encouragement. Thanks go to all my relatives for their prayers and support. My family and relatives have played a vital role in helping me to reach this milestone.

Lastly, my special thanks go again to Lester Gilbert, for being such a great human and for everything that he has done for me throughout the four long years.

With the oversight of my main supervisor, editorial advice has been sought, and the thesis was edited by Alison Williamson of Burgess Pre-Publishing (www.burgessprep.com). No changes of intellectual content were made as a result of this advice.

Definitions and Abbreviations

KM	Knowledge Management
ILO	Intended Learning Outcome
OSC	Ontologically Structured Competences
SMC	Social Media Competence
CDT	Component Display Theory
XML	Extensible Markup Language
RDF	Resource Description Framework
SPARQL	SPARQL Protocol and RDF Query Language
OWL	Web Ontology Language
W3C	World Wide Web Consortium
URI	Uniform Resource Identifier
WWW	World Wide Web
URL	Universal Resource Locator
API	Application Programming Interface
MANOVA	Multivariate Analysis of Variance
ANOVA	Analysis of Variance
N	Sample Size
Std. Deviation	Standard Deviation
SE	Standard Error
Sig	Statistics Significant Value
p	probability

Instructor, *lecturer* and *teacher*, and *learner* and *student* are terms used throughout this thesis with similar meanings. In the relevant sections, they are mentioned interchangeably, according to the surrounding content.

Chapter 1: Introduction

The integration of social media, knowledge management (KM), and e-learning prompted this investigation into the nature of the connection. In terms of e-learning, educational issues have been revealed such as the connection of the subject matter content to a capability verb, the competence structure, and the alignment of the assessment task with competence statements. Currently, KM connects with e-learning in terms of the subject matter, and with social media in terms of supporting the notion of creating, sharing, and disseminating knowledge within organisations. Social media connect to e-learning in terms of delivering the processes of an e-learning transaction that, in turn, provides the content of subject matter. Social media may be used in the field of education to support teaching and learning, and to increase the engagement by teachers and students with a subject, also as effective tools for collaborative learning (Dabbagh & Kitsantas, 2012; Kreijns, Kirschner & Jochems, 2003; Boulos, Maramba & Wheeler, 2006). Learners can gather into groups and use special tools to share content or conduct a group discussion. Such connections between the three different areas of KM, e-learning, and social media suggest that providing competence structures for both the learning task and collaborative working will result in improved student learning.

E-learning is defined as a learning system that uses web and internet technology to facilitate teaching and learning (IEEE, 2012). The definition relates to the purposes of this research, which intends to provide a system via social media to support students' learning. A consideration of various pedagogical issues can help to design an effective e-learning system. One of these is allowing students to work collaboratively on a task that is based on specific competences, using particular social media tools. The task involves a number of competences, yet will correspond to a main competence. A competence is composed of an Intended Learning Outcome (ILO) consisting of a capability verb and content in the form of subject matter, at a minimum. Providing students with structured competences for a specific task will allow them to complete it successfully. In addition, providing them with several competences of collaborative working will help them to form and manage their groups. These collaborative working competences introduce an additional component to the teaching and learning environment.

Knowledge management is knowledge creation, followed by knowledge interpretation, knowledge dissemination and use, then knowledge retention and refinement (De Jarnett, 1996). The definition relates to this research purpose, as it intends to construct an ontology of learning tasks and collaborative working, then allow students to explore, create and share content relating to a given task collaboratively. KM is about creating knowledge, then interpreting it for dissemination and use in institutions (Gupta, Iyer & Aronson 2000). It can be seen in terms of creating structures for both types of competence. Task competences will be constructed using four different categories of subject matter: fact; concept; procedure; and principle. Each has a special diagrammatic approach that allows teacher to populate it with information to be retrieved by students, and will be linked to competences. Collaborative working competences are based on commonly available social skills that allow students to divide the work among themselves and run their group successfully. The structure of both competences will be presented ontologically, so that students can consider what is required by the task and what by the group work. Based on these requirements, students may then identify potential group members according to their social and skill information that is available on their profiles and that, ideally, match the required competences.

Social media is defined as a variety of technologies and networking tools playing important roles in emphasising social aspects of the internet, such as communication and collaboration (Dabbagh & Kitsantas, 2012). The definition relates to the purpose of this research in terms of allowing students to work collaboratively, through a social media tool, such as by communicating with each other creating ontologically structured content, and sharing it collaboratively. Social media tools include blogs, wikis, and social networking sites such as Facebook, Twitter and Google Plus. These may be used to promote KM in terms of creating and disseminating knowledge within institutions (Dabbagh & Kitsantas, 2012). They can be used to define the information or tasks necessary to achieve the purpose of a project or the goal of an institution. Examples might be creating a page in a particular social media tool, updating the progress made or noting the new tasks to be considered. Such tools can be used to spread information easily among people within an institution. Currently, as will be discussed in Chapter 2, the literature considers these tools as KM when contributing to content. However, on social networking sites such as Facebook, added information and resources have no specific structure or special category and this method of adding resources is not considered to be KM, due to the potential difficulty of retrieving the information in the future (Bosch, 2009). Nevertheless, this research aims to employ a common tool of social media: Facebook. For the purpose of this research, Facebook will be examined in terms of its ability to support e-learning and KM.

The application is intended to be developed using Facebook Groups, a Facebook product comprising a gathering of individuals with a common interest, for the purpose of sharing resources such as documents, files, links and photos (Hoffman, 2009). The application exploits most features of Facebook Groups that support e-learning and KM. Students will explore task competences and collaborative working through this application by selecting a competence then viewing the related sub-competences and their additional content. In addition, they may link shared resources in Facebook Groups to related competences in the ontologies, to enable them to be shared with others. Some information in each user's profile, such as their professional skills, biographical content and gender, will be generated in order to reveal the social attributes and skills that are available. This will enable students to match the requirements of their assignment and group work with the available skills, and will help them to form groups with various competences in a professional manner.

The developed application uses Facebook Groups as a tool of social media, and both ontologies as a KM technique. It does five essential things. The first is to provide students with the requirements or competences of a specific task or assignment to be accomplished. The second is to provide students with competences of collaborative working with their related roles. The third is to generate available social information about students to compare to the requirements of assignments and group working, in order to facilitate the formation of their group. The fourth is structuring the added resources of the Facebook group when linking them ontologically to related competences. The fifth is making notes about group members' progress with the assigned tasks. Any content added through the application will be appended with who added it, the date and the time.

This study offers a description of a method for structuring competences for a chosen knowledge domain. The method of constructing the ontology for assignments is based on a competence structure and related subject matter categories. The collaborative working ontology construction is described by introducing the essentials of collaborative working, with related roles on how to perform those competences (Kane, 2010). The study presents an analysis of the Facebook profile taxonomy so that it can be exploited and generated by the developed application. Furthermore, this study presents the design and implementation of the developed social application. The application has been given a name: 'the Social Media Competence (SMC) application'.

The research aims to evaluate the developed SMC application in a learning and teaching situation. The experiment was conducted in order to assess the effectiveness of the SMC application in terms of enabling students to obtain better learning results in their assignments, their evaluation of the Ontologically Structured Competences (OSC) and how well it meets with their satisfaction. These support better collaborative working and facilitate group formation. In terms of teaching, another experiment was conducted in order to improve teaching performance by using OSC instead of a conventional list of competences. The instructors' satisfaction with using OSC was measured. In addition, a study survey was conducted in order to evaluate instructors' opinions of the use of Facebook Groups for module activities to enhance the teaching and learning environment.

1.1 Research Objectives

The aim of the research is to develop a social application which has ontological content as KM, delivered via Facebook Groups as a social media tool. The application is intended to enable students to obtain better learning results for given assignments and support better collaborative working. The application will be considered successful if students are able to accomplish their assignments with a higher evaluation than that of non-application users of the content of the application. This leads to following main research questions and sub-research questions:

1. Do ontologically structured competences enable students to achieve better learning results using the social media SMC application collaboratively?
    - Is there a relationship between the levels of Bloom's taxonomy and students' learning results?
2. Do ontologically structured competences of subject matter through the SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing competences?
3. Do ontologically structured competences of collaborative working through the SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing competences of group working?
4. Does the SMC application support better collaborative working for groups of students using social media?
    - Is there a relationship between communication, information sharing, and conversation and social skills when groups work collaboratively?
5. Does the SMC application facilitate group formation using social media?
    - Does groups of students' prior knowledge influence learning results?
    - Does retrieved related social information meet with the satisfaction of groups of students?

On the teaching side, the ontologically structured competences are applied in order to measure the potential for improving teaching performance, so the following research question was raised:

6. Do instructors think that using ontologically structured competences leads to better teaching?

For enhancing the teaching and learning environment, Facebook Groups will be introduced to instructors in order to measure its effectiveness when using it for module activities, so the following research question was raised:

7. Do instructors think that Facebook Groups enhances the students' teaching and learning environment?

1.2 Thesis Structure

This thesis is divided into ten chapters.

Chapter 2 gives a general background to the three main areas of KM, social media and e-learning, as well as state-of-the-art combinations of KM and social media; KM and e-learning; social media and e-learning; and KM, social media and e-learning together. In addition, it describes techniques of knowledge representation. These are explored with a view to generating competences that can be ontologically structured. It discusses a number of languages that may be used to represent the knowledge on the web and the approach to representing a competence structure.

Chapter 3 presents the research problems as a scenario, setting up the research conjecture with related research questions.

Chapter 4 discusses the analysis and design of the SMC application and its content. In this chapter, there is a description of the requirements analysis, the design of the application process, constructing the competences, building the ontologies and analysing the social media content.

Chapter 5 describes the implementation of the SMC application. It includes the ontology databases and using Facebook API to read and generate the content of profiles and other information from Facebook Groups, such as the name of group and the number of group members.

Chapter 6 deals with the experiments methodology and additional study survey. The first experiment has eight sections in order to evaluate the SMC application in learning terms. The second experiment deals with the teaching side, in terms of improving teaching performance by using OSC, and the study survey deals with enhancing the teaching and learning environment by using Facebook Groups for module activities.

Chapter 7 presents the statistical results of the experiment and its sub-sections. Each is presented separately.

Chapter 8 presents the statistical results of another experiment and additional research survey regarding improving teaching, and enhancing the environment for learning and teaching.

Chapter 9 discusses the results and the possible reasons why user groups obtained higher marks on the assignments and gave higher evaluations to the application content than did the non-user groups. In addition, it discusses the results of second experiment and an additional study survey, with possible reasons for thinking that OSC can improve teaching performance and that using Facebook Groups can enhance the teaching and learning environment.

Chapter 10 comprises the conclusion of the study, the contributions made by this research and highlights of work for the future.

Chapter 2: Background and Literature Review

This chapter presents the background of pedagogy, in particular of e-learning, KM and social media. In addition, the chapter discusses research that combines KM and e-learning, KM and social media, and social media and e-learning. Next, the three approaches being integrated (Figure 2-1):

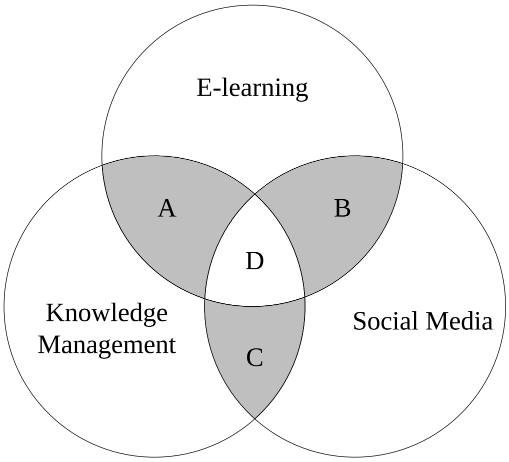


Figure 2-1: Overlap between knowledge management, e-learning and social media

A: e-learning and knowledge management, B: e-learning and social media, C: knowledge management and social media. D: knowledge management & social media & e-learning.

2.1 Pedagogy

Pedagogy is defined as the ‘art or science of teaching’ (Beetham & Sharpe, 2013). It is the basic theory that describes the teaching skills and knowledge required to educate learners. Teachers need to understand the term in order to provide study materials that are both well matched to learners’ needs and based on educational objectives. Pedagogy refers to any effective behaviour or designed activities that are used in the teaching and learning process and students’ learning outcomes (Mehanna, 2004). In order to develop an e-learning system, there should be collaborative research among computer scientists, educators and designers (Vrasidas, 2004). In terms of web-based education and distance learning, pedagogical design plays a most important role in the success of learners (Boulton, 2002). According to pedagogy theory, it is essential to take into account various pedagogical and technical issues when designing an effective e-learning system, for example the educational objectives of the intended learning outcomes or competences.

This section describes the relevant aspects of learning, teaching and structuring of an e-learning transaction. In general, teaching involves the creation of an environment that supports learning, and learning takes place when a learner's behaviour changes. In a teaching environment, learners receive information and then are asked questions in order to provide feedback on their performance. When this takes place, a teaching environment is considered effective. The term 'e-learning' can simply describe all forms of electronic technology that support learning. The next sub-sections discuss the finer points of learning, teaching and structuring of an e-learning transaction and subject matter, the structure of ILOs, the enabling outcomes and their constructive alignment, and competences.

2.1.1 Learning

Learning theories do not focus on the value of what is being learned, but are instead concerned with the actual learning process (Zhang, Zhao, Zhou, & Nunamaker Jr, 2004). Learning theories provide three main perspectives from which to understand the nature of the learning process in which learners build knowledge in a particular environment. The first is that of constructivism, guiding learners to conduct personal learning activities through collaborative learning, where the instructors can manage and encourage learning activities. The constructivist approach is student focused, meaning based, process oriented, interactive and responsive to students' personal interests and needs (Johnson, 2004, 2009). The key idea of constructivist learning is that, individually, learners actively construct their knowledge based on existing experiences (Johnson, 2004). Vygotsky's social development (1978) is a well-known theory that forms the foundations of the social constructivist approach. It focuses on the interaction between human and social context in order to interact with shared experiences. Piaget's constructivist theory is a well-known developmental theory that states how children become progressively practised with reality, and are gradually able to understand symbolic objects. The learner's interactions with the environment and ability to understand reality are the core concepts of constructivism (Piaget, 1955). The second is cognitivism, describing learning as the building of cognitive structures through which information may be processed and stored.. The last is behaviourism, considering learning as the observable changes in a learner's behaviour. These three perspectives show that learning is concerned with the acquisition of new knowledge, information and skills (Kahiigi, Ekenberg, Hansson & Tusubira, 2007).

2.1.2 Teaching

Teaching methods refer to the ways in which instructors deliver information and enable learners to access these information (Govindasamy, 2002). Ramsden (2003) suggests that teaching should involve a number of processes in order to support students learning and build ideas of knowledge such as classroom activities and teamwork colleagues. The classroom activities and teamwork enable students for deep understanding on learning concepts. In addition, the activities are motivating students' more than traditional teaching methods (Ramsden, 2003). The approach of designing activities for students learning is also suggested by Brunner (1966). Bruner also focuses on environment that involves learning activities. The learning instruments should be compatible with considered environment for students learning (Bruner, 1966). The literature contains descriptions of a number of teaching methods such as traditional learning (face-to-face), e-learning (using information and communication technologies) and blended learning (a combination of face-to-face classroom activities, live e-learning, and self-based learning). Mobile learning uses portable technologies such as mobile phones to deliver the content to learners, and personalised learning supports and facilitates an individual's learning. In individualised learning, each learner has a special learning path that considers their needs and interests in a meaningful way (Kahiigi et al, 2007).

Since teaching consists of creating an environment that supports learning, the environment has the purpose of enhancing what the instructor teaches. It has two essential aspects, the teacher and the student or students and, for learning to be effective, each has specific tasks to perform. The task of the teacher is to convey information to the students, known as telling and showing the content, then asking the students questions to provide feedback on their performance. The task of the students is to carry out what the teacher asks, particularly to respond when prompted. Gilbert and Gale (2007, p. 40) discuss the interaction components of learning and teaching from the perspective of e-learning, terming this process 'an e-learning transaction', as shown in Figure 2-2. The teacher's role consists of telling and showing students the content of the material that they are required to learn, known as the subject matter. Each item of subject matter should fall into one of four categories: fact, concept, procedure or principle (Merrill, 1994), as discussed in section 2.1.5.1.

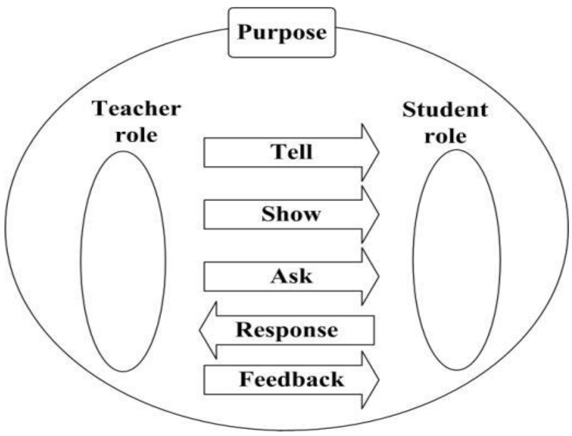


Figure 2-2: An e-learning transaction, reproduced from Gilbert & Gale (2007, p. 41)

2.1.3 Learning Design

Learning design as a process describes the means or activities that are associated with creating learning activities (Conole, 2008), and as an outcome represents the learning activities that can be reused by tutors and designers. The benefit is the illustration of learning activities in a way that is easy to understand, such as diagrams or text that can be shared between teacher and designer, or repurposed by another teacher (Conole et al., 2007). The learning design can guide individuals to create new learning activities, which in turn aid learners engaged in complex activities by guiding them through the activity sequence. Learning design is different from pedagogy design. In a learning design, the focus is on teacher practice (McAndrew et al., 2006). It covers how teachers prepare teaching sessions or teaching material, or how they decide which activities or technology to use, whereas pedagogy design focuses on tasks that students undertake to achieve a set of intended learning outcomes.

2.1.4 E-learning

E-learning has two aspects to its definition: 'E' (referring to technology) and 'learning' (referring to teaching and learning activities). A number of definitions of 'e-learning' have been published and each refers to the same educational experience. A verbatim selection of definitions follows (Kahiigi et al., 2007):

- Instructions delivered via all electronic media including the internet, intranet, extranet, satellite broadcasts, audio/video, interactive TV and CD-ROM. (Engelbrecht, 2003)
- Learning facilitated by internet and www technologies, delivered via end-user computing that creates connectivity between people and information and creates opportunities for social learning approaches. (Meredith & Newton, 2003)
- Distance education using the internet and/or other information technologies. (Watanabe, 2005)
- A learning system that uses web and internet technology to facilitate teaching and learning (IEEE, 2012).

2.1.5 E-learning transactions

E-learning transactions (Figure 2-2) are considered the smallest elements of teaching and learning (Gilbert & Gale, 2007, p. 40). They are based on the generalisation of Laurillard's conversation model (Laurillard, 1993) that describes the learning and teaching environment in higher education . Laurillard assumes that learning and teaching dialogue in higher education must involve both theoretical and practical concepts. Technology enables knowledge to be imparted to learners and helps them to identify material or information that assists in their learning outcomes. E-learning transactions are part of this study because the purpose, or intended learning outcome/competence, is a major aspect of knowledge management and social media; both aid the delivery of the ‘tell,’ ‘show,’ ‘ask’ and ‘feedback’ aspects of learning and teaching.

2.1.6 Intended Learning Outcomes

E-learning transactions (Figure 2-2) seek to accomplish specific ILOs, also known as the educational objectives of a given transaction. Educational objectives describe what learners need to be able to do to complete the course (Macdonald, 1999). E-learning needs to embrace this along with the provision of all necessary learning materials and teaching resources. An ideal e-learning system will incorporate all elements of e-learning transactions, because these aid the analysis and design of learning and teaching situations. In addition, ILOs are an important aspect of the design of any pedagogical system because they help to develop effective learning transactions beyond the simple transmission of information (Gilbert, Sim, & Wang, 2005). The transaction emphasises the learning objective or purpose, constituting an integral component of e-learning (Gilbert & Gale, 2007, p. 41) in addition to assessment and feedback (Whitelock, Gilbert, & Gale, 2011).

Taking into consideration the ILOs of a given learning transaction is a component central to the design and structure of both professional training and educational systems(Gagne, Wager, Golas, & Keller, 2004); (Reigeluth, 1999). The benefit of considering ILOs is making a judgment on whether students in fact learn and acquire new knowledge (Laurillard, 1993). ILOs have two essential elements, consisting of a statement of the topic, domain content or subject matter, and a statement of the learner’s capability when dealing with the subject matter (Sitthisak, Gilbert, & Davis, 2008). Figure 2-3 shows that an ILO consists of capability verb and subject matter.

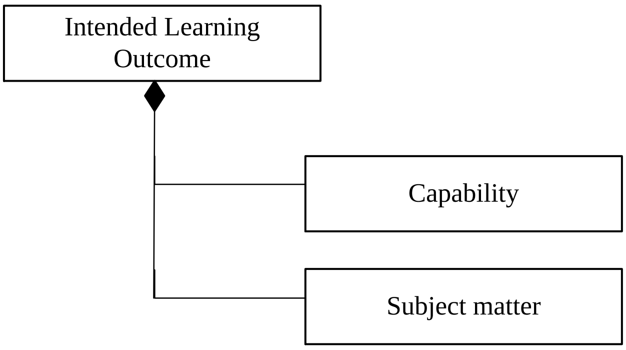


Figure 2-3: Composition of intended learning outcomes, consisting of a capability verb and the subject matter. From the COMBA model as proposed by Sitthisak, Gilbert, & Davis (2008)

2.1.6.1 Subject matter categories

Merrill (1994) analysed the concept of subject matter and identified four categories; the approach is termed Component Display Theory (CDT) and these categories are fact, concept, procedure and principle. Table 2-1 provides a definition of each category.

Table 2-1: Definition of CDT categories of subject matter adapted from Gilbert & Gale (2007, p. 152)

CDT Categories	Definition
Fact	A fact consists of two specifics, termed a ‘fact pair’.
Concept	A concept involves having a name and a superordinate class, where the attributes are value pairs that classify objects.
Procedure	The procedure has a name and is used in a situation to achieve a goal via a set of steps employing tools.
Principle	The principle has a name and is applied in a situation; it involves analysing cause–effect relationships between objects or events.

This thesis aims to analyse and understand the categories of subject matter in order to provide learners with a classified knowledge domain of subject matter with materials relating to a specific category. To achieve this classification, the task analysis of subject matter must be considered. Task analysis in instruction design is a process that involves analysing the learning content in a form that enables learners to understand what exactly to do with the learning content (Jonassen, Tessmer, & Hannum, 1998). The nature of the subject matter can be represented in different diagrammatic approaches based on CDT categories. Each category of subject matter has a unique representation of its task analysis (Gilbert & Gale, 2007, p. 82); (Sitthisak & Gilbert, 2014). In this thesis, each element in a fact pair is represented as a circle, as shown in Figure 2-4.

Figure 2-4: Representation of ‘fact’

Facts usually consist of two specifics, termed a ‘fact pair’.

As an example, Gilbert and Gale consider the fact: ‘the Battle of Hastings was fought in 1066’ (Gilbert & Gale, 2007, p. 152). The ‘Battle of Hastings’ is the first fact name, while ‘1066’ is the second. In teaching, students could explicitly be told the fact statement, ‘The Battle of Hastings was fought in 1066’, or they could be asked to recall or name a fact, such as, ‘When was the Battle of Hastings?’, or ‘Which battle took place in 1066?’ (Gilbert & Gale, 2007, p. 158). Figure 2-5 illustrates this example:

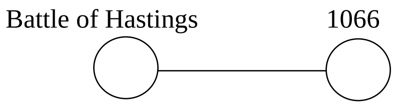


Figure 2-5: Example of ‘fact’, “Battle of Hastings”

This battle took place in 1066. The name of the battle and its date are considered two specific elements, termed a ‘fact pair’

This thesis represents a concept as a triangle. A concept is always associated with attribute-value pairs, where attributes refer to the characteristics that describe a concept and its values. Attribute-value pairs comprise facts. In addition, a concept defines three kinds of relationships between concepts and attribute-value pairs. The first relationship is ‘is a kind of’: this links the concept name to its superordinate class. The second relationship is ‘where’: this links the concept name to the relevant attribute-value pair. The last relationship is ‘value’: this combines two facts in one attribute. Figure 2-6 shows the overview of the task analysis of a concept.

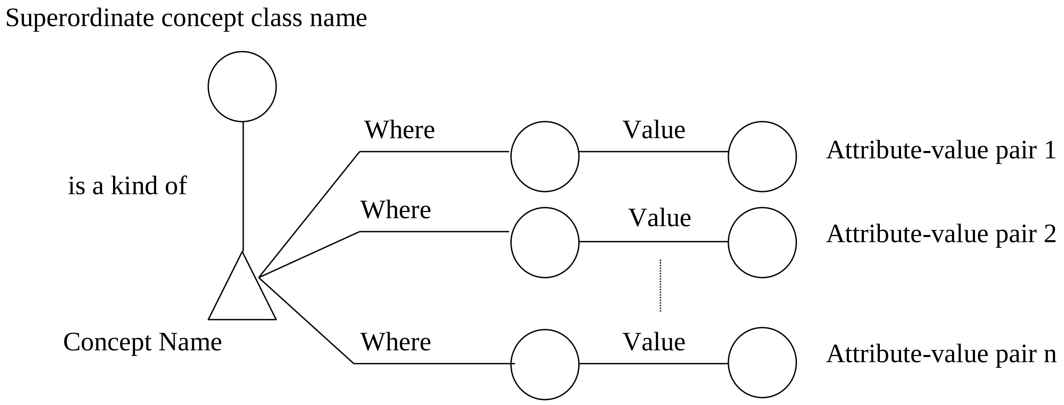


Figure 2-6: Representation of 'concept'

The concept name connects its superordinate class through a relationship termed 'is a kind of'. The name of a concept may be described by a number of characteristics known as attributes. Each attribute has a value for describing the concept. These attributes connect with the concept name through a 'where' relationship

For example, take the concept of a predator: an animal that hunts and eats other animals. The concept name is 'predator'. The superordinate class to which a predator belongs is 'animal'. One of the attribute-value pairs of 'predator' is that its 'feeding behaviour' is 'hunting'. Another attribute-value pair is that its 'food' is 'another animal'. The key feature of a concept is that a number of attributes are used to classify or categorise aspects that coordinate to the values of those attributes: 'is a' is the key phrase that distinguishes a concept from a fact (Gilbert & Gale, 2007, pp. 152–153). Figure 2-7 illustrates this example:

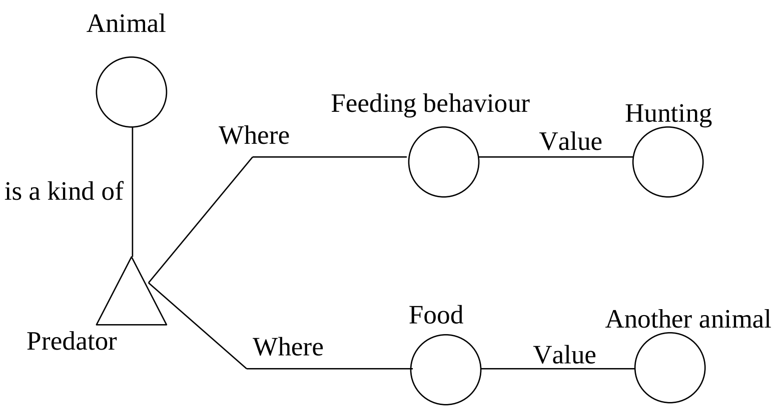


Figure 2-7: Example of 'concept', "predator"

A predator 'is a kind of' animal, 'where' it has a number of characteristics such as feeding behaviour and type of food. These characteristics or attributes have values, as shown: 'hunting' and 'another animal'.

The procedure involves a number of steps, represented as rectangles in this thesis, which are designed to achieve a goal in a specific situation. Figure 2-8 gives an overview of the task analysis of a procedure:

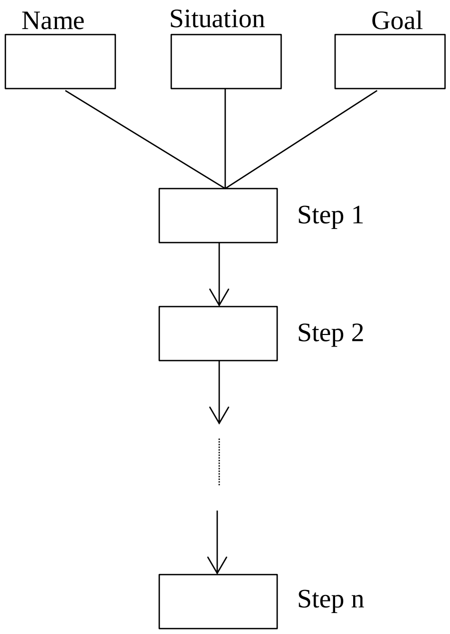


Figure 2-8: Representation of 'procedure'

A procedure usually involves a number of steps. Each rectangle shows a specific step toward the final goal of a specific procedure.

For example, undertaking market research in the street to obtain information involves wearing business clothes and approaching strangers to ask them to complete a survey. The procedure name is 'market research', and it is used in a situation 'in the street' to achieve a goal of 'obtaining information'. The steps involve 'wearing business clothes', 'approaching strangers' and 'asking them to complete a survey'. The key feature of a procedure is that it involves a series of steps or actions (Gilbert & Gale, 2007, p. 153). Figure 2-9 illustrates this example:

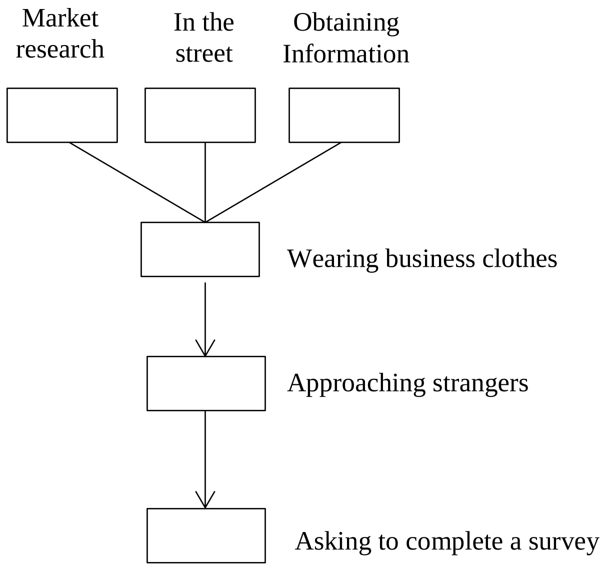


Figure 2-9: Example of 'procedure' for on-street market research for obtaining information from people

The three steps are wearing business clothes; approaching strangers; and asking them to complete a survey.

A principle contains cause and effect relationships. Figure 2-10 presents the task analysis of a principle using a pentagon shape. Cause is shown on the left-hand side of the pentagon and effect on the right-hand side. Every cause has an effect, and these are considered as facts.

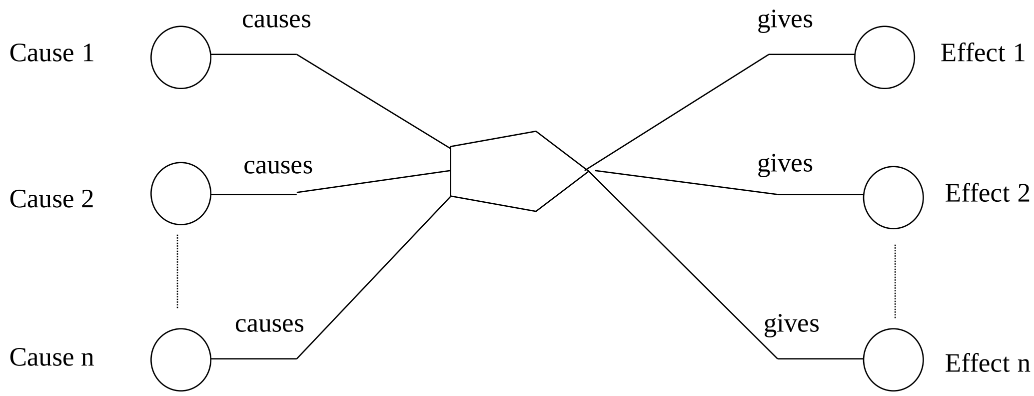


Figure 2-10: Representation of 'principle'

The principle involves specification of cause–effect relationships. Each cause has a specific effect.

For example, “the principle of gravity applies to two or more bodies in a region of space such that they mutually attract each other, according to their mass and the inverse of the square of the distance between them. The principle, and its name of ‘gravity’, is applicable in a situation ‘when two or more bodies occupy a region of space’ so that there is a first cause–effect relationship between ‘mass of body’ and ‘mutual attraction’ of ‘directly related’, and another cause–effect relationship between ‘distance between bodies’ and ‘mutual attraction’ of ‘inversely related to its square’, where the event and objects are ‘bodies’ and ‘attraction’. The key feature of a principle is that it involves cause–effect relationships that may usually be expressed as some sort of an equation” (Gilbert & Gale, 2007, p. 153). Figure 2-11 illustrates the above example:

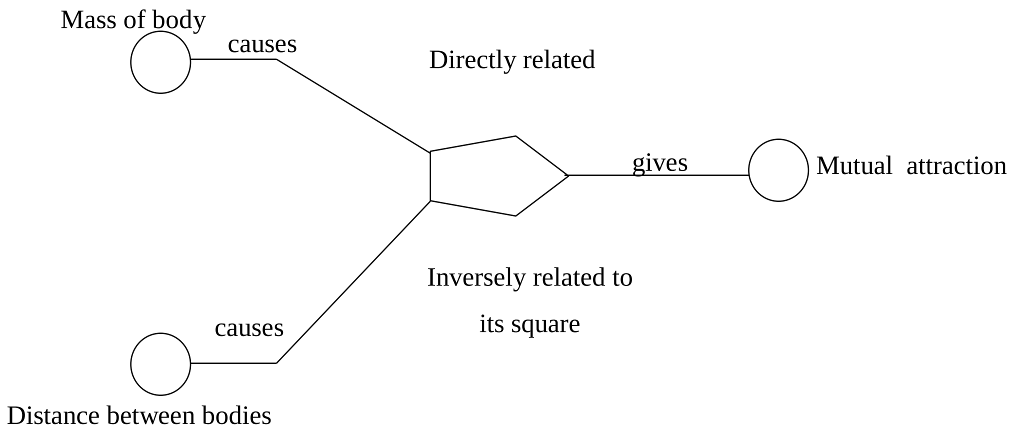


Figure 2-11: Example of principle of ‘gravity’

It has two causes: mass of body, and distance between bodies. The relationships (directly related, and inversely related to its square) are the effect from those causes: mutual attraction.

2.1.6.2 Capability categories

An e-learning objective or intended learning outcome can be expressed in the statement: “The learner will be able to X”, where X is a performance (Gilbert & Gale, 2007, p. 87). A performance refers to an ability or capability, as proposed by Bloom (1956) and Mager (1997). Bloom’s taxonomy includes varied educational objectives categorised into three domains; cognitive (knowledge), affective (attitude) and psychomotor (skills). The cognitive domain (Bloom, 1956) involves the development of knowledge and intellectual skills. The affective domain (Krathwohl, 1964) deals with the learner’s manner and emotional concerns, such as feelings, values, motivation and attitude. The psychomotor domain e.g. (Simpson, 1972) is concerned with the learner’s physical movement, co-ordination and use of motor skills.

This research will focus on the cognitive domain, as most forms of traditional education emphasise these skills. The taxonomy of the cognitive domain has six levels: ‘know’, ‘comprehend’, ‘apply’, ‘analyse’, ‘evaluate’ and ‘synthesise.’ Table 2-2 contains explanations of the terms and keywords defining each category of Bloom’s revised taxonomy as they relate to the capacity of the cognitive domain (Anderson et al., 2000).

Table 2-2: Description and examples of verbs of Bloom’s Taxonomy of Capability in the cognitive domain (Anderson et al., 2000; Dalton & Smith, 1986)

Category/Level	Description	Capability Verbs
Know	Can exhibit memory of previously learned materials by recalling facts, terms, basic concepts, and answers	Name, label, define, state, recognise, list, recall, identify
Comprehend	Can demonstrate understanding of facts and ideas by organising, comparing, translating, interpreting, giving description, and stating main ideas	Explain, classify, summarise, extrapolate, interpret, convert
Apply	Can use new knowledge; can solve problems of new situations by applying acquired knowledge, facts, techniques and rules in a different way	Calculate, solve, construct, use, prepare, predict, demonstrate
Analyse	Can examine and break information into parts by identifying motives or causes; can make inferences and find evidence to support generalisations	Compare, contrast, infer, explain
Evaluate	Can present and defend opinions by making judgments about information, validity of ideas, or quality of work based on a set of criteria	Appraise, argue, evaluate, criticise, assess, discriminate
Synthesise	Can compile information in a different way by combining elements in a new pattern or proposing alternative solutions	Compose, originate, design, create

Building on Bloom’s taxonomy, Gagne et al. (2004) produced nine areas of skill and capability with associated verbs. These verbs can be used to formulate any learning objective of a related area, and Table 2-3 shows the standard learned capability verbs.

Merrill (1994) identified a similar list of capability with assessable behaviour verbs for formulating learning objectives. Merrill divided the cognitive domain into three main areas – ‘know’, ‘use’ and ‘find’ – that are combined with four categories of subject matter. Table 2-4 shows the observable ability verbs according to Merrill (1994).

Table 2-3: Standard learned capability verbs after Gagne et al. (2004)

Skill or competence	Learned capability verb
Knows facts	states
Discriminates	discriminates
Identifies concepts	identifies
Classifies information	classifies
Applies rules	demonstrates
Solves problems	generates
Applies procedures or strategies	adopts
Uses motor skills	executes
Attitude	chooses

Table 2-4: Observable ability verbs, after Merrill (1994)

Capability	Standard learned capability verb	Assessable behaviour
Knows facts	Recalls	Writing, drawing, indicating
Knows concepts	Defines	Writing, selecting
Knows procedures	States steps	Writing, drawing, flowcharting
Knows principles	States cause–effect relationships	Writing, drawing, graphing, specifying formulae
Uses concepts	Classifies	Writing, selecting, sorting, arranging
Uses procedures	Demonstrates	Manipulating, calculating, measuring, constructing
Uses principles	Predicts	Calculating, drawing, graphing
Find concepts	Invents	Sorting, specifying
Find procedures	Devises	Experimenting, analysing
Find principles	Discovers	Experimenting, analysing, observing, demonstrating

This research aims to integrate subject matter with capability verbs. The verbs will be integrated with items of subject matter. This integration is based on defined ILOs and uses the provided structure of different categories of subject matter. The final aim is to provide students with a list of related ILOs or competences for a specific knowledge domain as a hierarchy of top-level competences and a set of enabling competences that act as prerequisites for other competences. The terms of competence will be discussed in section 2.1.8. These competences will give students an indication of what is required for a given task. All competences and their related subject matter's key terms will be created in a knowledge base that will allow filtering, searching, creating, reading, updating and deleting the content, which is the subject matter integrated with the capability.

2.1.7 Constructive alignment and ILOs

A perspective on learning theory mentioned in section 2.1.1 is constructivism. This approach takes into consideration the interests and needs of students, creating a student-focused, meaning-based, process-oriented, interactive and responsive approach to learning (Johnson, 2004, 2009). The main idea behind constructivist learning is that students may build their knowledge on a base of existing experience (Bodner & Klobuchar, 2001; Johnson 2009). Using this prior knowledge, they may form an understanding of the subject matter. This leads to constructed knowledge, rather than receiving the knowledge from instructors (Svinicki, 1998). There are four approaches associated with constructivism: social constructivism, constructionism, constructive alignment and minimally guided instruction. Constructive alignment is both relevant and important to this research.

The concept of constructive alignment has two aspects (Biggs, 2003). The first is the constructive component, in which students need to create and understand the content by accomplishing tasks to create their own knowledge. The second aspect is alignment, through which instructors ensure that the learning tasks or assessments they provide are appropriate to the learning outcomes and it is an essential part of teaching to align pedagogical activities with learning outcomes using teaching methods and assessments (Biggs, 2003). Figure 2-12 summarises the main characteristics of constructive alignments.

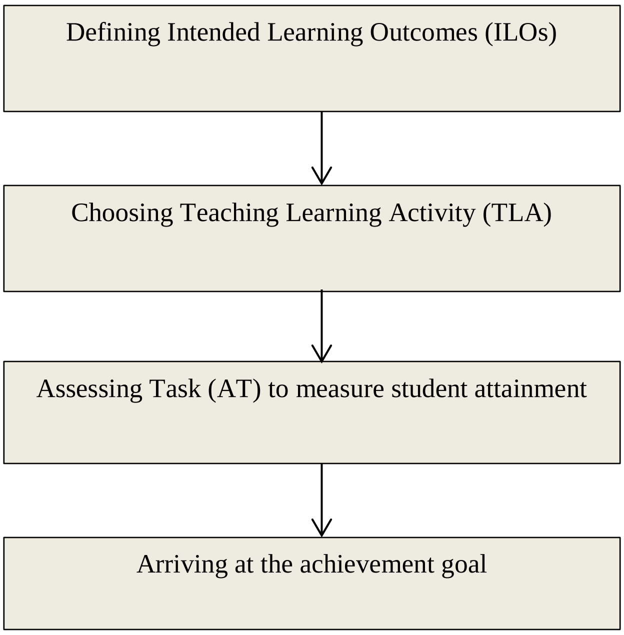


Figure 2-12: Constructive alignment steps (Biggs, 2003)

Defining the ILOs helps to focus on what and how students learn, rather than on the specific topic. The ILO statement contains a verb that gives students an indication of what to expect in their behaviour as a result of learning. Choosing the activities of teaching and learning should be related to the chosen verb when defining the ILOs, as students will not pay attention to a lecturer who will not help them to achieve the outcomes of course. Assessment tasks that correspond to ILOs will aid a students' progress, while at the same time achieving the defined ILOs for the course (Biggs & Tang, 2011, p. 191).

This study aims to use examples that match most of the categories of subject matter, as well as to define all the ILOs required to learn specific content. In addition, the assessment tasks or problems to be solved will relate to the ILOs. The unique key is the verb for ILOs and the assessments tasks; in other words, the assessment tasks correspond to the ILOs. For example, if the ILO is that the students will be able to identify the primary key in a database table, the corresponding assessment asks, 'Dear student, please identify the primary key in this database table'. The verb and the subject matter key terms are used to filter and search the knowledge base in order to generate or explore the competences of the learning task. By doing so, students will establish what is required to complete the task.

2.1.8 Summary of ILOs and constructive alignment and their relation to this research

Previous sub-sections reviewed the pedagogical approach in terms of designing the education technology or systems for learners. The discussion highlighted the important issues of learning and teaching activities, e-learning transaction, ILOs or educational objectives. The optimum e-learning system involves all elements of e-learning transactions in terms of 'tell', 'show', 'ask' and 'feedback'. Consideration of the ILO is an important part of this study, because it identifies what learners need in order to complete the course successfully. The ILO consists of subject matter and a capability verb. Subject matter categories have been analysed in different forms in order to clarify knowledge domains and make them more accessible to learners when integrated with a related capability verb. The verb plays an important role, as it allows students to filter or search the proposed knowledge base and to respond with the related competences for a given learning task.

In addition, previous sub-sections introduced the constructive alignment component of teaching. Constructive alignment aims to define ILOs' corresponding assessment tasks. The ILOs determine the activities with which students need to engage in order to achieve the top-level objectives, and they form a hierarchy of enabling and prerequisite outcomes. Some of the ILOs require others before they can be achieved. When students filter or search the knowledge base by using a capability verb and subject matter key terms to obtain the related competences, they will become aware of all the requirements of given learning task.

Based on constructive alignment theory, any assessment task should correspond to an ILO or competence. Enabling ILOs should have corresponding assessment tasks with the same structure as the capability verb and subject matter. They are termed ‘competences’, because they constitute a compulsory part of an ILO and share its structure, thus any given task involves a number of competences to accomplish it. This research will use term ‘competence’ instead of ‘ILO’ for the remainder of this thesis.

The next sub-section will introduce competence and its relationship to ILOs and corresponding assessment tasks.

2.1.9 Competency model

This section introduces the competency model proposed by Sitthisak et al. (2008). The ability to perform specific activities to a prescribed standard is known as ‘competency’ (Smith, 1996). The literature uses the terms ‘competency’ and ‘competence’ with a variety of implications and classifications, and researchers distinguish between the two (De Coi et al., 2007; Prins et al., 2008). Prins et al. (2008) propose that ‘competence is given a generic or holistic meaning and refers to a person’s overall capability whereas competency refers to specific capabilities or skills’. Both terms will be considered in this research; the term ‘competence’ is used in the context of the competence structure and learner competence, while ‘competency’ is used in the competency model.

2.1.9.1 Definition of competency

The literature identifies a number of definitions of competency. One is provided by McClelland, (1973), who states that ‘competency can be the knowledge, skills, traits, attitudes, self-concepts, values, or motives related to job performance or important life outcomes’. Friesen and Anderson, (2004) define competence as ‘the integrated application of knowledge, skills, value, experience, contacts, external knowledge resources and tools to solve a problem, to perform an activity or to handle a situation’. Moreover, the following general definition of competency is suggested by Cheetham and Chivers, (2005): ‘effective overall performance within an occupation, which may range from the basic level of proficiency through the highest levels of excellence’.

The competence approach to pedagogical activities has been associated with education systems (Stoof, Martens, & Van Merriënboer, 2007) and professional development (Eraut, 1994). In an education system competence plays an important role in describing the final attainment levels of an educational programme (Stoof et al., 2007). With respect to professional development, competence may be the criteria for selecting the appropriate person for a given task (Eraut, 1994). The major components of competence will be discussed in the following section.

2.1.9.2 Competence structure

Sitthisak, Gilbert and Davis (2008) propose a competency model called COMpetence-Based learner knowledge for personalised Assessment (COMBA). The model consists of the following three components: subject matter, capability and context, as shown in Figure 2-13. The combination of capability and subject matter leading to ILOs is essential to this research, as discussed in section 2.1.5, therefore the COMBA model supports the pedagogical approach in terms of learning transactions.

The other component of the COMBA model is context. Context represents the conditions, situation and environment, and the tools, time or even places associated with the pedagogical activities or ILOs. In addition, competence has a property called the 'prerequisite of competence', described as a prior competence in the learning structure. Therefore, the learning structure shows prerequisite learning relations between competences(Reigeluth, Merrill, Wilson, & Spiller, 1980). Furthermore, the competence supports teaching and learning activities. These two supporting components have an important role in indicating educational achievement; involving learning and teaching activities in pedagogical tasks accomplishes common goals in teaching and learning. The competence structure in learning and teaching is shown in Figure 2-14.

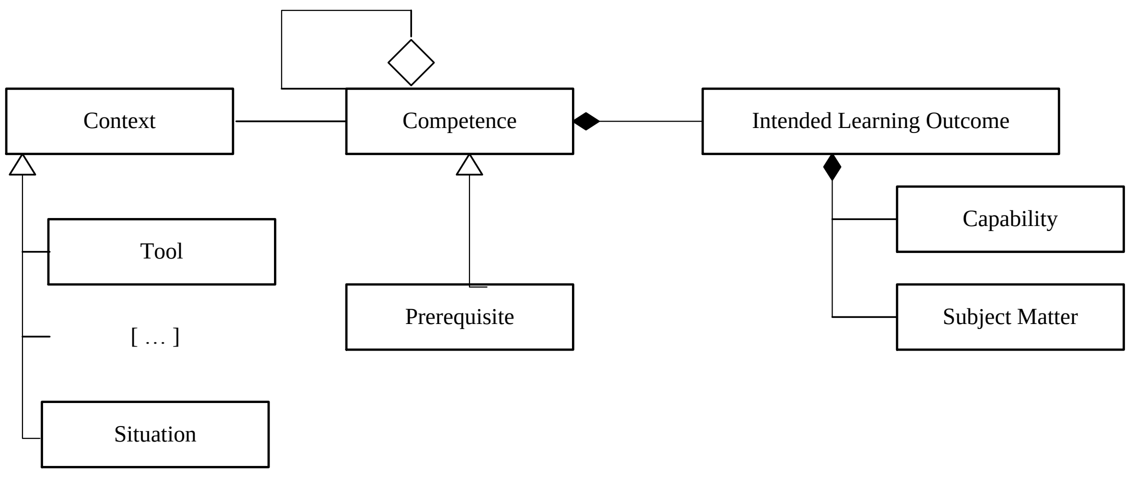


Figure 2-13: Competency model derived from COMBA model of Sitthisak, Gilbert & Davis (2008)

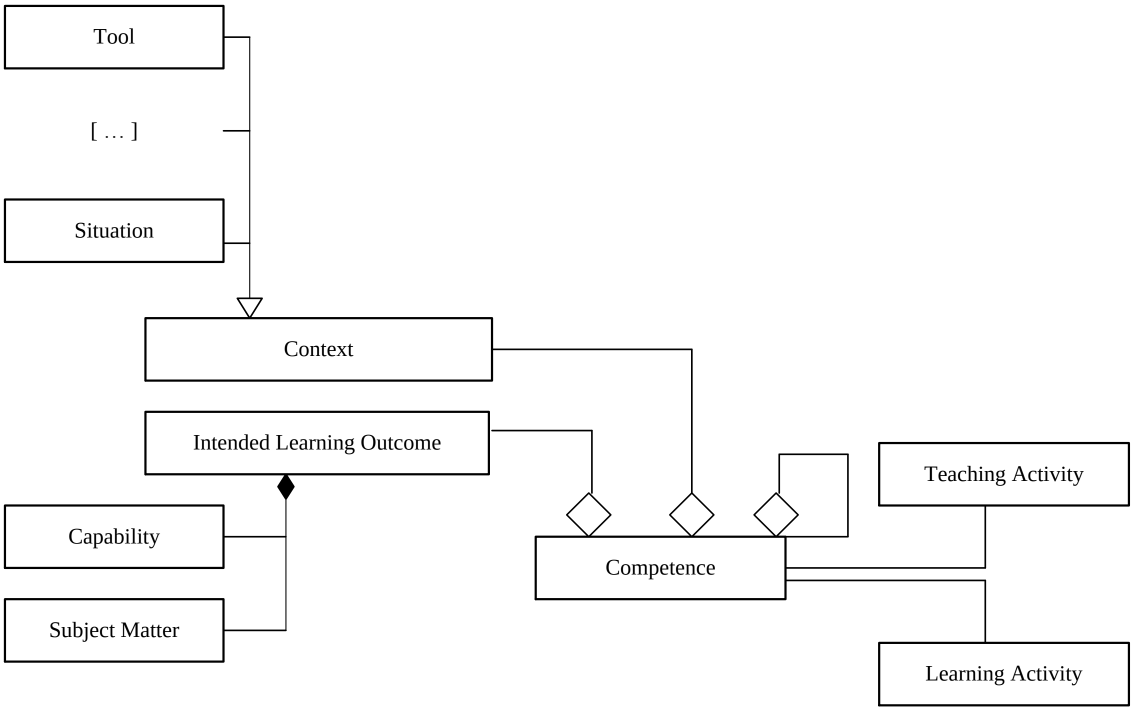


Figure 2-14: The conceptual model of competence in learning and teaching

Sitthisak, Gilbert and Soonklang, (2013) created a new version of the competency model based on the proposed COMBA model shown in Figure 2-13. Although it shares the same structure as the competency model, this has extra components in terms of linking a number of resources to the competence and indicating evidence of learner competency in a number of ways. This improved version of the competency model is illustrated in Figure 2-15. The competency evidence proves the existence, sufficiency or level of competence. The test results, reports and evaluation could be included in competency evidence in this model, while the knowledge resources support the problem solving, activity performance or competency situation handling (Sitthisak et al., 2013).

Three important principles are evident in the proposed competency models. The first is activity-based teaching and learning. The second is identifying and integrating appropriate subject matter content within the larger context of teaching and learning through a hierarchy of linked competences. The last is identifying assessment that demonstrates successful teaching and learning. In the structure of the COMBA model ‘enabling competences’ refers to competences that support and are linked to the given competence. ‘Top-level competence’ refers to when the competence is supported by others, in other words the structure of the competence is the same as that of the ILO or educational objective, as shown in Figure 2-15 (Sitthisak et al., 2013).

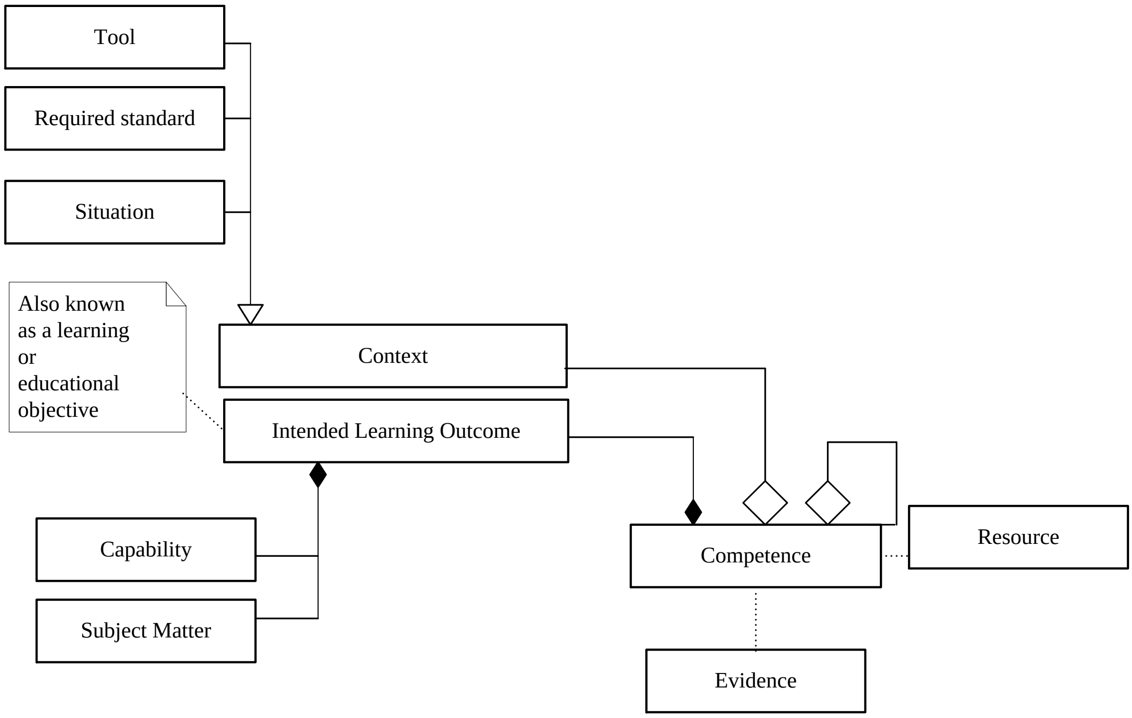


Figure 2-15: Improved competency model (Sitthisak et al., 2013)

2.1.9.3 Adoption of the COMBA competency model in this research

From the proposed competency models, it is clear that the COMBA model incorporates ILOs that can be formally described as a combination of 'capability' and 'subject matter'. This study is concerned with the structure of competences that are for a specific knowledge domain and appropriate to helping students to complete a given task successfully. Providing a system that involves a logical order of the competences of a particular domain will support individuals to learn satisfactorily. By providing explicit statements about competences, they will be able to collaborate with each other to achieve the given competences in terms of sharing related resources and finding suitable colleagues to help. Moreover, to enable them to generate the specific task competences, it is necessary to construct a knowledge base containing all competences, and this must support searching, filtering, updating, creating and deleting content. These activities may be regarded in terms of knowledge management. The next section introduces knowledge management and related techniques.

2.2 Knowledge Management

Knowledge management (KM) has become a topic of interest within organisations aiming to manage the knowledge of their staff. KM includes repositories of knowledge that may be used by the workforce to achieve specific goals. Organisations also aim to ensure that employees have the appropriate knowledge to enable them to use information acquired earlier, when that is necessary to achieve peak performance. The thesis aims to apply the idea of KM to learning and teaching situation through competences as introduced in section 2.1.8. More details about connecting KM to competence can be found in section 2.2.5.

2.2.1 Definition of knowledge management

There are a number of definitions of KM, depending on context, and the following definition is representative and relates to an aim of this study. According to De Jarnett, (1996) 'knowledge management is knowledge creation, which is followed by knowledge interpretation, knowledge dissemination and use, and knowledge retention and refinement' De Jarnett, (1996).

2.2.2 Knowledge management processes

KM includes knowledge creation, validation, presentation, distribution, and application (Bhatt, 2001). Knowledge creation involves the development of novel ideas and solutions. Knowledge validation reflects upon knowledge and evaluates its effectiveness in the organisational environment. Knowledge presentation refers to the manner in which knowledge is displayed to the people in organisations. After these have been addressed, knowledge needs to be distributed and shared before it can be exploited at an organisational level (Walsham, 2001). The last process is knowledge application; this is when knowledge is made active and relevant to organisational services or processes (Alavi & Leidner, 1999).

2.2.3 Evaluating knowledge management

As mentioned above, most prior studies have discussed the collection and storage of knowledge and how to make it available for use. In fact, there is no literal sense in which knowledge can be collected or shared, because knowledge is based in people's heads; what people do is to collect and share data or information. Nevertheless, the following discussion uses the term 'knowledge' rather than 'information' to comply with the literature. External data become information when they are relevant to a purpose, and information becomes knowledge when it is used effectively (Bhatt, 2001). Thus, knowledge is based on the effective use of available information.

Before data and information can be transformed into useful knowledge they must be collected and analysed. At this stage, tacit knowledge is converted into explicit knowledge. Tacit knowledge resides in the human mind and evolves from interactions among people; skill and practice are required. Explicit knowledge is documented and therefore is public. Usually, explicit knowledge is captured and shared using information technology (McAdam & McCreedy, 1999).

The conversion of tacit knowledge into explicit knowledge or new forms of tacit knowledge, and of explicit knowledge into tacit knowledge or new forms of explicit knowledge, takes place in four different phases, as illustrated in Figure 2-16. Transferring tacit knowledge into new forms of tacit knowledge may be achieved through the process of socialisation, which consists of transferring knowledge from one person to another. In addition, tacit knowledge may be transferred into explicit knowledge through the process of externalisation, which consists of transferring tacit knowledge into explicit knowledge held in a repository (Martensson, 2000).

Furthermore, explicit knowledge can be transferred into tacit knowledge through the process of internalisation, consisting of extracting the explicit knowledge from a repository that is relevant to the needs of a particular person and delivering it to that person, who translates it into tacit knowledge. Moreover, explicit knowledge can be transferred by combining different bodies of explicit knowledge to create new forms of explicit knowledge (Martensson, 2000).

The process of converting tacit knowledge into explicit knowledge may be codified or documented and, therefore, captured, stored, transmitted, and used and acted upon by others. This is the goal of KM: to convert tacit knowledge into explicit knowledge and to disseminate it effectively. This is a considerable challenge as the process requires combining old and new information into forms that may be disseminated and made available (Gupta, Iyer, & Aronson, 2000); Fischer, Ostwald & Santayana, 2001). In order to achieve the goal of KM, there is a need to consider the language used in representing knowledge. There is a variety of languages for representing and making knowledge machine processable, sharable and modifiable. The next section discusses knowledge representation. It also discusses the language that will be used to implement the competence structure of a specific knowledge domain.

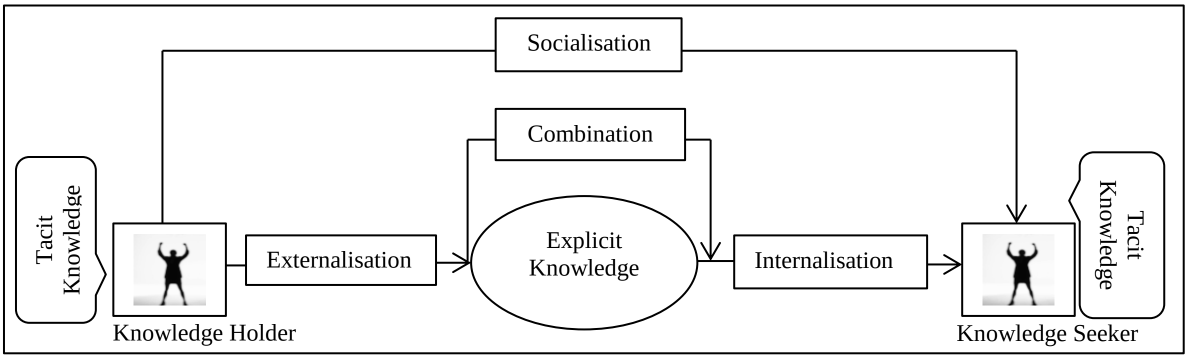


Figure 2-16: Knowledge management phases

2.2.4 Overview of knowledge representation

Knowledge representation refers using explicit symbols to share knowledge unambiguously. It may be defined as 'a multidisciplinary subject that applies theories from three fields: logic, ontology, and computation'(Sowa, 2000). Under this definition, logic identifies the formal structure and rules of inference, and ontology refers to the type of things in the application domain where computation allows applications to distinguish knowledge representation from pure philosophy.

Another notion of knowledge management is proposed by Levesque, (1986): 'this is simply dealing with writing down, in some language or communicative medium, descriptions or pictures that correspond to a state of the world'. However, researchers disagree on the presentation scheme employed for the fundamental issue of knowledge representation and the research area where knowledge representation evolved, for instance logic, philosophy, linguistics or psychology (Levesque, 1986). In order to form structures for the knowledge base, Levesque (1986) suggests that two properties are considered. The first is the interpretation of knowledge representation propositionally, in a true theory of language expression. The second is the enactment of the system in such a way as to match the presence of the structures.

In terms of e-learning and knowledge representation, the literature reveals a number of related studies. Melis et al. (2003) introduced ACTIVEMATH, a web-based learning environment to present mathematics courses in a way that matches students' capabilities, goals, knowledge and preferences. Knowledge representation was considered in this study to provide the content structure of mathematical learning documents by using OMDoc (Kohlhase, 2000). OMDoc is an extension of the OpenMath XML-Standard used to represent a grammar of mathematical objects and a number of related standardised symbols. In addition, Marshall et al. (2003) conducted a study that provided learners with a tool called GetSmart for creating and sharing knowledge, whereby users may construct their acquired knowledge as a conceptual map developed in XML format in order to be able to be shared. Another approach known as TopicMaps was proposed by Mendes, Martinez, and Sacks, (2002). The idea behind this approach is discovering and representing knowledge based on a fuzzy clustering algorithm that identifies the relationship between learning materials to be used as adaptive link documents, while the tool itself deals with modelling and managing a knowledge structure, again encoded as an XML document.

Knowledge representation will be seen in this study in terms of providing the correct structure of competences for specific knowledge domains. Understanding this concept helps to analyse the subject matter in a particular format and to link content to the desired competences. It provides a number of available languages to represent knowledge such as XML, XML-schema, resource description framework (RDF) and ontology. These languages appear in the semantic web layer cake (Halpin et al., 2009) in Figure 2-17, showing the current state of the art in knowledge representation of data on the web and as the planned future standard. The following section will discuss those related languages and highlight the language considered for this study.

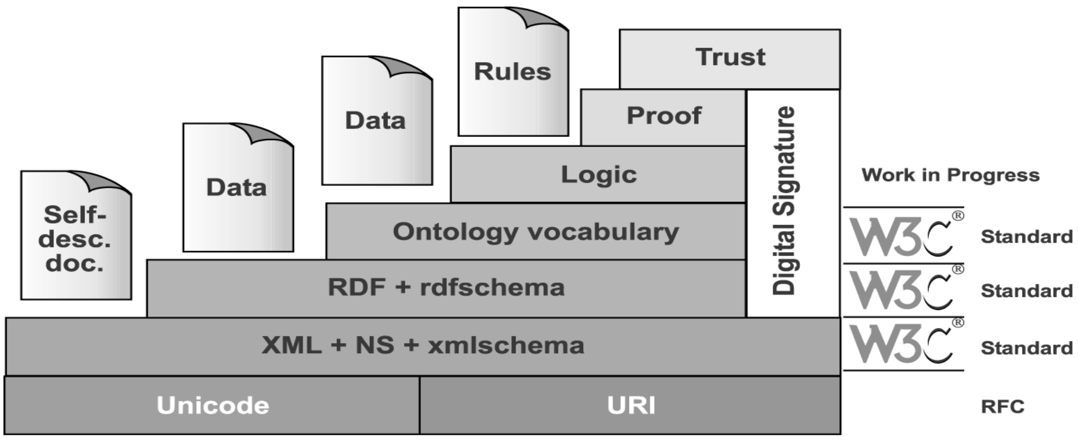


Figure 2-17: Semantic layer cake (Halpin et al., 2009)

2.2.4.1 Extensible Markup Language (XML) and XML-schema

XML aims to manage data by allowing users to customise tags to organise information (Bray & Paoli, 1999). XML is meta-markup language described as an application profile or a restricted form of SGML, the Standard Generalized Markup Language (Bray & Paoli, 1999). XML documents consist of a number of storage units known as entities that contain either parsed or unparsed data. There are various design goals for XML such as being easy to use over the internet and with ability to create an XML document with the ability to support a variety of applications and be humanly readable. In addition, XML provides a special property called XML namespaces (Bray, Hollander, Layman, Tobin, & Thompson, 2009) for avoiding element name conflicts when XML documents are integrated. XML allows navigation between documents by using XPath (Clark & DeRose, 1999) to define path expressions. Furthermore, XML documents can be transformed to HTML document through XSLT (CLARK, 1999) and XML validation provides well-formed XML documents with the correct syntax.

This study could use XML validation to achieve well-formed documents of the competence structure by allowing developers to store information relating to competences, such as capability and subject matter key terms in particular knowledge domains. This can be performed through two types of XML validation, that is, DTD and XML-schema. The most recent and powerful technique in describing XML document is XML-schema (Ioannides, 2000), with the ability to present rich data and use an XML-based format.

Considering using the XML-schema means taking into account the definition of terms, relationships and constraints that demand supporting communication in a particular application domain (Carlson, 2001). The motivation to use it to create the documents is its ability to define and document the vocabulary for all users. In addition, it can validate the documents by using XML parsers and employs the XML authorising tool to provide a guidance structure for content providers. Furthermore, the XML-schema has the ability to define a new application of domains of specific data types.

2.2.4.2 Resource Description Framework

In general, a Resource Description Framework (RDF) language describes how information on the web is represented (Beckett & McBride, 2004), consisting of resource, property and statement. This resource may be seen in webpages identified with URI and may be described in statements. It has a number of characteristics such as the ability to create properties, to convert any RDF file to XML and to consider any value, property or statement as a resource, including metadata that may have been created by other people or organisations (Beckett & McBride, 2004).

The representation of RDF data can be seen as a directed or labelled graph on the web. In order to retrieve specific data of the graph, the SPARQL query must be used. This can conduct queries for required or optional graph patterns, resulting in sets of RDF graphs (Prud’hommeaux & Seaborne, 2008). When comparing XML and RDF-based representations using a semantic web approach, it is clear that RDF is better because it allows the creation of a number of triples, which enables users to choose related triples and to ignore others (Berners-lee, 1998). On the other hand, when comparing them based on their competence structure, RDF seems the better approach to structuring ILOs because the relationship between task analysis and subject matter can be represented as a property in the RDF language, unlike in the XML language.

2.2.4.3 Web Ontology Language

The definition of ontology in section 2.2.4 refers to the type of items in the application domain. Also, ontology was defined as 'an explicit specification of conceptualisation' (Gruber, 1993). The ontology specification represents a vocabulary of a specific shared domain consisting of defined classes, relations, functions and other objects. The ontology language is 'OWL', and may be used by applications to process content information instead of presenting that information to humans (McGuinness & Van Harmelen, 2004). A special feature of OWL is its superior machine interpretability of web content compared to either RDF or XML, as it provides additional vocabulary with formal semantics for describing classes, properties and relations between classes, such as disjoint classes (McGuinness & Van Harmelen, 2004). The OWL language is considered to be the most recent development standard in ontology languages from the World Wide Web Consortium (W3C).

OWL has three different sub-languages: OWL-Lite, OWL-DL, and OWL-Full (Horridge et al., 2004). OWL-Lite is considered to be the least expressive sub-language, so is used when defining a simple class hierarchy and the constraints of ontology. OWL-DL depends on description logic, so is considered more expressive than OWL-Lite. It enables developers to define a subclass for a number of main classes, but that class must not be an instance of another class (McGuinness & Van Harmelen, 2004). OWL-Full is considered to be the most expressive OWL sub-language and is used with a high expressive language of computational completeness. Section 4.4 will give further details regarding developing such an ontology.

2.2.4.4 Discussion of considered language

The three languages require to implement the competence structure of a specific knowledge domain have been discussed. XML has a limitation in terms of the relationship between task analysis and subject matter but, while this can be avoided by using RDF, the ontology language is the most recent and well-supported technique in KM. In addition, there is a further aim for this study – achieving competences in a collaborative fashion. This requires group working and demands another kind of competence. Collaborative working competences can only be developed ontologically if they are to enable students to connect statements about various competences with colleagues' skills; without an ontology, this connection will not be made.

The social media section will introduce collaborative working and related competences. Learning task competences will be represented ontologically by linking a competence to the related subject matter content. The categories of subject matter content are considered to be based on a task analysis that is provided. Each category will be represented in a special class that is connected to the subject matter's key terms. The between-classes relationships of task analysis will be represented as properties. Further details about building ontologies can be found in section 4.4.

2.2.5 Summary of knowledge management and knowledge representation with their relation to competence structure

Knowledge management involves knowledge creation, validation, presentation, distribution and application. When knowledge is created and presented it may be easily shared among people in institutions or organisations. The idea is to manage human knowledge by providing the necessary information to people with problems, concerns or questions. This can be achieved once the knowledge is structured and organised in such way as to allow people to access the whole repository.

This thesis aims to apply the idea of KM to learning and teaching situations through competences, and this demands the creation of a feasible structure to serve both learning and teaching. It will be a competence structure consisting of subject matter and capability verbs; subject matter is additionally analysed using different categories and approaches. The structure will be used to populate the categories with information from particular knowledge domains. Learners will be able to access the necessary competences of a given learning task based on the capability verbs and subject matter key terms, because the verb is common to the competence statement and the assessment task. Once the student has clicked on the verb and the competence, the whole set of competences of that task will be appeared.

The competence structure of specific knowledge domain needs to be machine processable, modifiable and sharable, so knowledge representation and related techniques must be considered. The semantic web standard (XML, RDF, Web Ontology Language) is considered. The best-supported technique for KM is ontology, so this technique will be used to represent the structure of competence structure of specific knowledge domains. Students will use the competences in the ontological database to navigate it to establish what is required by a provided task. The ontology structure of learning tasks is presented in section 4.4.1.

Social media supports KM in terms of creating, validating, presenting, distributing and using knowledge within organisations or institutions. Available forms of social media have different features that enable the creation of content and the sharing of that content between people in organisations. The next section gives an overview of social media and collaboration in learning and teaching situations. In addition, it discusses the chosen social media tool that derives the ontology of task competences through an application. This application supports KM with social media, and e-learning using social media.

2.3 Social Media

The term 'social media' is currently used to define a variety of technologies and networking tools (Dabbagh & Kitsantas, 2012) that play important roles in emphasising social aspects of the internet as a channel for communication, collaboration and creative expression. Moreover, the term is often interchangeable with the terms 'Web 2.0' and 'social software' (Lee & McLoughlin, 2011).

Social media include various types of experience- and resource-sharing tools. These tools and resources may be divided into six different categories. Resources for the enabling of online or social bookmarking and blogging consist of Twitter, WordPress and Del.icio.us. Resources for creating collaborative workspaces consist of wiki software such as PBworks. Resources for enabling social tagging consist of tools such as Flicker and YouTube. Those for enabling social networking consist of such sites as Facebook and LinkedIn, while those for enabling calendar sharing, editing and documentation consist of web-based (cloud-computing) office tools such as Google Apps. In addition, social cataloguing functionalities such as tagging and Really Simple Syndication (RSS) are used to enrich content (Dabbagh & Kitsantas, 2012).

2.3.1 Available social media tools

Nowadays, most people are familiar with social media such as wiki pages, blogging, RSS, social networking sites and others that allow users to create and share information. Table 2-5 lists common social media with descriptions of their features:

Table 2-5: Examples of available social media tools with different categories and features[1]

Category	Social media	Description
Social publishing	Blog	Can be used to place content in categories and allows task planning; provides comments on basic interaction; additional content can be added using RSS.
	YouTube/ Flicker	Can be used to set up media archives related to content; sharing and joining with other related media is possible.
Collective intelligent tools	Wiki pages	Can be used as settings for content of an organisation and management-specific content; editing of and commenting on content is possible. Also, a Wiki page enables multiple users to make contributions to content.
Social cataloguing	RSS	Can be used to connect to feeds related to written content.
	Tagging	Can be used to tag pages related to the content; pages are read and shared.

Category	Social media	Description
Online/social bookmarking with blogging and micro-blogging	Del.icio.us	Can be used to organise content and collaborate with other users to create and share bookmarks of specific content.
	Twitter	A micro-blogging site that enables users to follow others via brief messages. Also, can be used for communication between users to raise questions and hold a discussion.
Social networking sites	Facebook MySpace	The site's pages can be used to connect people with common interests and to create and share related content with others.
	LinkedIn	Can be used to create an online academic career profile read by others with related professional goals.
	Google Plus	This site can be used for creating content and sharing them with others. In addition, it allows following and interacting others' updates.
Document and calendar sharing with editing	Google Calendar	Can be used as a personal calendar. Enables sharing of features and provision of comments on shared material. Also, can be used for archiving personal or group plans for tasks to be accomplished.

[1] Avram (2006); Yates & Paquette (2011); Hoffman (2009); Pettenati & Ranieri (2006); Baird & Fisher (2005); Fisher & Baird (2005); Dabbagh & Kitsantas (2012); Kane et al. (2010); Kaplan & Haenlein (2010); Levy (2009).

2.3.2 Discussion on different social media tools

Wiki pages and various types of blogs are different yet share presentation features of the structured content. A wiki page is a structured website that allows many pages to be collected and shared using a template (Grace, 2009). In addition, it allows multiple users to contribute to the content of a single page (a wiki) by editing and adding content. Moreover, it allows sharing and content to be updated quickly; users can be very active in terms of sharing and improving content. On the other hand, a blog is an individual website; only one user controls the content but others may share opinions by adding comments to a post. Blogging and wiki pages are valuable in terms of KM because they allow individuals to create, access and share content within organisations or institutions (Hemmi, Bayne & Land, 2009; Kaplan & Haenlein, 2010).

RSS and tagging are forms of social cataloguing, whereas Twitter is a form of social micro-blogging. RSS automatically feeds a page with other resources relating to the content of that page (Levy, 2009) and tagging tools allow users to mark any page relevant to a specific topic to share with others (Kane, Robinson-Combre, & Berge, 2010). Both RSS and tagging may be used in a wiki page, a blog, a social networking site or any social publishing tool to enrich the content of a page. KM takes advantage of RSS or tagging to enrich data content or to ensure that information may later be used effectively in organisations. Other social micro-blogging tools such as Twitter allow users to follow brief messages written by others and to communicate with each other. In terms of KM, Twitter enables users to hold a virtual discussion on a specific topic and to share useful information within institutions or organisations (Kaplan & Haenlein, 2010).

Social networking sites such as Facebook, MySpace and LinkedIn are important in organisations by allowing content creation and connecting people. Users can also connect to experts in a specific field to ask detailed questions (Levy, 2009). Currently, organisations use these and other websites to interconnect their people, hence the sites serve as KM tools (Levy, 2009). The principle of KM is to create and share content and these websites enable users to develop and share content. In addition, they attract those with knowledge of previous specific problems (and the solutions). Users can thus seek help (Fisher & Baird, 2005).

Increasingly, KM uses social media (Yates & Paquette, 2011). The available media capture user knowledge and quickly share that knowledge around an organisation. Moreover, social media are used in learning and teaching, or perhaps to support them. This technology is termed 'e-learning'. Social media may be used to increase motivation toward learning and interactions between students and teachers, or even to improve self-regulated learning. In addition, KM and e-learning may share subject matter, with social media being used to deliver it.

2.3.3 Facebook

A number of social media tools have been discussed in the previous section. Facebook is the selected social media tool for the purpose of this study, specifically the Facebook Group feature. Facebook will be investigated in terms of supporting KM and e-learning. It defines itself as a free social networking website that allows people to register and create their own profile in order to share photos, videos and documents. In addition, it allows people to exchange messages and to keep in touch with family, friends and colleagues. Currently, Facebook is available in 37 different languages (WhatIs.com, 2014). Facebook includes features such as:

- Posts: Members may post anything in their 'profile' to share and discuss with others.
- Groups: members can find similar people who share an interest to interact with them.
- Events: Facebook provides event invitation and tracking the attendance.
- Pages: Facebook allows members to create a public page about a specific topic.
- Presence technology: Facebook allows members to see who is online to chat and supports the development of applications that use Facebook features. (WhatIs.com, 2014)

In addition, Facebook includes a large taxonomy of user profiles. These contain information about employment and education such as place of work, place of study, graduated school or university and professional skills. Also, the profile contains basic information such as date of birth, contact information, details about the user and interests. These classifications are not found in other commonly used social media tools. Moreover, the Group feature in Facebook includes uploading documents, files, asking questions and voting, knowing members, exchange messaging for group discussion and posting in the group. The Group feature is important to this study because it gathers all students undertaking the module and allows them to communicate with each other (Phosaard & Wiriyapinit, 2011). In other words, Facebook allows students to collaborate on a task set by the teacher in order to accomplish that task. The next section introduces collaboration in a learning and teaching situation.

2.3.4 Collaboration using social media (Facebook Group) and relation to KM as ontologically structured competences

Social media support collaborative learning because they consider as a community those people who have the same interests. The term ‘collaborative learning’ includes a number of activities in an educational context such as sharing assignments and course materials (Dillenbourg, 1999). It is important to distinguish between cooperative and collaborative learning. Cooperative learning is ‘a protocol in which the task is in advance split into sub-tasks that the partners solve independently’ (Curtis & Lawson, 2001), whereas collaborative learning ‘describes the situation in which two or more subjects build synchronously and interactively a joint solution to some problems’ (Curtis & Lawson, 2001).

Collaborative learning is evident in various types of behaviours such as asking for help and assistance, exchanging resources and information, explaining information, sharing existing knowledge with colleagues, providing and receiving feedback, tracking each other's work, engaging with group skills and challenging another’s contribution (Johnson D.W & Johnson, 1996). These types of collaborative learning should be reflected in social media, and in particular in Facebook, to work collaboratively on a given task.

The KM section introduced an ontology of task competences, and the social media section discussed encouraging collaborative learning so, for the purpose of this study, a learning task may be accomplished by group work. The competences of a specific task should be divided between group members in order to complete the task successfully. To help students to find appropriate group members, this study will construct another kind of competence, termed ‘collaborative working competence’. Students study what is required for a given task and group work. The collaborative working competences will be developed ontologically in order to help students to find group members based on the provided competences. The competence structure of collaborative working will be discussed in section 4.5.

This study concerns two types of competences that need to be developed ontologically. Both ontologies need to be derived by an application, and Facebook supports building social applications using its various features. The application will use Facebook features such as exchanging messages, providing personal profiles and sharing resources for the purpose of this study. The provided personal profiles will be exploited to connect with collaborative working competences in order to build effective groups. The shared resources such as documents, files, and links will be exploited to connect with task competences.

The following sections discuss the combination in the literature of e-learning, KM and social media. The purpose of combining them is to investigate the possibility of finding studies that deal with competences in the context of ontologies and using particular social media tools, in addition showing how literature expresses e-learning and KM when integrating them with social media.

2.4 Knowledge Management and Social Media

The Web has transformed from being a means of simply transmitting information to become a platform on which users can create, share, remix and repurpose information, resulting in collaborations between users and the widespread distribution of content (Alexander, 2006). In addition, the growing use of social media tools such as wikis, blogs, RSS and media-sharing supports such collaborations and facilitates connections and exchange of information. Figure 2-18 shows the common connection between KM and social media, namely collaboration. The following sub-sections give examples of social media that support KM in creating, validating, presenting and distributing information through organisations.

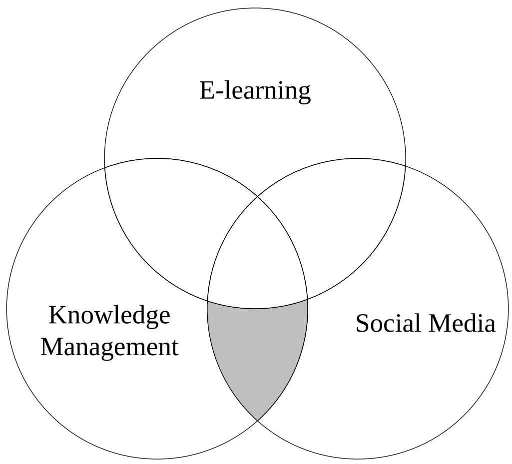


Figure 2-18: Combination of knowledge management and social media (collaboration)

2.4.1 Wikis as popular knowledge management tools within organisation

Wikis are KM tools favoured by organisations because of their ease of use and the fact that sites may be tracked and edited (Grace, 2009). Wikis can link different sites with related content, thus fleshing out the information. In addition, wikis play an important role in building trustful cultures and as central repositories of information within organisations. Moreover, wikis have inbuilt search functions that help users to obtain information. A significant benefit of using wikis is that they save time and money, making them an excellent choice for organisational use (Cole, 2009).

2.4.2 Evaluating wikis in terms of benefits and challenges

Ease of use was the most frequently cited benefit of wikis in three case studies (Grace, 2009). They also serve as coherent repositories of information and feature a user-friendly, bottom-up, informal approach. The tracking and revision features facilitate collaboration among organisations (Wagner.C, 2004). Elimination of information overload via email as also seen as a benefit of wikis in case studies (Grace, 2009).

A number of challenges must be overcome when implementing wikis in organisations. These include security (someone in the organisation must monitor the wikis to ensure that the application is secure and that the content does not present legal issues); data migration (management must perform rigid security checks to examine the adaptability of a wiki engine) (Grace, 2009); training (although most members of organisations are required to be computer literate); and categorisation of information (every member contributes to wiki structures and categorisation of explicit, and tacit knowledge is often based on natural and subjective language) (Wagner.C, 2004).

2.4.3 Other tools relevant to knowledge management

Table 2-6 lists social media tools in addition to wikis (including blogs, RSS, tagging and social computing) relevant to KM, although limitations are apparent. The ‘Attributes relevant to knowledge management’ (Levy, 2009) section of Table 2-6 illustrates KM-related techniques for each tool.

Table 2-6: Social media attributes relevant to knowledge management (Levy, 2009)

Social media	Attribute	Attributes relevant to knowledge management	Gaps
Wiki	Structures the content of pages	Uses tools to provide rich content sites, such as Web content management, which is part of KM	Flexibility in content and structure can be a disadvantage because of the high level of connectivity between items, which may lead to site homogeny or integration of several wikis
Blog	Documents things with easy access to page history	Uses KM tools like enterprise content management and the portal style tool	Easy to copy ideas using various KM tools and reading, which leads to special placement in search results and RSS feeds
RSS	Alerts users to the addition of new content or changes made to existing content	Alert mechanism can be used with enterprise content management tools, portals, a common weblet 'What's new,' and search engines	Packages information instead of providing separate alerts for individual resources; some alert sources may be overlooked because the requested information is defined by category
Tagging (folks-onomy)	Ability of users to tag their own information	Tags can be provided using several tools, such as portals, via the navigation menu and search engines, by filtering attributes that are part of enterprise content management	A page can be tagged more than once; tags are subjective and there are no pre-defined lists of attributes or values that define allowed tags
Social computing	Creating social communities over the net	Communities of practice	Communities of practice are based on hobbies and fields of interest; they focus on professional issues that are complemented by face-to-face gatherings, rare in Web 2.0

2.4.4 Supporting KM principles using social media

Social media support the principles of KM in terms of creating, sharing and publishing knowledge. Blogs and wikis are excellent tools for collecting information that may improve an organisation's performance, perhaps even by editing the content of information on a site such as Wikipedia. Browsing others' tags and bookmarks saves time when searching for information, whereas social networking yields information on contacts or links employees with interests in common. In addition, blogs and wikis may be used to capture and document ideas during a search process or project development. Social networking sites may be used to acquire new customers, employees or consultants by allowing companies to discover individual needs and expertise. Pages of interesting bookmarks or tags may be used to sort and organise content for future use. Moreover, the use of social media is an easy way in which to package, codify, represent and store acquired information or activities to apply, share or transfer information using blogs, wikis or social networking. RSS feeds help users stay up-to-date with the latest news or information. Furthermore, users may re-use, innovate, evolve and transform knowledge by discussing and using ideas from blogs, improving the content of wikis, using social networking sites to hold discussions via instant messaging or sending content to others for further discussion (Avram, 2006).

2.4.5 Summary: Managing knowledge in the light of social media

Wikis are considered to be successful organisational tools because they contain flexible content that is easy to share with users (Levy, 2009). Also, blogs may be helpful when an organisation has an expert willing to write, has a continuous stream of material to write about and knows how to write. On the other hand, because social networking tools evolve from various technological and social changes, they enrich many KM tools. This is dependent on the emphasis placed on each tool and how common use of that tool successfully disseminates information and news throughout an organisation. However, some studies have shown that most organisations are not sufficiently mature to use social media as a KM tool (Brady, Holcomb, & Smith, 2010).

In general, when combining KM and social media, the literature points to information being created and shared with others. There is no systematic way to create the information in special categories or topics. This gap may frequently be seen with common social networking tools such as Facebook, where users add content without classifications. The aim of this study is to bring aspects of KM into social media, in particular Facebook Group. The idea is to develop an ontology of task competences so newly added resources will be linked to related competences through the proposed application. Students can find specific resources for specific competence, rather than lists of unstructured resources. The other ontology, collaborative working competences, will be the same and exploit the information in users’ profiles in order to connect them to working groups. With effective group working, collaboration will be achieved in social media to contribute to solving the given task.

2.5 Knowledge Management and E-learning

KM and e-learning have a common connection: subject matter (Figure 2-19). Subject matter is content that needs to be delivered to learners. E-learning focuses on methods of delivering learning content, whereas KM controls the quality of the delivered content.

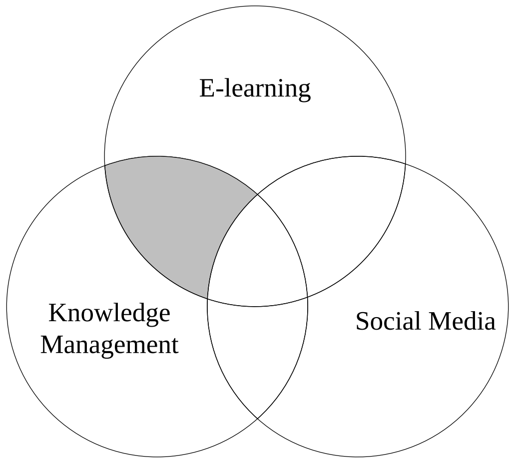


Figure 2-19: Combination of knowledge management and e-learning (subject matter)

Information on KM and subject matter may be used by designers to create learning modules (Kane et al., 2010) that integrate KM with e-learning, yielding online courses and modules that use knowledge verified by experts (Sammour, Schreurs, Al-Zoubi, & Vanhoof, 2008). Time, resources, and pre-determined user knowledge and skill sets are required to build online courses and modules. Therefore, KM and e-learning have the same aim: to facilitate organisational learning and knowledge acquisition. They have other common features such as flexibility and user collaboration, and have proven useful in integration and learning (Kane et al., 2010).

2.5.1 Improving e-learning effectiveness using knowledge management

E-learning can be made more effective by using KM tools that assist learning in diverse learning environments (Lytras, Naeve, & Pouloudi, 2005). The perspective of KM directs learners to complete a number of processes to acquire knowledge: collaboration, exchange, sharing, acquisition, creation, distribution, dissemination, storage and personalisation. These processes work effectively alongside KM tools such as community-building, social software, search engines and taxonomy, peer-to-peer interaction and personalised knowledge management. Together, they promote an effective learning environment (Lau & Tsui, 2009). Table 2-7 lists these KM tools, their associated features and how they relate to e-learning processes.

Table 2-7: Features of knowledge management tools and corresponding processes in e-learning (Lau & Tsui, 2009)

Knowledge management tool	**Features of knowledge management tool**	**Corresponding knowledge management processes for e-learning**
Collaboration and community	Groupware, workflow systems, emails, chat rooms, workspace, discussion rooms	Knowledge collaboration, sharing, and creation
Social software	Social network analyses, weblogs, RSS feeds, podcasts, photo-sharing, social bookmarking	Knowledge exchange, sharing, acquisition, creation, distribution, and dissemination
Search engines and taxonomy tools	Searching for, classifying, and indexing information	Knowledge distribution and dissemination
Personal KM	Searching for, classifying, and indexing information; contact management; knowledge mapping	Knowledge acquisition, storage, and personalisation
Peer-to-peer KM	Distributing and searching for information, creating workspaces, file-sharing, content distribution, synchronous communication	Knowledge collaboration, exchange, sharing, distribution, and dissemination

Collaboration and community tools such as workflow systems and email services help learners to create knowledge based on collaboration and sharing, and to link those learners who have interests in common, thus helping them learn by community interaction (Jameson, Ferrell, Kelly, Walker, & Ryan, 2006). Social software enables learners to distribute or exchange information verbally, though video, peer-to-peer or as a group. This creates a personal knowledge repository that consists of all learners and their virtually distributed shared information. Search engines help learners find required learning content on the internet and then to classify it structurally to support knowledge distribution and dissemination. The peer-to-peer function enables learners to collaborate, exchange, share, distribute and disseminate knowledge (Zhuge, 2002). Also, this tool simulates a 'real' learning environment in terms of communication. Material is shared and group work performed; learners both motivate and learn from each other. The outcomes of personal KM depend on learner preferences when selecting, storing, navigating and searching content for their personal repositories. Learners can reduce search times and acquire new knowledge via externalisation, internalisation, combination and personalisation (Lau & Tsui, 2009).

2.5.2 Summary of e-learning and knowledge management

The differences between e-learning and KM may be summarised in two key points: e-learning helps learners to expand their knowledge using structured content, with intercommunication being focused on a specific topic, whereas KM provides knowledge using a content management system based on searching and collaboration between experts and users on different topics. Additionally, e-learning systems measure learner progress when administering tests and examinations, whereas KM focuses on skill management and career planning (Shawar, 2009).

However, a number of similarities between e-learning and KM are apparent. Both provide knowledge in a variety of different forms and content can thus be re-used, modified or annotated in various ways. Also, both e-learning and KM use client-server architecture. In addition, communication and co-operation are important in both e-learning and KM. Moreover, personalisation also plays an important role in both systems; both require support in terms of role-based or personal orientation. Finally, both e-learning and KM structure information contextually rather than being mere repositories of information (Shawar, 2009).

The literature mentions no studies that consider the competences to be constructed and delivered to students. Neither is constructing collaborative working competences addressed through KM techniques; the literature deals only with subject matter. However, this study aims to construct competences for both task and collaborative working and make them ontologically structured.

2.6 Social Media and E-learning

As discussed in section 2.1.4, an e-learning transaction contains four elements: tell, show, ask and feedback. These elements, and combinations of e-learning and social media, yield processes that deliver specified subject matter as shown in Figure 2-20. Unfortunately, the literature contains no report of the application of e-learning to social media. However, these media have been used in higher education, for example to increase engagement between students and teachers, to facilitate teaching and learning and to support self-regulated learning in a personal learning environment. The next sub-sections contain relevant examples.

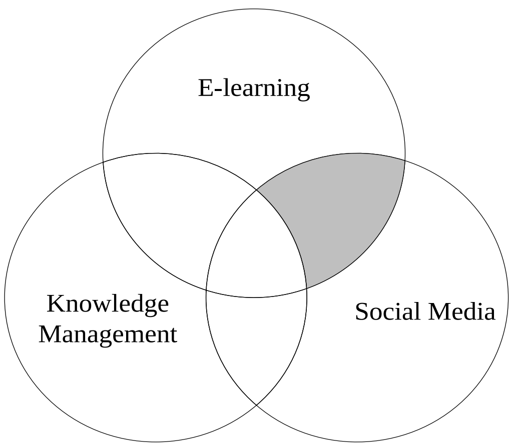


Figure 2-20: Combining of e-learning and social media (processes)

2.6.1 Using Facebook for teaching and learning

Facebook is a Web 2.0 application that is potentially useful in education and learning since the current generation of students uses Facebook for web interaction. The University of Cape Town explored using Facebook to network, in the classroom and to encourage lecturer engagement with students. It was found that students mentioned Facebook often and shared related information. In addition, they sometimes used Facebook to ask classmates questions or to discuss courses; Facebook thus may indeed be used for learning and teaching. It was found that many lecturers ignored friendly requests from students and preferred to keep personal information private. However, a few engaged with students on Facebook, answering questions about lectures and discussing them. Thus, to some extent, Facebook may be used to enhance student–lecturer engagement (Bosch, Preez, & Michell, 2009).

2.6.2 Using wikis to support students engagement

Cole (2009), in a third-year undergraduate project, examined the use of wiki technology to support student engagement through a qualitative approach, applying two popular learning theories, constructive and collaborative, to students' activities with wikis. The former refers to activities to build their own learning environments, including building on prior knowledge and constructing knowledge, whereas the latter is social interaction such as working on projects and solving problems in teams. The study concluded that wikis had little impact on student engagement, as the students did not post on the wikis. This failure may be attributed to the design of the subject, not to the technology *per se* (Cole, 2009).

2.6.3 Using social media to support self-regulated learning

Personal learning environments are potentially promising pedagogical spaces allowing formal and informal learning to be integrated using social media and supporting self-regulated learning in higher education. To examine their potential, a pedagogical framework was created to allow college instructors to demonstrate how to use social media to create personal learning environments supporting learner-centred pedagogy and fostering self-regulated learning (Dabbagh & Kitsantas, 2012). The framework had three levels: personal information management, social interaction and collaboration, and information aggregation and management. These levels interacted with several tools including blogs, wikis, Google Calendar, YouTube, Flicker, social networking site, and social bookmarking, as shown in Table 2-8 (Dabbagh & Kitsantas, 2012).

Table 2-8: Framework for using social media to support self-regulated learning in a personal learning environment (Dabbagh & Kitsantas, 2012)

Tool	(level 1) Personal information management	(level 2) Social interaction and collaboration	(level 3) Information aggregation and management
Blogs	Instructor encourages students to use a blog as a private journal to set learning goals and plan for course assignments and tasks	Instructor encourages students to enable the blog comment feature to allow for instructor and peer feedback enabling basic interaction and sharing	Instructor demonstrates how to configure a blog to pull in additional content and how to add the blog to RSS aggregation services
Wikis	Instructor encourages students to use a wiki as a personal space for content organisation and management	Instructor encourages students to enable the wiki's collaborative editing and commenting features for feedback	Instructor demonstrates how to view a wiki's history to promote student self-evaluation of their learning across time
Goggle Calendar	Instructor encourages students to use Google Calendar for personal planning	Instructor encourages students to enable the calendar sharing features to allow feedback and collaboration to complete course tasks	Instructor demonstrates how to archive personal and group calendars to promote student self-valuation regarding time planning and management
YouTube or Flicker	Instructor encourages students to use Flickr or YouTube to set up a personal media archive related to course content	Instructor encourages students to enable the sharing feature of the media archive and join similar media archives created by peers	Instructor demonstrates how to aggregate media from several media archives to refine their personal archive
Social networking sites	Instructor encourages students to create an academic and career profile on LinkedIn	Instructor encourages students to connect to online communities related to their professional goals	Instructor asks students to engage in self-reflection with the goal to restructure their profile and social presence
Social bookmarking	Instructor encourages students to use a social bookmarking tool (e.g., Del.icio.us) to organise course content	Instructor encourages students to collaborate with other classmates and create a shared list of bookmarks related to a specific learning topic or project	Instructor asks students to self-reflect on their personal and group bookmarks to enhance the desired learning outcome

2.6.4 Evaluation of examples of social media

The previous instance of using social media in the classroom commenced with a Facebook example. The results were positive in that students shared information and became mutually involved. However, Facebook was not examined in terms of an e-learning tool for delivery of material or for learning. Wikis are popular in higher education settings; learning materials are posted online and co-operation between teachers and students or students and peers is encouraged. However, a wiki is not considered a valuable tool in this context because students generally do not like to use wikis; some studies even reference the failure of wikis to present engaging content to students. A final example explored the role played by social media in self-regulated learning in a personal environment and designed a framework by which the goal could be attained. Unfortunately, this framework has not been tested in practice.

In addition, there is currently no system or application that uses social media tools to deliver content to students. This has prompted this study to develop an application that uses the Facebook Group feature and both ontologies to help students to collaborate on given assignments.

2.7 Knowledge Management, E-learning and Social Media

The relationships between KM and social media, KM and e-learning, and e-learning and social media were examined above. This section will focus on their integration, as shown in Figure 2-21, considering the collaborative delivery of subject matter. Unfortunately, the literature lacks information on this topic; Table 2-9 lists a number of social media tools that may be used for KM and e-learning. This is followed by discussion of a single example from the literature that references social media, e-learning and KM as a community of practice.

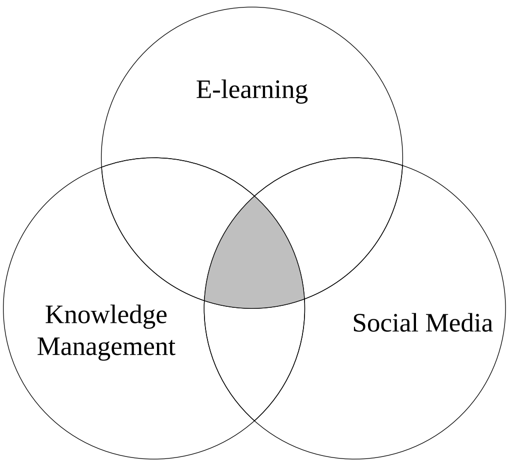


Figure 2-21: The combination of social media, knowledge management and e-learning

Table 2-9: Social media tools in terms of knowledge management and e-learning (Kane et al., 2010)

Social media	How social media can serve knowledge management and e-learning
Blogs	Websites with regular postings of ideas, news, and opinions by an individual user. Blogs are considered a valuable tool for connecting KM and e-learning, allowing users to access blogs and share information or re-use information as e-learning content.
Wikis	Allow multiple users to contribute to the content of a website. Wikis are considered examples of collaborative knowledge sharing; it is easy to update content and make that content available quickly. Wikis are KM tools that can encourage learners to be active in terms of knowledge sharing.
Twitter	Considered a micro-blogging site; it allows learners to 'follow' others' brief messages. Twitter contributes to KM and e-learning because it allows users to ask colleagues questions and enables others to see the answers when 'following' the communication thread. Also, 'tweets' (messages) can be collected and sorted in categories to share them. Twitter could also be used to hold a discussion after an e-learning class or to make connections with experts in other fields.
Facebook, My Space, Ning	These are examples of social networking sites that connect users with common interests. They allow users to create and share profiles, building networks that enable information-sharing and collaborative knowledge sharing. For e-learning purposes, they locate subject matter by the searching of profiles by course development experts.
Instant messaging (IM)	IM is communication between two or more users online to discuss issues or work on projects. This leads to knowledge sharing between users with shared experiences. In terms of e-learning, IM can provide captured, shared, information useful for repurposing content. These captured conversations can be put in blog form to help solve problems or can show the process of incorporation of a formal e-learning module.

2.7.1 Social communities of practice

Gunawardena et al. (2009) developed a theoretical framework allowing the establishment of online communities of practice and learning, based on the use of a group of social networking tools including Facebook, Delicious, Mashups, Flicker, blogs, RSS feeds and wikis. These tools were employed to develop online communities using learning theories relevant to research in such communities. Knowledge creation used Web 2.0 tools. Building a learning community is a process that starts within a given sociocultural context and spirals through discourse, action, reflection and reorganisation to become socially mediated metacognition (Gunawardena et al., 2009). Figure 2-22 illustrates the structure of such a framework:

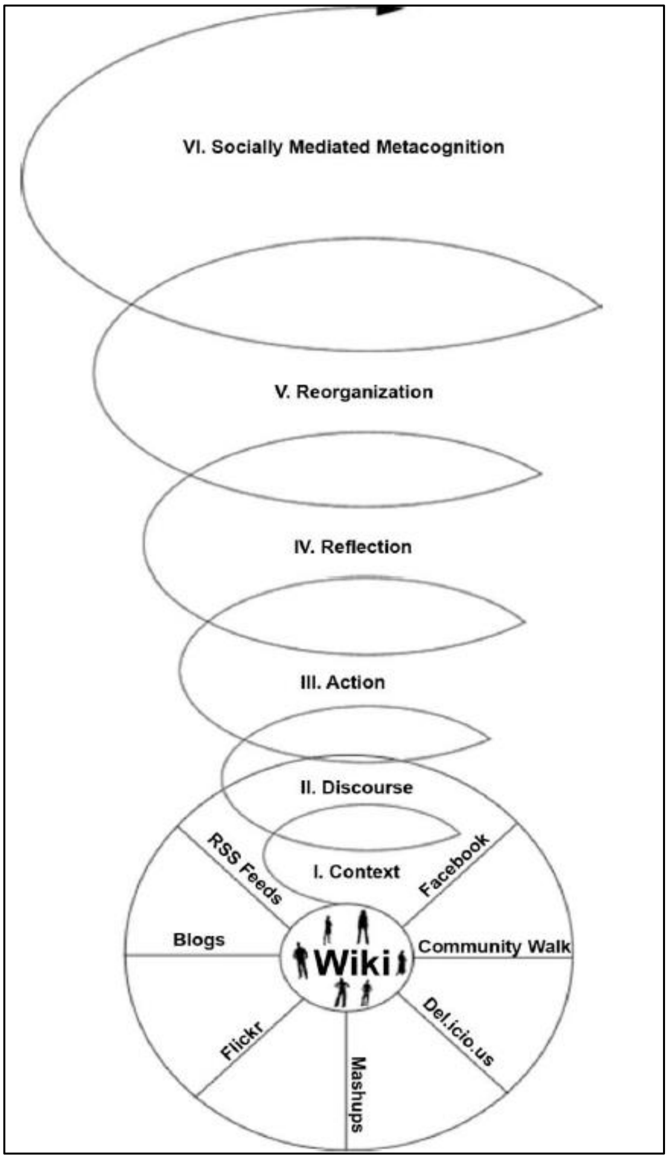


Figure 2-22: Framework for social communities of practice (Gunawardena et al., 2009)

Wikis display the results of the evolving process of gathering information in conjunction with other tools to enhance the learning process. Facebook enables learners to connect with others via profiles, and Community Walk refers to identifying user locations using a tracking system. Mashups enable users to create huge bodies of knowledge from different sources, while Del.icio.us provides reference records and organises selected links into specific categories. Other tools such as blogs are used to show the results of personal learning and to express learners' views, challenges and reflections on a research topic. Flicker allows users to share photos and to tag relevant materials. RSS provides the community with any changes to a topic and updates websites with visitor data (Gunawardena et al., 2009).

The first phase of the learning process is the context, manipulated to create an environment that gathers all knowledge and experience. The second phase is discourse, which includes analysing and shaping context meaning. In phase three, the action phase, the learning goal is identified and shared with others. The fourth phase is reflection, which encompasses the personal experiences, interactions and group interactions that characterise the learning process. After the reflection phase comes the reorganisation phase, where members process and adjust to a new learning goal within the social networking environment. The previous phases work together in order to create socially mediated metacognition that reflects the group development process (Gunawardena et al., 2009). The idea behind building social communities of practice is to get people involved with each other, but this community could be exclusive to people of a specific society. Also, people may find it difficult to engage using so many different social networking tools, all of which were built for social purposes rather than for e-learning.

2.8 Summary

This chapter introduces competence, which is composed of an ILO. Competence consists of a capability verb, subject matter and other components. Subject matter falls into four different categories: fact, concept; principle; and procedure. Each has a different diagrammatic approach. Integrating a capability verb with the related subject matter results in competences. An assessment involves a number of competences. Through generating these competences, students will establish what is required by the task that they have been set. The structure of the subject matter that is linked to the related capability will be presented ontologically. Students need to work collaboratively on the task, so they also need a further kind of competence. These new competences are termed ‘collaborative working competences’ and allow students to form and manage their groups. Collaborative working competences will also be presented ontologically.

The literature uses the terms ‘knowledge management’, ‘social media’ and ‘e-learning’ in creating unstructured materials, and ‘self-regulated learning’ or ‘increasing the engagement between students and teachers’ for collaborative working. However, this research aims to develop an application that supports both KM and e-learning using a particular social media tool, Facebook Groups, a feature of the familiar and popular tool of social media. Facebook can support the principles of KM and e-learning through the developed application, which will use both ontologies to generate competences for students. In addition, students can add new resources through Facebook Groups and link them ontologically to task competences. It will be easy to retrieve any resources relating to a specific competence.

The application supports students in terms of forming groups, through linking the information from their profiles to the ontology of collaborative working competences.

Chapter 3: Conjecture and Research Questions

The literature was reviewed in Chapter 2. This chapter presents the research problems identified in the literature in the context of a scenario. In addition, it introduces the conjecture of this research and presents related research questions.

3.1 A Scenario

The following scenario is presented to show current problems affecting students attempting to learn collaboratively, using Facebook Group as a tool of social media to complete their assignments:

> Edrees is a university lecturer and is the module leader for databases. Edrees has set up a Facebook group to include all students undertaking the module to help them learn collaboratively on given assignments he has set through this medium. Edrees has posted the assignments to all members of the group: ‘Dear students, please could you collaboratively answer the posted assignments regarding database normalisation and group work.’ Edrees has asked all students undertaking the module to form their own groups. Each should consist of 3–5 students.
>
> Robin is a student on the database module and sees the assignment set by Edrees in the Facebook group as a general post. Robin is looking to form a group of students with various competences to help to complete the assignment. In order to complete this task, Robin has to complete following activities:
>
> a) Knowing all task competences.
> b) Knowing what is required for working collaboratively
> c) Knowing the various competences or skills of all students
> d) Making connections between task competences, collaborative working and potential group members.

There are four problems identified in this scenario that need to be addressed to help students work collaboratively using Facebook Groups. The following section summarises these research problems and their relevance to KM, social media and e-learning. In addition, the following section introduces the conjecture of this thesis, followed by related research questions. The term ‘conjecture’ describes as ‘the way in which knowledge progresses, and especially our scientific knowledge, is by unjustified (and unjustifiable) anticipations, by guesses, by tentative solutions to our problems, by *conjectures’* (Popper, 2014).

3.2 Conjecture

The aim of this research is to investigate the possibility of enhancing e-learning by integrating KM and social media. One of e-learning's contributions lies in achieving competences, so this is from the e-learning side, while making an ontological structure of various competences that results in achieving the competences is a contribution by KM. Enhancing and encouraging collaboration on a specific learning task is again from social media. The learning task involves a number of competences. Traditionally, if students have an assignment that requires collaborative working, they gather into friendship groups and invite each other to join, checking if they indeed need to do so just for one assignment. These groups rely on no specific requirements to achieve smooth collaboration. It is difficult to determine the quality of working together in order to establish how collaboration relates to the assignment output, yet we believe that it is possible to overcome the challenges to achieve better collaborative learning and teaching. Social media allows and encourages collaboration, hence an environment that uses social media could be more effective if it uses explicit statements about collaboration. Students can get to know each other's skills and gather together to complete the given task in a more effective group.

Unfortunately, there are no commonly used tools of social media that allow people to form groups and share resources for a specific task in a systematic and structured way. However, this can be achieved by providing an application that allows students to understand what is required for collaborative working, known as competences in collaborative working. What is required for the learning task is known as task competences. After being provided with a suitable system, students need to be shown the skills relevant to both competences in order to form effective groups. This could support better collaborative learning using social media when additional components for collaboration are introduced to learning and teaching situation. We thus state the conjecture:

> *If competences, including collaborative working, are ontologically structured through a social media application, then the students would achieve better learning results.*

This conjecture is an unproven claim, because nowadays there is no common application of supporting collaborative learning using any well-known tools of social media. The term social media is a general one, so this study focuses on Facebook Group in particular as a popular tool of social media as discussed in section 2.3.4, where the term 'application' means developing a social application using Facebook Group to enhance student learning. In addition, there is no representation of learning task competences with collaborative learning competences that enables students to form and manage their groups based on provided competences and available students' skills. This representation would result in supporting collaborative learning in terms of sharing resources or conducting group discussions through the proposed social application.

The term 'ontologically structured' in this sense means forming navigable, clickable, and consistence competences of learning task and collaborative working with available student skills in order to form an effective group. On the other hand, the conjecture states that better learning is a result, meaning that students have the ability to form more appropriate groups. These groups have a set of skills that match the assignment results. In addition, better learning results mean students can achieve higher marks for assignments. Moreover, better learning results mean that students may more effectively demonstrate achieving collaborative competences. The following section starts with the formulation of the research questions.

3.3 Research Questions

The above conjecture leads to the following research questions:

1. Do ontologically structured competences enable students to achieve better learning results using the social media SMC application collaboratively?

    - Is there a relationship between the levels of Bloom's taxonomy and students' learning results?

The main research question aims to build knowledge bases (ontologies) consisting of a range of competences. This enables students to access, navigate and read the content, then contribute to adding/viewing/deleting shared resources. These ontologies deliver via a developed social application by using Facebook Groups as a tool of social media.

The set assignment's questions correspond to specific levels of Bloom's taxonomy, so the sub research question investigates the possibility of a developed social application to support higher levels of Bloom's taxonomy.

2. Do ontologically structured competences of subject matter through the SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing competences?

This research question aims to investigate the way that a task's competence ontology is designed and developed in order to generate clear and effective content for students. In addition, it investigates the effectiveness of the designed subject matter categories and links them to the desired competence.

3. Do ontologically structured competences of collaborative working through the SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing competences of group working?

This research question aims to investigate the way in which the collaborative working ontology is designed and developed in order to generate clear and effective content for students. In addition, this research question investigates the effectiveness of designed roles to each collaborative working competence.

4. Does the SMC application support better collaborative working for groups of students using social media?
    - Is there a relationship between communication, information sharing, and conversation and social skills when groups work collaboratively?

The main research question aims to investigate students' ability to form effective groups, based on the provided competences, and to contribute in terms of sharing resources and conducting group discussions to accomplish the task. In other words, it deals with building the application as a way of using social media to integrate the group so that students work better collaboratively, with a structure of provided competences that involves a considerable amount of work to set up.

The sub research question aims to measure the connection between a numbers of aspects of collaborative working for students' performance. In order to further the study, the proposed system is able to support students to enhance their collaborative learning performance. It aims to investigate the improvement in collaborative learning results when the application is used.

5. Does the SMC application facilitate group formation using social media?
    - Does groups of students' prior knowledge influence learning results?
    - Does retrieved related social information meet with the satisfaction of groups of students?

The main research question aims to exploit certain functionalities of the particular social media tool to show their relevance to the collaboration process and technical task, such as information from user profiles in connection with the appropriate task.

The sub research question (a) aims to judge whether the developed application and its content help students to obtain higher results to a greater extent than other factors.

The sub research question (b) aims to investigate students' reaction towards generating social information that is made available to all students in order to form effective groups.

6. Do instructors think that using ontologically structured competences leads to better teaching?

Having explored the learning side by students, this research question aims to investigate the teaching side by taking into account instructors' opinions of ontologically structured competences for improved teaching performance.

7. Do instructors think that Facebook Groups enhances the students' teaching and learning environment?

This research question aims to investigate the enhancement of the teaching and learning environment by introducing Facebook Groups, taking into account instructors' opinions on using this for module activities.

The experiment design in the methodology chapter, Chapter 6, will explore in more details these research questions. The next chapter presents the design of Social Media Competence Application followed by implementation and evaluation methodology.

Chapter 4: Analysis and Design of Social Media Competence Application

The previous chapter illustrated the student problem by way of a scenario, and showed how an application derived from a social media tool, together with ontological content, can help to accomplish assignments that use group work. This chapter discusses the analysis and design of the developed Social Media Competence application (SMC). It provides the information necessary to complete a specific task successfully, to enhance collaborative working, and to form and manage effective group work. It is based on provided ontological competences and generated student skills or social information.

The chapter begins with a system analysis. In this section, a use case diagram is provided. The following section illustrates the structure of competences for a particular knowledge domain, including the collaborative working competences. The ontological structure of competences is an essential component within the social application. This chapter describes how retrieving social information about students could help to form effective groups through comparing the generated skills with the provided competences. The SMC application activity diagram and user interfaces are designed in this chapter.

4.1 System Analysis

This section establishes the requirement for SMC application. The proposed use case describes how both the teacher and the students interact with the application. Figures 4-1 and 4-2 show the use case diagram of the SMC application for a teacher and for the students as actors, respectively.

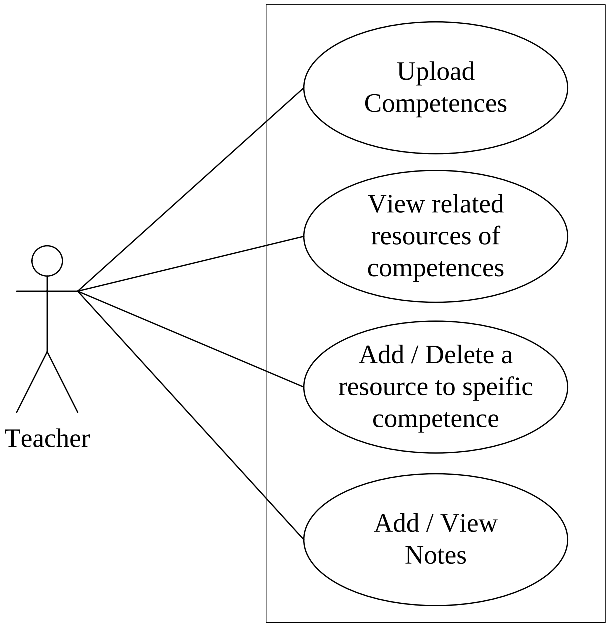


Figure 4-1: Social Media Competence application use case diagram (teacher side)

Figure 4-1 illustrates the use case diagram for a teacher. This research is neither concerned with nor studies teachers' reactions to dealing with the developed social media application in terms of uploading competence into ontology, adding resources and making notes about members through the application. The teacher's job is regarded here just as uploading the competences of a specific task into an ontology file directly, in order to make it visible to students. There are no special interfaces for adding competences, and the teacher interacts with the SMC application just as students do. The students will recognise added resources or notes when they see the name of their teacher.

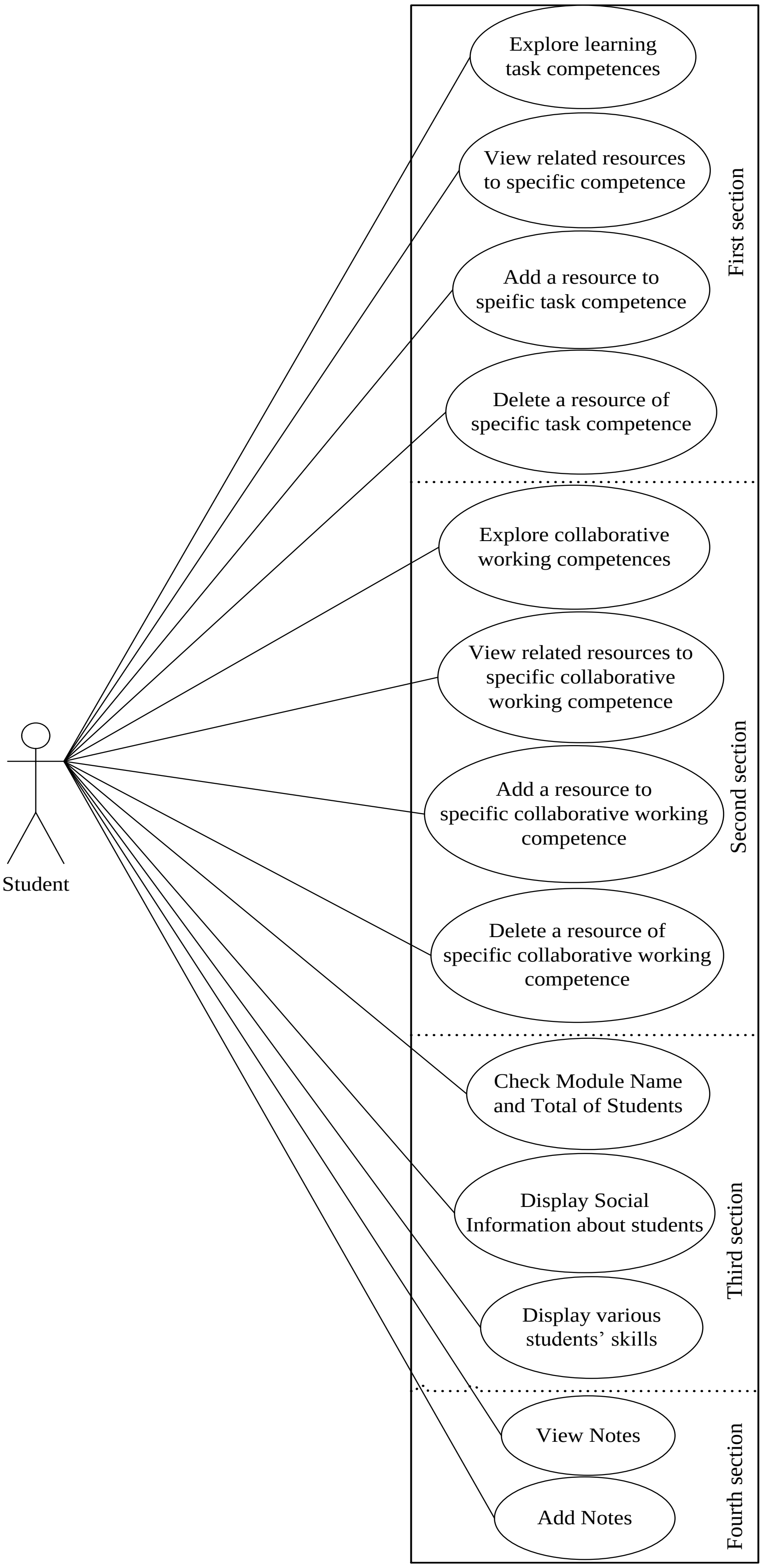


Figure 4-2: Social Media Competence application use case diagram (student side)

Figure 4-2 illustrates the use case diagram for students. There are four main sections of the SMC application. The first is related to a specific assignment. A student can explore what is required to answer this assignment. In addition, the student can find any supported resources for a specific competence that have been ontologically tagged. Moreover, the student can add resources to a specific competence of the ontology, and has the option to delete any of their own added resources.

The second section of the use case diagram in Figure 4-2 relates to collaborative working competences. A student can explore what is required to work collaboratively in effective group work. Beside studying and knowing the requirements for group working, students have to answer an assignment on collaborative working. They can find additional resources for specific competences that have been ontologically tagged and can add resources to specific collaborative working competence in the ontology, with the option of deleting their own. As there are ontological competences for the technical task that is set, so there are ontological competences for the group working task, with the same features of viewing, adding and deleting resources.

Having explored competences and established the requirements for answering both assignments, students need to form groups with a variety of competences, if possible. The third section of the use case diagram of Figure 4-2 relates to social information and skills of potential group members. A student can check the number of students who are registered for a particular module, their gender and available social information about their professional skills. This can be generated automatically from the Facebook profiles of the members who joined a Facebook group for the module, as illustrated in the scenario. Students can exchange messages using the Facebook messages service to invite each other to work together as a group.

The SMC application is considered to be a social application, so members may need to make notes about each other to divide up the tasks, defining group membership and other interactions. Therefore, the fourth section in the use case diagram in Figure 4-2 relates to a notes section on group members. Students are free to note their interactions in a systematic way and it is easy to come back to the notes later to see what is happening. Students will use this section to monitor progress, to check the assigned tasks and to define the groups, making any comments about group members that are worth bringing up. This section can enhance group formation by finding out additional information about potential group members.

4.2 Design of Process within the SMC application

The overview of the process within the application design, illustrated in Figure 4-3, shows how students interact with the application. The idea behind the application is improving students' results by providing them with the following. They need the requirements to answer a given assignment through a number of ontologically structured competences, the requirements to work collaboratively in effective way through a number of ontologically structured competences, to form groups in more systematic and effective way by matching students skills with available competences, if possible, and to allow students to contribute to the ontologies' knowledge base by adding additional resources to specific competences when working as groups to answer given assignments. In addition, the application allows students to make notes about group members' progress.

There are five main processes in the SMC application, as illustrated in Figure 4-3. Each has its own special role, such as constructing the ontology database or using Facebook API to retrieve data. The ontology databases need to be populated with the necessary information, and special user interfaces need to be developed for students to contribute to these knowledge bases by adding resources. In addition, other user interfaces are needed to allow students to delete their own added resources from the original ontology database, as well as viewing the content of ontology databases such as competences and added resources. There are at least three main independent ontologies that will be used in the SMC application.

Facebook API will be used in order to retrieve the data of users who have already joined a Facebook group. Some information from the original user profiles, such as name, gender, professional skills and biography, will be retrieved via the application. The group's name and total number of members, with names, will be retrieved from the Facebook group. This information will help group formation and note taking. The following sections will discuss the processes of the SMC application in detail.

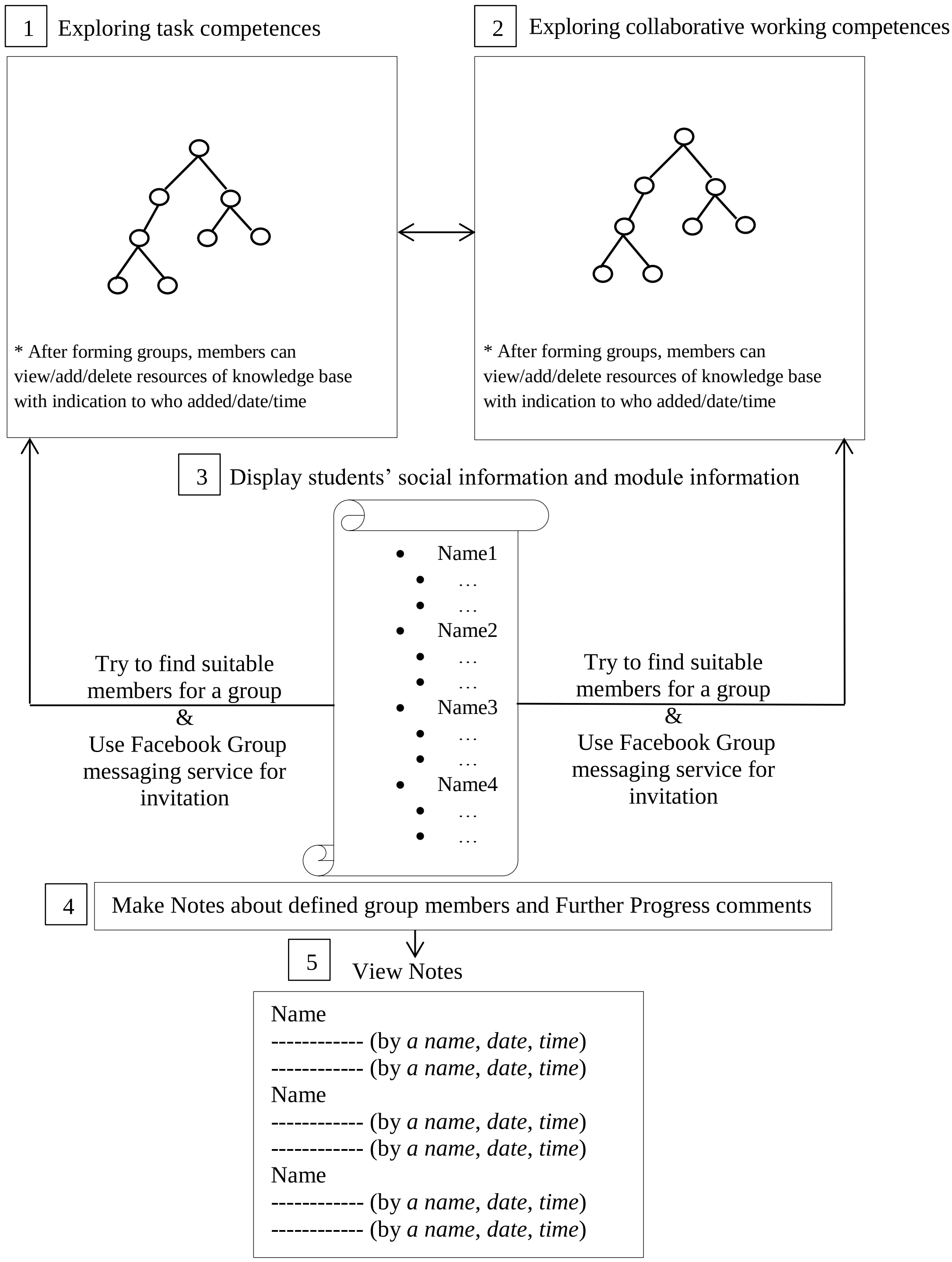


Figure 4-3: Working Process within SMC application

4.3 A Competence Structure Design for Learning Task

In order to explore a number of task competences for a given assignment, a competence structure needs to be constructed. Consideration of the competence structure of the specific learning task is essential, because it will be implemented within the application through an ontology to show the range of competences for a particular knowledge domain. The following sub-section presents the method of constructing competences in general, then applies the method to a particular knowledge domain.

4.3.1 Overview of constructing competence in general

In order to design a large and complex structure of competence ontologically, information on ILOs on specific knowledge domains is required. As discussed in section 2.1.5, an ILO statement consists of the following six components: objective; performance; ability; learned capability verb; learned capability object; and assessable behaviour. Combining these components helps to write the ILO statement. There are two essential components to be included in each ILO statement, namely capability verb and subject matter, as seen in Figure 2-3 (Sitthisak, Gilbert, & Davis, 2008). The competence consists of the same components of ILO, in addition to the context, as seen in Figure 2-15. The terms 'ILO' and 'competence' have the same components, but competence comprises more elements, where this research would use word 'competence'. It is a mandatory part of an ILO, and this study assumes that every competence has a capability verb and subject matter. In order to construct specific competences, teachers or instructors should consider the specific knowledge domain so as to determine specific competences leading to specific learning content. The following sub-sections illustrate the process of constructing the competence structure for a specific knowledge domain.

4.3.2 Step1: Choosing the knowledge domain

To construct competences, we must examine the ILOs of a particular domain. This research considered the available published ILOs in the Curriculum Guidelines for Undergraduate Degree Programs in Information Technology (Association for Computing Machinery, IEEE Computer Society). The course chosen was Information Management (IM3), Data Organisation Architecture (Curricula, 2001). This course features a topic known as Normal Forms and includes subtopics such as Functional Dependency, 1NF, 2NF and 3NF. The core learning outcomes for the topic are 'Explain the relationship between functional dependencies and keys and give examples', and 'Explain how having normal form relations reduces or eliminates attribute redundancy and update/delete anomalies'. These indicate that instructors should teach students database keys, such as the primary and foreign keys. In addition, it is important that they teach them the meaning of functional dependency and how to remove it from a database table belonging to the Third Normal Form. Moreover, Third Normal Form requires the database table to be in Second Normal Form, and Second Normal Form requires the database table to be in First Normal Form, to undergo the normalisation process. Each topic has its own requirements, linked together to achieve the Third Normal Form requirements. Therefore, this research combines these two core learning outcomes into a single ILO or competence, as follows: 'The student will be able to normalise an unnormalised database table to Third Normal Form'. This learning outcome or competence involves most aspects of normalisation with the associated requirements that learners process in order to achieve normalised Third Normal Form. This thesis chooses normalisation as the knowledge domain and, in particular, normalising an unnormalised database table to Third Normal Form. The entire set of competences relating to the chosen knowledge domain is as follows:

- Normalise an unnormalised database table to Third Normal Form
- Normalise to First Normal Form
- Normalise to Second Normal Form
- Remove functional dependency
- Remove repeating groups of data
- Remove partial dependency
- Identify the primary key
- Define primary key
- List primary key characteristics
- List un-normalised form of database table characteristics
- List repeating group of data characteristics
- List partial dependency characteristics
- List functional dependency characteristics
- Define normalisation
- Define un-normalised form
- State the procedure of normalisation.

After considering the information needed for competences of a specific knowledge domain, they must be put into different categories of subject matter and tagged with relevant capabilities in order to secure a structure of competences. The following section illustrates the procedure of analysis.

4.3.3 Step 2: Task analysis of subject matter

After defining the competences of a particular domain, it is important to analyse the subject matter relating to each competence. To do so, Merrill (1994) categorised the content into four different categories (fact, concept, procedure and principle), as discussed in section 2.1.5.1. Considering the structure of the subject matter helps learners to understand the knowledge and the cognitive skills of a particular domain, so the highlighted competences may fit various categories of subject matter based on task analysis. In addition, task analysis provides the relationships and structure of subject matter. Gilbert and Gale (2007) provide a diagrammatic approach to each category of subject matter that can help to analyse the content, as discussed in section 2.1.5.1. This research will analyse the content of subject matter based on task analysis by Gilbert and Gale (2007), and Sitthisak and Gilbert (2014), then apply categories of subject matter to an ontological design with content.

The defined competences of the normalisation domain could be matched to most categories of subject matter. The ‘fact’ category consists of definitions, which have two components. The ‘concept’ category consists of any characteristics that can be analysed in a systematic way to identify the concept, such as how a primary key has a number of characteristics that make it different from a foreign key. The ‘procedure’ category consists of sequence steps, such as that processing an unnormalised database table to Third Normal Form requires the table to be processed to First and Second Normal Forms. The list of subject matter and its categorisation is provided in Table 4-1.

Table 4-1: Subject matter content of Third Normal Form (normalisation topic) and their categories

Subject matter type	Subject matter
Fact	Normalisation definition, primary key definition, un-normalised form definition
Concept	Functional dependency, partial dependency, repeating groups, primary key, un-normalised form characteristics
Procedure	Normalisation procedure
Principle	(Normalisation does not have any principle)

As discussed in section 2.1.5.1, fact elements may be represented by two circles, making a ‘fact pair’. Each circle has specific element of fact; for example, one is that the definition of normalisation is a process that puts data into tabular form by removing duplicate data from relation tables. ‘The Normalisation’ is the first element, and ‘Process that puts data into tabular form by removing duplicate data from relation tables’ is the second (Figure 4-4).

Learners may be told or presented with both elements, such as, ‘The definition of normalisation is a process that puts data into tabular form by removing duplicate data from relation tables’, or be asked to recall those specific elements, such as ‘What is the definition of normalisation?’ or ‘What is this a definition of: “A process that puts data into tabular form by removing duplicate data from relation tables”?’ The same process design and analysis will be applied to the definition of both the primary key and the un-normalised form of database table.

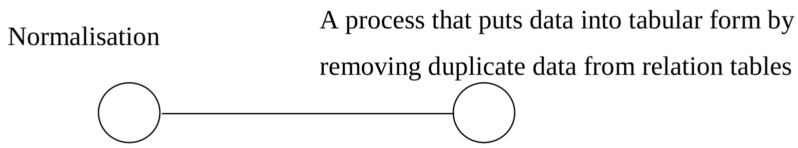


Figure 4-4: Task analysis of definition of Normalisation as an example of a fact in the chosen knowledge domain

This example presents the first specific element – ‘Normalisation’ – and second specific element – ‘process that puts data into tabular form by removing duplicate data from relation tables’ –, which make a fact pair. The expression ‘normalisation’ is the whole definition that belongs to ‘normalisation definition’.

A concept may be shown as a triangle bearing its name and superordinate class, and is considered a fact. The relation between class and superordinate class is termed ‘is a kind of’. Concept has associated attribute–value pairs linked by a concept. Figure 4-5 shows the primary key characteristics concept. The other concepts that are specified in Table 4-1 will use the same process design and analysis of content.

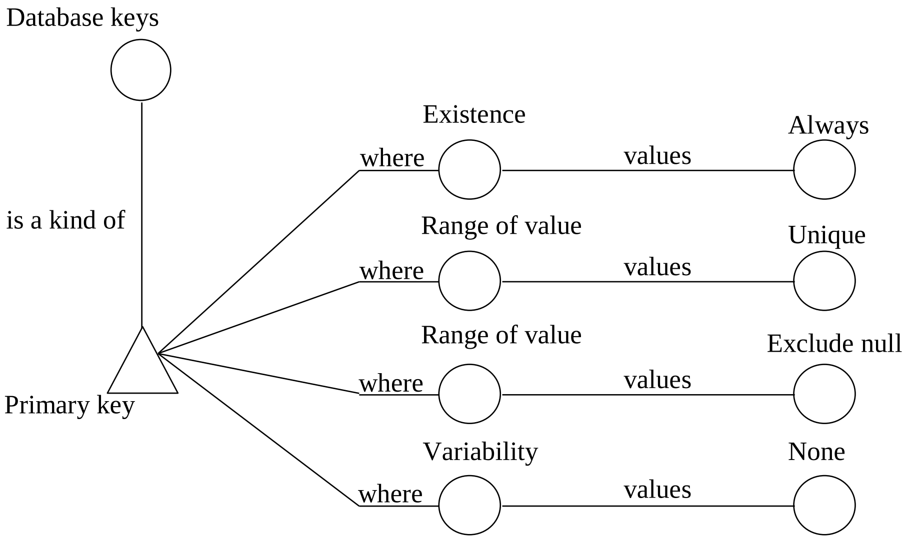


Figure 4-5: Task analysis of Primary Key as an example of a concept in the chosen knowledge domain

A primary key is a kind of database key with several characteristics. These are analysed into lists of attributes value pairs. One characteristic is that value always exists. The attribute of this characteristic is ‘existence’ and its value is ‘always’. The same goes for the primary key, which must contain a unique value and not contain null. The attribute is a range of values, and the values are unique and exclude null. Also, the primary key does not change over time. The attribute is variability, and the value is none.

A procedure consists of a number of steps, represented as rectangles. Figure 4-6 shows the normalisation procedure.

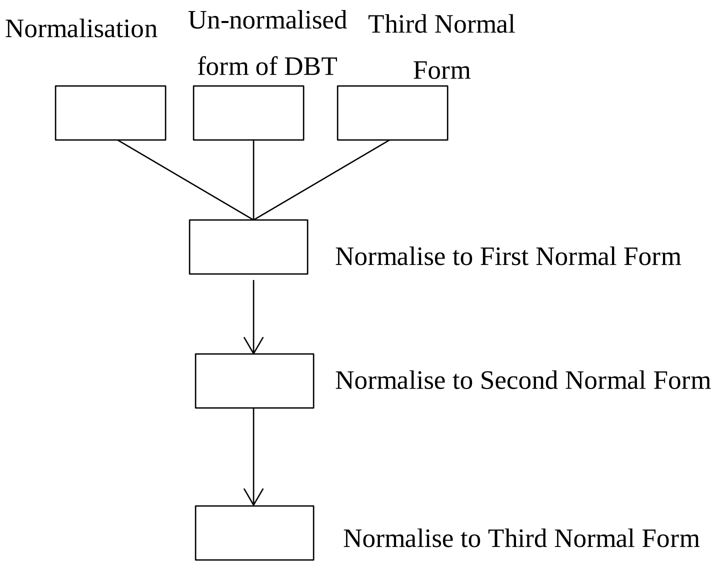


Figure 4-6: Task analysis of normalisation steps as an example of procedure in the chosen knowledge domain

Normalisation applies to un-normalised form of database table to Third Normal Form. The Third Normal Form requires database table to be in Second Normal Form. The Second Normal Form requires database table to be in First Normal Form. So, to state the normalisation procedure: 1NF, 2NF, 3NF.

The above diagrammatic approaches are a sample of each category of subject matter. The whole structure of subject matter categories of Third Normal Form as a topic of normalisation will be presented in the following section. The ontology design will be based on a structure of competence with a subject matter category design. The competences will be linked together in order to show main, sub, or sub-sub competences that lead to answering a given assignment successfully with related subject matter content for a specific competence.

4.3.4 Step 3: Structuring subject matter

This section presents the subject matter structure of the Third Normal Form as a topic of normalisation. It can be seen from Figure 4-7 that students can access any level of subject matter structure and read about it, but there is no guidance or structure that tells students what to do.

4.3.5 Step 4: Finalised competence structure

Once capability verbs are tagged with related subject matter, the competence structure of the Third Normal Form may be constructed, as seen in Figure 4-8. The verb gives students guidelines on what must be performed to complete the task. The verb will add value to KM because, once students have the knowledge structure, they possess the power to learn. However, the purpose of this research is making the competence ontologically structured. The competence structure of the learning task will be ontologically engineered. The following sections discuss the method of building ontology for learning task.

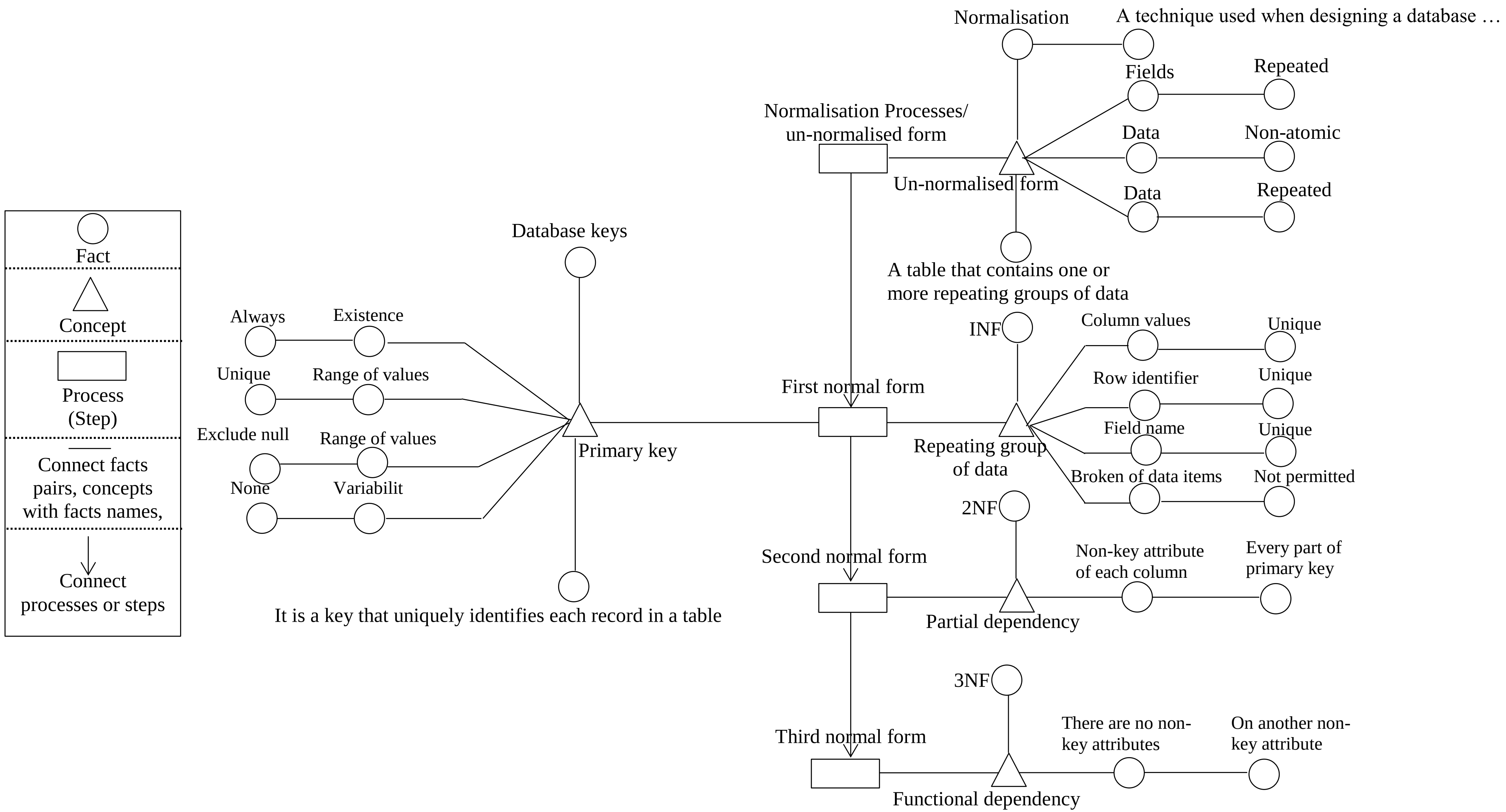


Figure 4-7: Subject matter structure of Third Normal form

The structure takes the task analysis approach, whereby each category of subject matter has a different representation. The knowledge domain has been analysed to show the different categories. Facts are represented by circles, concepts by triangles and procedures by rectangles.

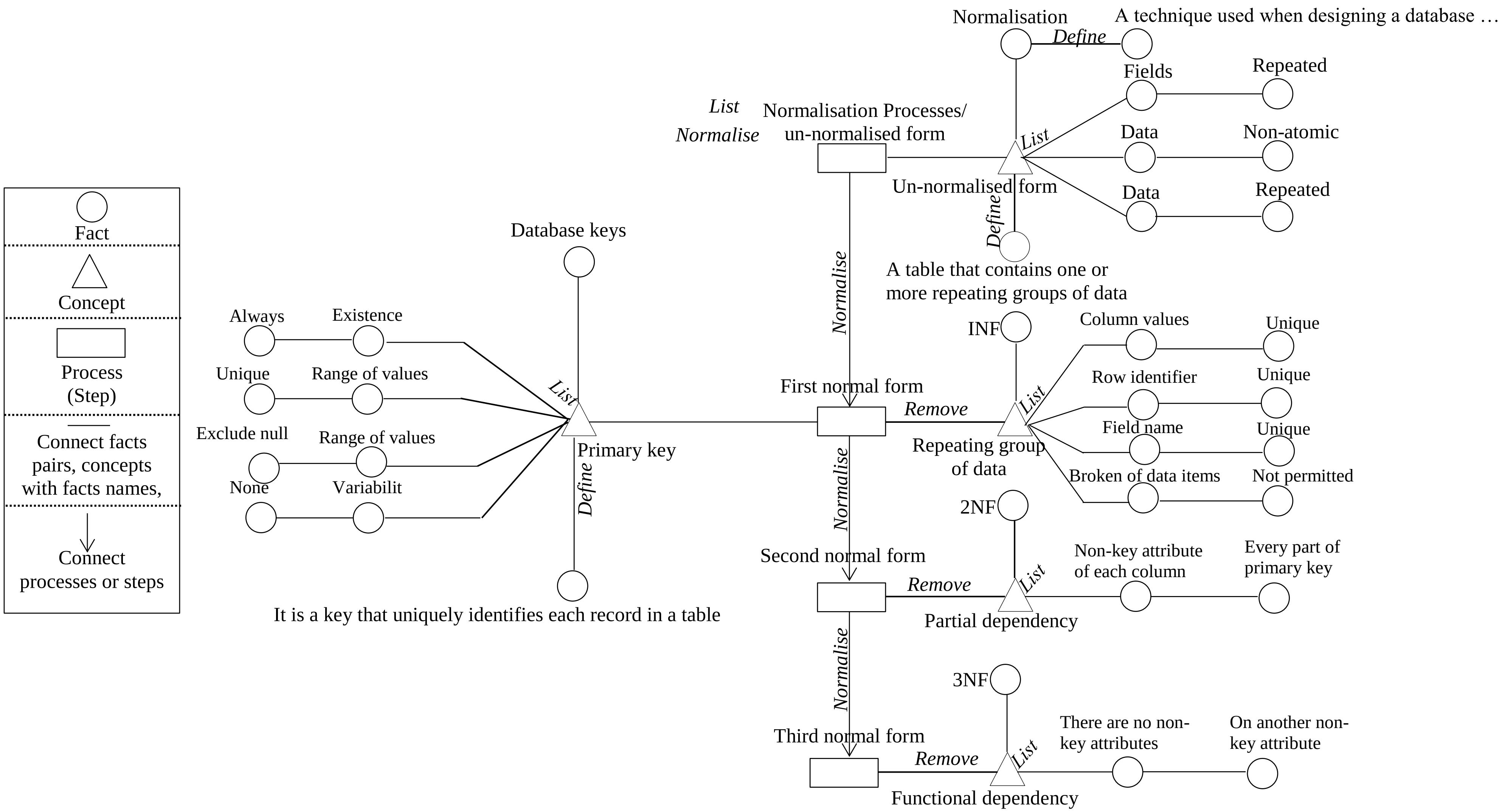


Figure 4-8: Competence structure of Third Normal Form

Each category of subject matter is associated with a capability verb. The verb tells learners what to do when accessing any item of subject matter, rather than reading the content without any guidance or structure.

4.4 Ontology Design

Knowledge Management is an important success factor for institutions or organisations, and is considered a major issue in human resource management. Information technology plays an important role in enabling the aspects of KM (Sure, Staab, & Studer, 2002). KM involves a number of processes to manage human knowledge, including knowledge gathering, knowledge structuring, knowledge refinement (correcting, updating, adding and deleting knowledge) and knowledge distribution; that is, bringing knowledge to people who need it (Benjamins & Fensel, 1998). In building effective KM systems, ontologies have the ability to structure the knowledge domain by modelling a concept of a particular domain and then sharing it with other people in institutions or organisations. In addition, ontology considers the most recent KM techniques, coming after XML and RDF.

There are five reasons for developing an ontology. One is sharing a common understanding of structured information among people in organisations or institutions, while the second is to re-use the knowledge domain. This enables others to re-use the developed ontology in their particular domain without spending time developing a new ontology. The third reason is making the domain assumptions explicit. This helps to modify the ontology easily when there are changes in the knowledge domain. The fourth reason is separating the domain knowledge from operational knowledge. The ontology may be used to configure others' domains of knowledge. The final reason is analysing the domain of knowledge to help to re-use existing ontologies or even to extend them, because ontologies are created to define sets of data and to use their structure in other programmes such as problem-solving methods, domain-independent applications and software agents (Noy & McGuinness, 1993).

There is no correct way of developing ontologies (modelling domains), and the best solution depends on the desired application and the anticipated extension. In order to construct ontology, there are six common steps. The first is determining the domain and scoping the ontology. This may be achieved by asking questions regarding the domain that the ontology will cover, the people who will use the ontology, the kind of information to which ontology should provide an answer and the purpose of developing the ontology. Answering these questions helps to model the knowledge domain. The second step is enumerating the terms in the ontology. This helps to structure the ontology content and generate properties for all terms. The third step is defining the classes and the class hierarchy. Defined terms help to structure the class hierarchy in developing ontologies. There are three possible approaches to developing the class hierarchy: top-down; bottom-up; and combinations of the two. The fourth step is defining properties of classes in order to answer the competency questions. Leaving classes without an internal structure of concept will not provide sufficient information to answer questions. The fifth step is defining the types of information of each class, such as string, number, Boolean and so on, while the final step is populating the classes with individual instances (Noy & McGuinness, 1993; Brewster et al., 2002).

The latest developed ontology language is OWL, developed by the World Wide Web Consortium (W3C). An editor and modelling domain only, Protégé is used to describe concepts and to build ontology. It is necessary to determine the objects (individuals) to be used in the chosen domain. In addition, it is necessary to define the relations (properties) that link the individuals. Those individuals or objects need to be: categories; in a set of classes; and in a hierarchical order (Horridge et al., 2009). The hierarchy of the classes is known as its taxonomy.

4.4.1 Design ontology for task competences

After discussing the methodology of building ontology in general, it is important to construct learning task competences based on that methodology. The domain that needs to be modelled is task competences. This domain will be used by students to generate various competences of a specific task in order to answer the given assignment successfully. In our case, the knowledge domain is normalisation, in particular the Third Normal Form. This topic has a number of competences that must be addressed by students. The ontology is considered as a database to be populated with information by teachers. The method of constructing the ontology is based on different categories of subject matter, as discussed in section 4.3.3. These categories are linked to a related competence that consists of capability verb and subject matter key terms, so students can choose a specific competence to generate relevant competences with related subject matter content on a specific assignment. The taxonomy ILO, which includes subject matter and capability, is used to build a learning task competences ontology.

The ontology consists of a top class called ‘task’. This has a sub-class, ‘competence’, which contains individual or objects about a capability verb and the subject matter key terms. The competence also has sub- and sub-sub-competences, in logical order. Competence class will be linked to other sub-classes, which are ‘capability’ and ‘subject matter’. The subject matter class of competence class has individual subject matter key terms that relate to a specific capability verb. Four sub-sub-classes of subject matter will be created, because different subject matter key terms will be fitted in different categories. Those sub-sub-classes are: fact; concept; procedure; and principle. Each class of these categories will contain additional sub-classes based on relationships of task analysis, as shown in Figure 4-9. The chosen topic has no principle, so the class has not been engineered in order to be populated with information.

When populating a competence with related information that fits the specific subject matter category, there may be a need to give students some extra content, such as an example. So, adding an example has been integrated into each class in the ontological design. One of the ontology features is making content explicit and understandable to users, so an adding connection has been fitted in order to link a fact name with a fact pair in a simple sentence. Making a connection between a concept name and its domain, attributes and their values is essential for a concept. In terms of procedure, there is a connection between a procedure name and its situation, the procedure situation and goal. The procedure steps must be logically ordered. In ontology design, these connections are called properties.

Furthermore, having additional resources or materials for specific competences in the ontology could enhance students' learning results, as stated in Figure 4-3 in the first step. There will be the opportunity for students to populate the ontology with extra resources when working together to lead to a better understanding of competence. Also, teachers can add resources if they see that students are experiencing difficulties with an assignment. The idea is to select a specific competence and add a URL to it. The URL will be ontologically tagged with that competence. Later, students can view the tagged resources that are available for a particular competence.

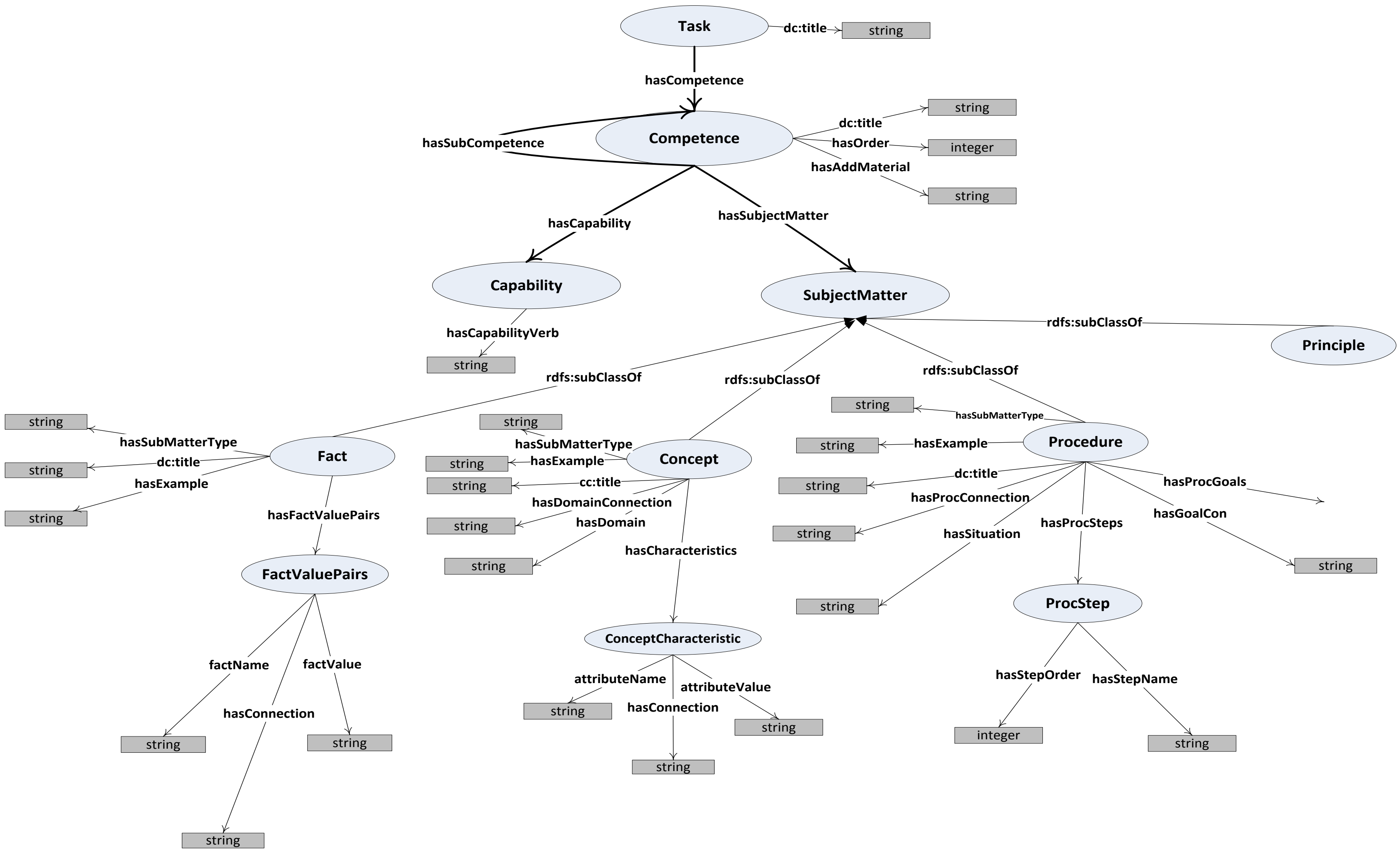


Figure 4-9: Ontological structure of learning task based on competence taxonomy and subject matter categories structure

4.5 Design of collaborative Working Competences

As students are to work collaboratively on the assignment on normalisation, they need to learn about group working in a systematic way. One of this study's purposes is to introduce additional components of the learning and teaching situation. These components are collaborative learning competences for group work. Students can study the task that is set for them and learn how to collaborate with each other. This study seeks to find lists of collaborative skills in classrooms and any collaborative social skills and then apply them for this research purpose. The aim is to gather a number of skills from various resources to achieve the proposed scenario and to enable students to undertake the work.

The University of Vermont introduced a list of the skills for collaboration in classrooms (Vermont-University, 2014) as part of a curriculum for creating a safe and supportive class environment. The following list in Table 4-2 is not exhaustive; there is scope to add more skills to meet specific needs.

Table 4-2: Range of collaborative working skills (Vermont University, 2014)

Collaborative Competences			
Begin a conversation	Ask questions	Know feelings	Take responsibility
End a conversation	Say thank you	Understand others' feelings	Complete task
Ask for help	Say no	Negotiate	Remind others to use collaborative skills
Ask a favour	Accept no	Express concern for another	Apologise
Give a compliment	Encourage others	Take ownership for own feelings	Convince others
Accept a compliment	Criticise ideas not people	Listen	Deal with another's anger
Join in	Summarise	Cool off	Deal with fear
Accept criticism	State feeling	Ignore distractions	Stand up for your rights
Follow directions	Express empathy	Take turns	Respond to teasing
Avoid trouble with others	Deal with embarrassment	Deal with persuasion	Respond to failure

Moreover, the literature indicates various important aspects of collaborative learning. One of these is group planning (Johnson & Johnson, 1990). Students' ability to plan may be seen in terms of setting objectives, agreeing on reaching decisions and considering the availability and interests of group members. In addition, leadership is essential to control and manage group work (Healey, 1992). This research will exploit the provided collaborative skills and other aspects of collaboration to form specific competences to be available in each group. The scenario restricts groups to between three and five members. Potential group members should together supply most of these provided competences, but this study will encourage students to assign three important roles in each group: planning; negotiating; and leading. These roles are linked to some of other competences in Table 4-2 to present them ontologically, as shown in Figure 4-10. As the task competences will be ontologically engineered, the collaborative working will be ontologically structured and presented ontologically, so that students can study what is required by a given task and group work. This may lead to better formation of groups.

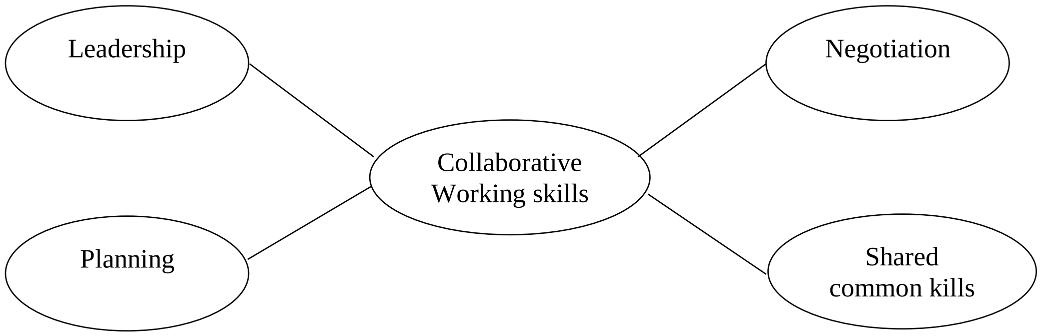


Figure 4-10: Main collaborative working competences

The following is a list of collaborative working competences with related roles which will be populated in ontology:

- A student will be able to lead and manage the group

- Draw directions to accomplish task successfully
- Listen to members and rise discussions
- Deal with persuasion
- Remind others to use collaborative skills
- Respond to failure
- Build and maintain trust with members
- Resolve conflicts
- Ask for feedback from members and share it in order to perform the task

- A student will be able to plan

- Assign tasks between members including (leader, planner and negotiator)
- Accurately estimate time and effort required to complete a task
- Track the progress of the group
- Maintain adequate preparation time for scheduled meetings/deadlines
- Ensure completing given task
- Summarise and report on progress
- Notify others about changes or any problems in a timely manner

- A student will be able to negotiate

- Deal with non-contributing members
- Encourage members

- Deal with embarrassment
- Smile
- Use eye contact
- Use reassuring nods and gestures
- Let them know that you found what they said was interesting
- Say something positive about their contribution
- Keep each other informed about developments

- All students will be able to share common skills

- Ask for help
- Give/accept a compliment
- Accept criticism
- Avoid trouble with others
- Say/accept NO
- Criticise ideas not people
- Take turn
- Take responsibility
- Ignore distractions
- Apologise
- Explain to others your achievement
- Share resources / knowledge of subject area with members
- Check your understanding of given task with others
- Explain your contribution to others
- Summarise the achievement
- Support group decisions, even if not in total agreement
- Listen to each other
- Have fun

4.5.1 Design ontology for collaborative working competences

Section 4.5 introduced a number of collaborative working skills. These skills or competences need to be gathered and implemented in an ontological structure. By having an ontological structure of collaborative working competences, students will be able to work collaboratively and form their own groups, based on provided competences, in more systematic way. In an ontological structure of collaborative working competences, a class called collaborative working competence will be implemented. This contains all relevant competences for group working with related roles. There are three important competences that should be available in each group. Also, there are competences that are shared among all members, namely leadership, planning and negotiation. Each has special roles, based on the available skills in Table 4-2, in order to form an effective group. Figure 4-11 shows a sample ontological structure of collaborative working competences.

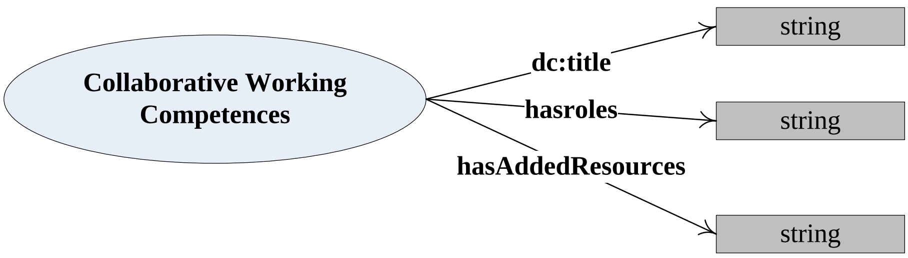


Figure 4-11: Ontological structure for collaborative working competences

Moreover, students can contribute to the knowledge base of collaborative working competences by adding resources to explain further the group work competences, such as YouTube videos as URLs. The idea is select specific collaborative working competence and adds a URL to it. The URL will be ontologically tagged with that collaborative working competence. Future students can view these tagged resources for the particular collaborative working competence.

4.6 Design Social Media Content

In general, social media are widely used to facilitate message exchange, provide personal profile information and share resources such as links, documents, calendars and photos, as discussed in section 2.3. KM can be seen in terms of providing personal profile information to help students to make their own groups and to share resources for a specific competence. Likewise, e-learning may be seen in terms of exchanging messages to provide feedback to students or to ask them to do something and, in sharing resources, to tell and show the content of a specific competence. This study will exploit these features in designing an application that uses social media to improve students' learning.

At this stage, this study begins by investigating Facebook as a popular social media tool that may help both KM and e-learning, as discussed section 2.3.3. One feature of Facebook is the Groups function. A group gathers a number of people who share an interest. A group will be constructed for a learning module, with members being drawn from students on the module who are studying a specific topic. The next section introduces the steps for retrieving and displaying some Facebook content.

4.6.1 Create a Facebook group

This study starts first with Facebook, specifically Facebook Groups, as an example of social media and to compare it with other social media tools such as Twitter and Google Plus. Facebook is widely used by teachers and students in the academic field, and Facebook Groups has a number of features not found in other social media tools, including the ability to upload documents and files to the group, to create events, to send messages to all members and to share videos and photos (Tiwana, 2000). The important features for the purpose of this study are exchanging messages to enable group discussion, providing personal profile information to make a group and sharing resources to complete a required task. In other words, KM may be seen in terms of providing personal profile information to connect ontologically the students' skills to the collaborative working competences provided and available task competences, and sharing resources when linking them to the ontology of task competences. In addition, e-learning may be seen in terms of providing feedback to group members or conducting a group discussion via the messaging service, and telling or showing which resources are related to the competence.

The teacher needs to create an account with Facebook. Once logged in successfully, the groups section is located in the main navigation area of the Facebook page. Teachers can then create a new Facebook group after defining its name and adjusting the privacy settings, such as a public group, a closed group or a secret group. The group name should be the same as the module name. After that, the teacher can add members (students) to the group or ask students to search for the group name, which is the same as module name, so they can join the Facebook group.

4.6.2 Edit personal profile information

Each member (student) of the newly created Facebook group has a personal profile. The personal profile consists of six different sections. Each requires different information to be edited. The first is about work and education, such as their workplace, professional skills, name of university and name of secondary school. The second is about their current city and home town, with other places they have lived in. The third is about contact and basic information, for example their mobile phone number, email address, other social media accounts, date of birth, gender, languages, interests and political views. The fourth is about family members who have Facebook accounts and current relationships. The fifth section is about general details such as biographical information, favourite quotes and other names, such as nicknames. The final section is about life events such as the date of their graduation, or when they became engaged or married.

The important feature about students' profiles is the professional skills at work and education section. These skills will be compared by students to the ontological competences that are required to answer a given assignment successfully and the ontological collaborative working competences for effective group work. Having displayed various skills about the students undertaking the module, besides presenting ontologically the competences, students will be able to form effective groups that are able to help to complete the assignment. In addition, the biographical information that is displayed about students, and their gender, could enhance group formation. So, students need to populate these particular sections in order to be read and generated by the application.

4.6.3 Display students social information

When generating content from Facebook as a component of social media, there are several aspects to take into account. Every component of social media uses an API (Application Programming Interface), yet some social media APIs have limitations on developing an application. It is necessary to check that the API features allow and support sign in, import and export data, and automatic posting information within the tool. The tools and techniques are vital to the development of applications. Some recommend specific tools such as asp.net, Java, PHP and so on (Wasserman & Faust, 1994).

The Facebook API allows developers to use the features for signing in and registering new users. In addition, there is a special Facebook Groups API to allow developers to retrieve uploaded files or documents from the group. The developed application will use this to tag any shared resources in a Facebook group to the task competences ontology or collaborative working competences. The reason behind tagging is to facilitate filtering after a long period of time, and it has structured resources with desired competences. Moreover, the Facebook Group API allows a developer to retrieve information about group members from their personal profile, the group name and the total membership of the group. This will be exploited to display students' skills and to connect them to the collaborative learning competences ontology. There is no need to implement group discussion in the SMC application, because Facebook already enables members to gather and exchange messages (Facebook-Developer, 2016;Wagner, 2011).

This research will use a number of APIs in order to retrieve students' names and skills, along with other features that will be implemented in the SMC application (Figure 4-12). Table 4-3 shows a list of all APIs that are intended to be implemented in the SMC application.

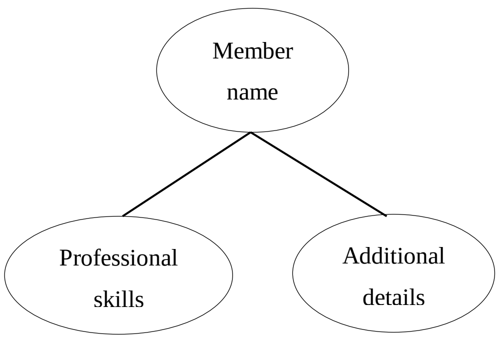


Figure 4-12: Information from each user's profile that are exploited by the SMC application

Table 4-3: List of Facebook APIs to be used in developing SMC application

Facebook API	Description
Log in	To sign into the SMC application
Log out	To sign out of the SMC application
First and last name	To show the name while logging into the application and when adding resources or notes
FB Group name	To show the module name
FB Group total members	To show the total number of students undertaking the module
FB Group members' names	To generate a list of names of those undertaking the module
FB Group members' gender	To define the gender of those undertaking the module under their name
FB Group members' professional skills	To generate a list of students' skills under their name
FB Group members' bio	To display additional information about each student under their name
FB Group members' email address	To display students' email address

After generating a list of all those students who are undertaking the module, with their social information such as professional skills, biographical content and gender, the student may send an invitation to potential group members to form a group. There is no need to implement the invitation feature into the SMC application, because Facebook already provides messaging services through Facebook Group. Student should already know the names of potential group members and send a message to each of them. In addition, the student will be able to include more than one member in a message through the Facebook messages service to communicate in order to form a group. Any member who agrees to work as a group with a number of potential members can send this communication via the Facebook messaging service.

4.6.4 Register the intended developed application with Facebook

In order to use available Facebook APIs for developing web-based or mobile-based applications, Facebook requires an intended developing application to be registered under the developer's name. Facebook provides a special section for the developer to create new applications and then start programming. Without registering the application, the developer cannot use or generate Facebook content through APIs. Registering the application allows users to undertake a search about the application within Facebook itself and use it, because the application is integrated with the Facebook community.

The developer needs to access the developer's section and, from the main drop-down list, choose to add a new application. The developer next has to select a platform for the intended developed application such as IOS, android or website. In order to create an application ID within Facebook, the developer has to provide a name for the application and a name space, and to choose a category for the proposed application – for example, books, business, communication, education, game, entertainment, finance, fashion or health. After providing this information, the application ID will be created and registered within Facebook. Next, the developer can start programming and generating Facebook content via application ID, using a secret code available through Facebook APIs. Having successfully registered application with Facebook, the developer administration and testers can see it in the applications section. Once programming and the required content are complete, the developer administration of Facebook can make it public and accessible to everyone who searches for the name of the application, ready to start using it like any other available application.

4.7 Making Notes about Defined Group Members and Relevant Task and Progress

The proposed developed application is considered to be a social application. So, besides allowing students to contribute to the knowledge base of both ontologies by adding additional resources to specific competences, the application will allow them to make notes about each other within the SMC application. The notes section of the application is more easily displayed and structured than that for general comments in Facebook Groups and, after a period of time, the inevitable difficulties in searching for them. The list of students undertaking the module will be generated through Facebook Groups using the desired APIs for this feature. That list will be designed as a drop-down list, so students can select a name and write relevant notes or comments on that student in a text box. By clicking the 'add' button, the selected name and text will be added to a database showing who wrote that comment, with the date and time of the written comments or notes. The date and time will be drawn from a programming library or package that displays the current date and time.

4.8 SMC Application Activity Diagram and Storyboard

This section provides a planned series of the user interfaces provided to students. According to the application process in Figure 4-3, an activity diagram represents the workflow behaviour within a SMC application, and the storyboard is then designed from the activity diagram.

4.8.1 SMC application activity diagram

An activity diagram provides details of how the application interacts with a student. It shows each step or process provided by an application to a student. The consideration of an activity diagram facilitates the design of all interfaces. Figure 4-13 shows the SMC application activity diagram for this research.

Assuming that all students who undertake the module have already joined a Facebook group, the teacher posts an assignment as a general post in Facebook Groups. The assignment requires group work. There will be an application that can help students to establish the requirements for completing the assignment successfully through a number of ontological competences. In addition, the application helps students to form an effective group, based on information that is provided, instead of random group formation or based on friendships.

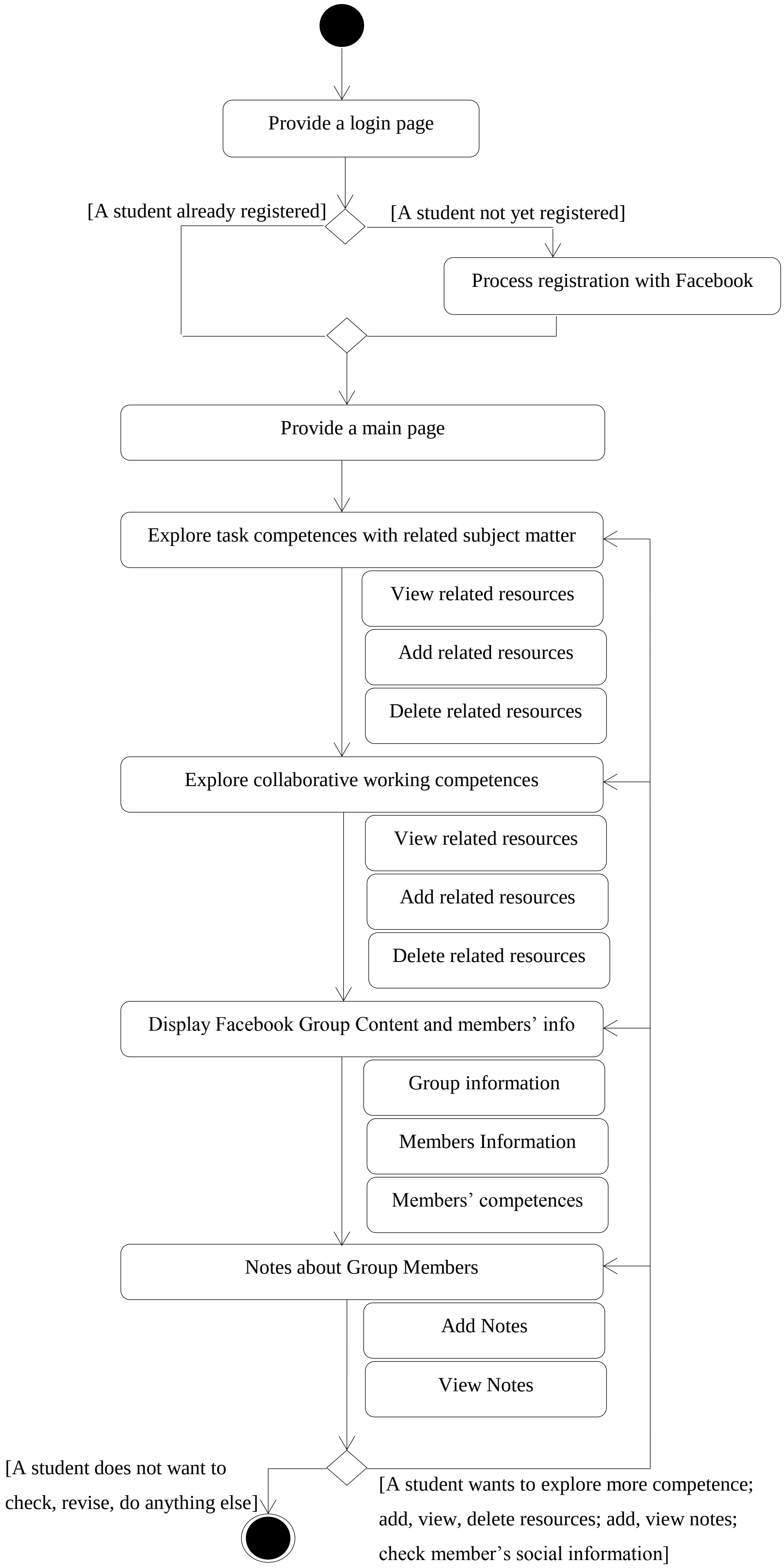


Figure 4-13: SMC application activity diagram

4.8.2 SMC application storyboard

Designing an application storyboard allows the developer to propose the intended user interface before the real implementation. There are 16 main pages of user interfaces. Figure 4-14 shows the first page, which provides an overview of the application and the specific knowledge domain with a scenario of how students interact and handle the application. Figures 4-15 to 4-18 show the task competences from the ontology database for exploration, with the ability to find extra resources for specific competences or contribute to the knowledge base by adding additional resources or deleting them. The same user interface procedure for collaborative working competences will be designed as shown in appendix H.1. Figures 4-20 to 4-22 are for generating content from Facebook Groups in terms of students' social information, such as skills, gender, name of module and total number of students undertaking the module. Figures 4-23 and 4-24 deal with notes and comments about group members, and have a list of all students who joined a Facebook group in order to make notes or comments about them.

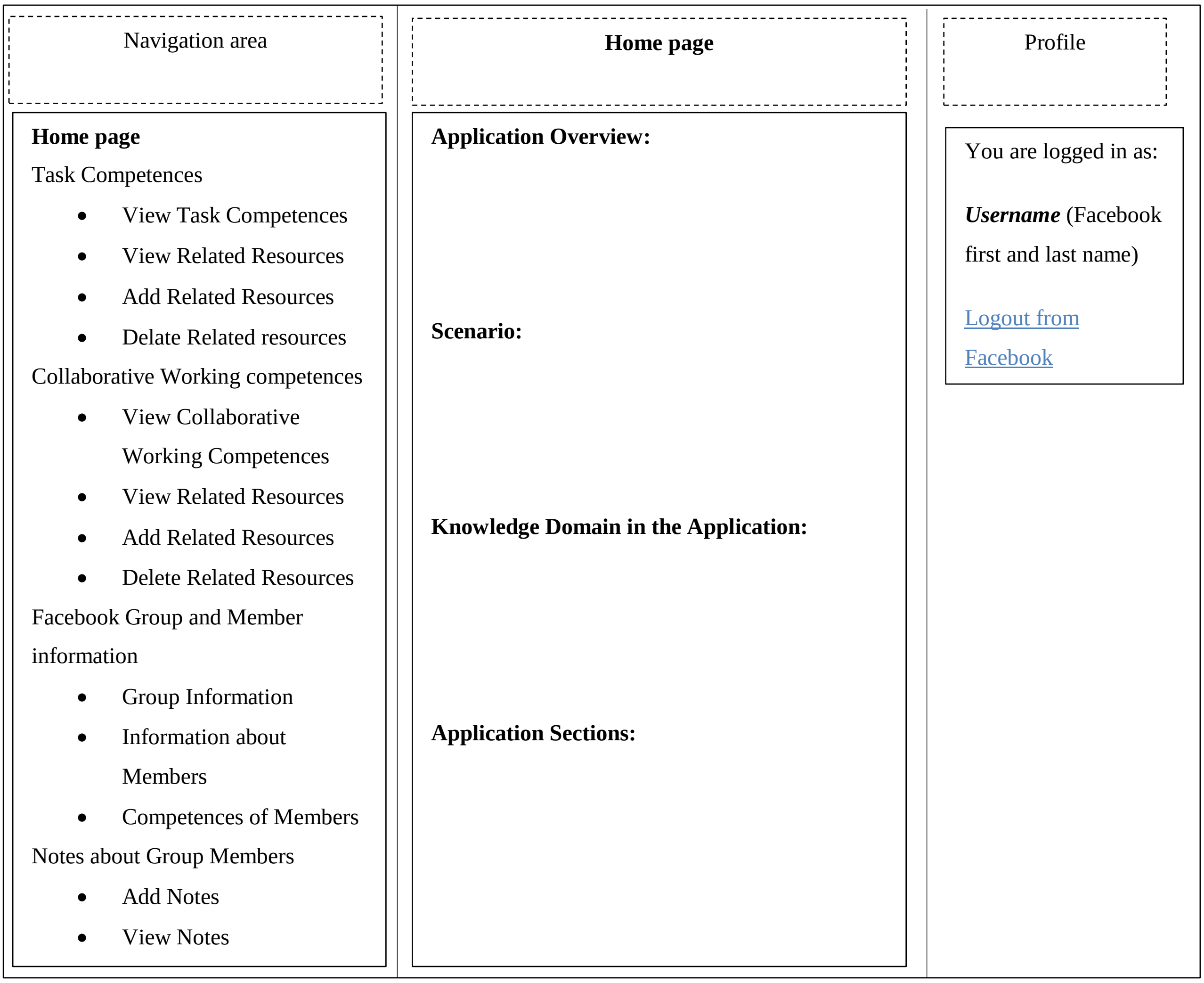


Figure 4-14: Main page after logging into application via actual Facebook username and password

The page in Figure 4-14 gives a general overview of the application and the chosen knowledge domain. In addition, it explains how to use the application. Before that, a student needs to log in using their Facebook username and password. There is special Facebook API for logging in using actual Facebook details.

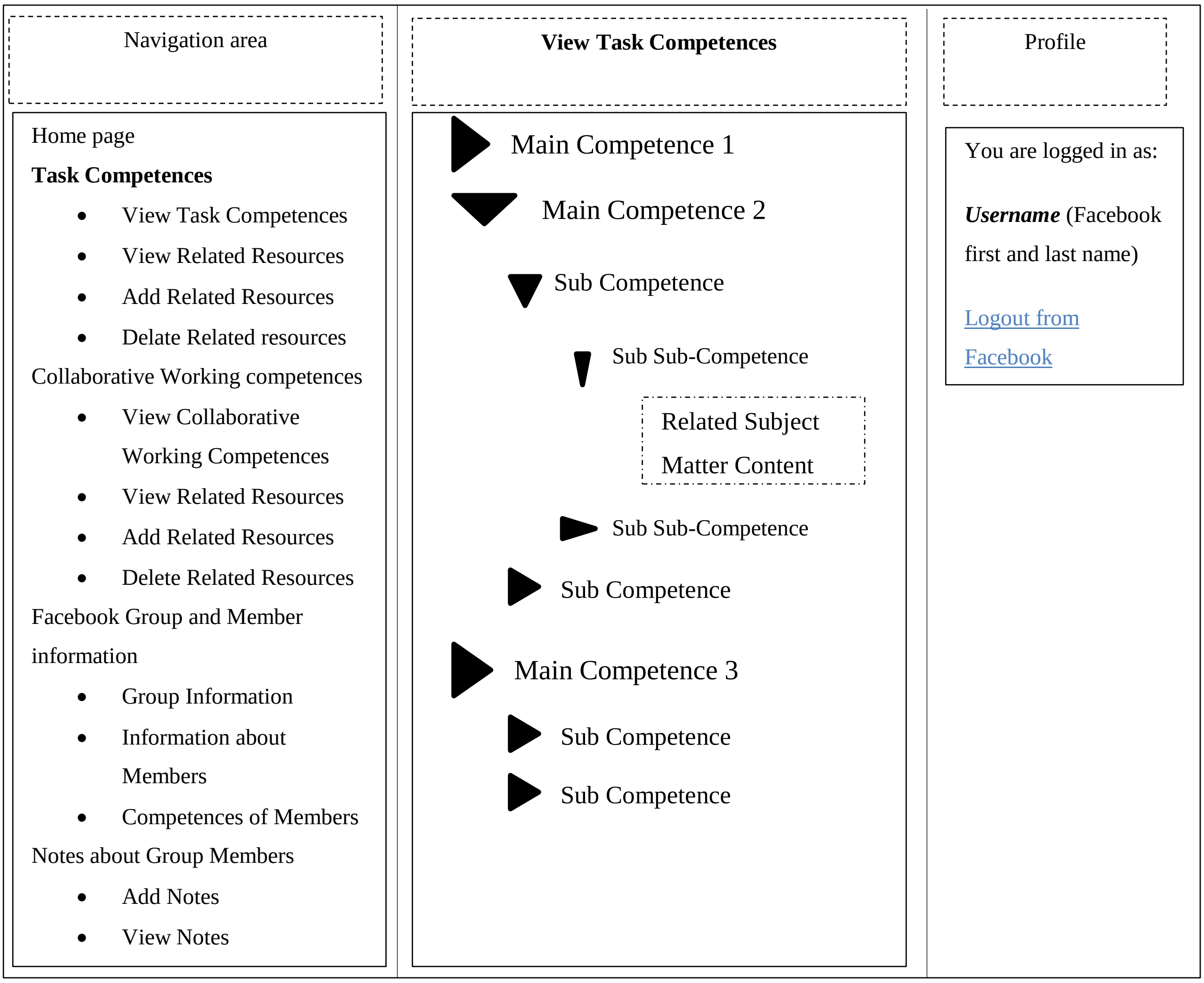


Figure 4-15: Page for exploring and viewing task competences from ontology database of task competences

The page in Figure 4-15 allows students to explore a number of ontological competences with related subject matter content, as structured in Figure 4-9. The page presents the ontological competences in a tree structure in order to facilitate navigation and consistency between competences, and easy access to related content based on the taxonomy of subject matter categories.

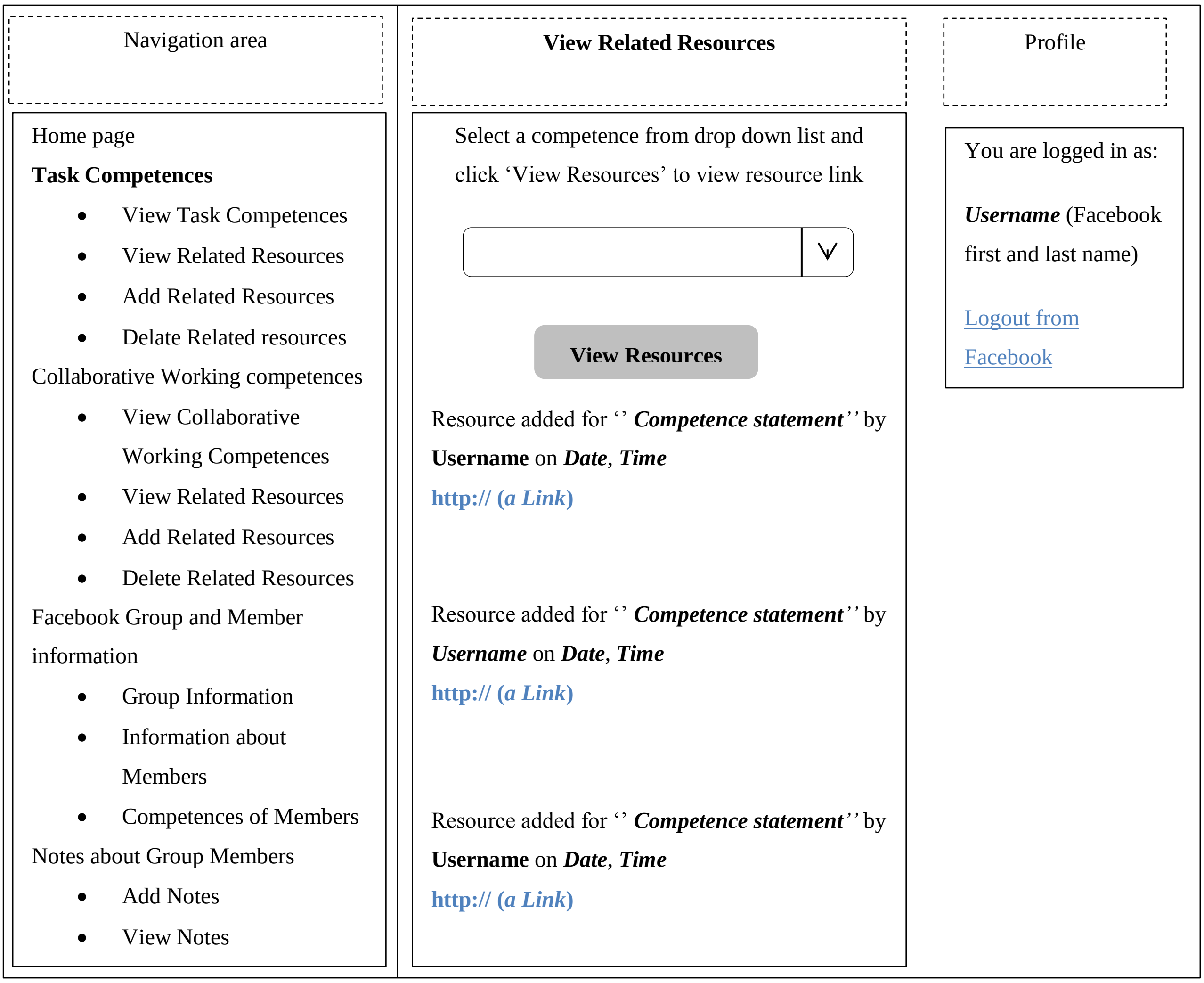


Figure 4-16: Page for finding resources related to specific competences, with mention of who added resources and when

All competences in the ontology as described in Figure 4-9 will be generated in a drop-down list. Students can find additional resources for specific competence for further explanation. In addition, there will be mention of who added resources, with the date and time. All resources will be ontologically tagged with related competences, in order to facilitate future searches or to generate a list of structured resources. This reflects knowledge management principles, such as having organised and structured content. In this screenshot, all resources are organised under the desired competences in a structured and organised manner. In addition, students can identify the value of added resources by seeing who added them, with the date and time.

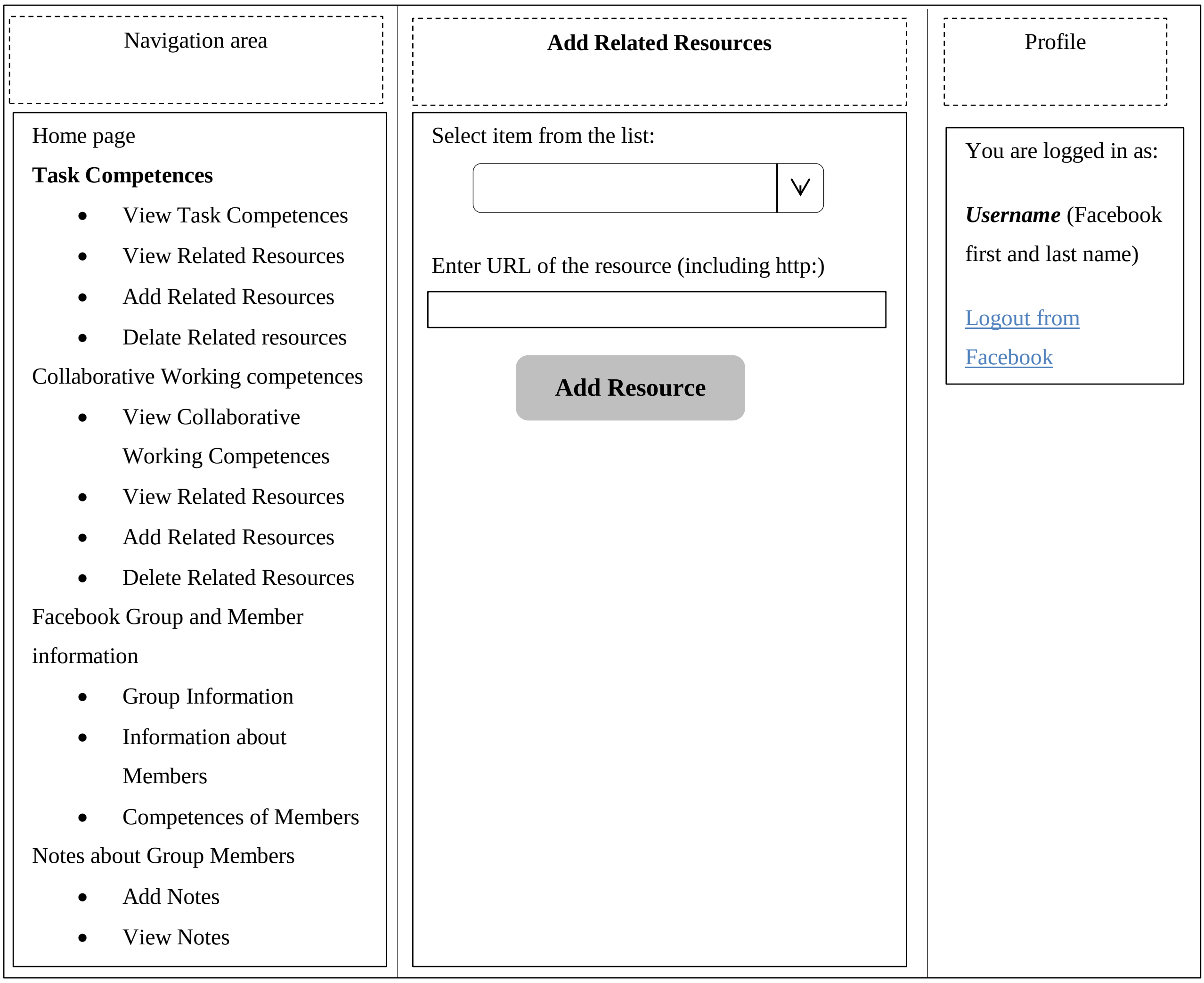


Figure 4-17: Page for tagging resources with related competence in task competence ontology database

The page in Figure 4-17 gives students or the teacher the ability to tag any useful resources with a specific competence by selecting a competence from a drop-down list. Entering a resource as URL link will save it in an ontology database for a specific competence, with mention of who added it, and the date and time. This screenshot reflects one of the principles of knowledge management, which is the ability to create content in a systematic way. Users can first choose a competence then add related resources, instead of randomly creating content without first specifying a category.

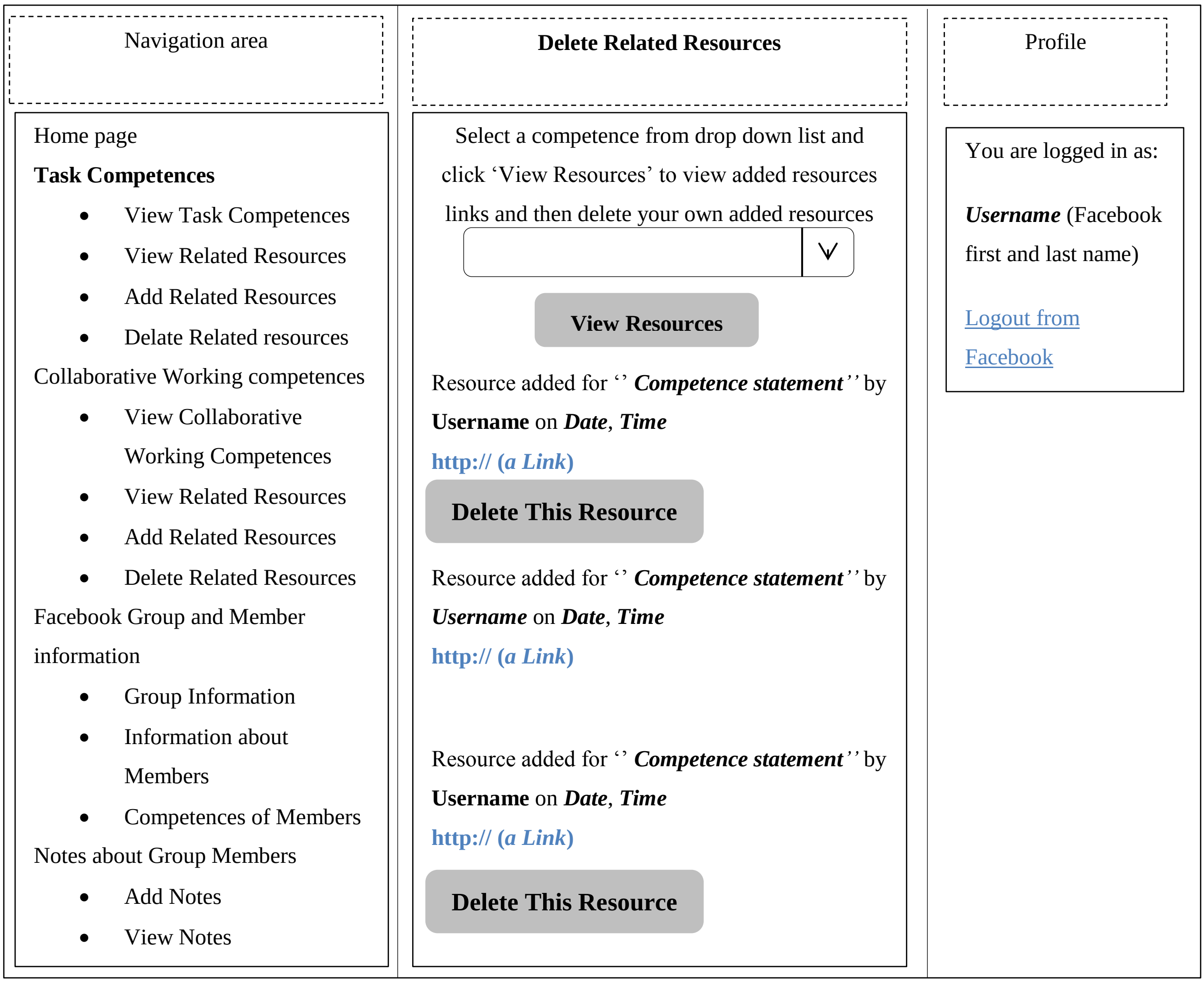


Figure 4-18: Page for deleting own added resources for a competence of task competence ontology

The page in Figure 4-18 allows students to delete their own added resources. After selecting a competence from a drop-down list, the application will generate all related resources for that competence. Only a student's own added resources will have against them the option to delete them. As, under knowledge management principles, users may create and share content, they have the ability to delete and update their own added resources. The screenshot demonstrates the ease of access to created content.

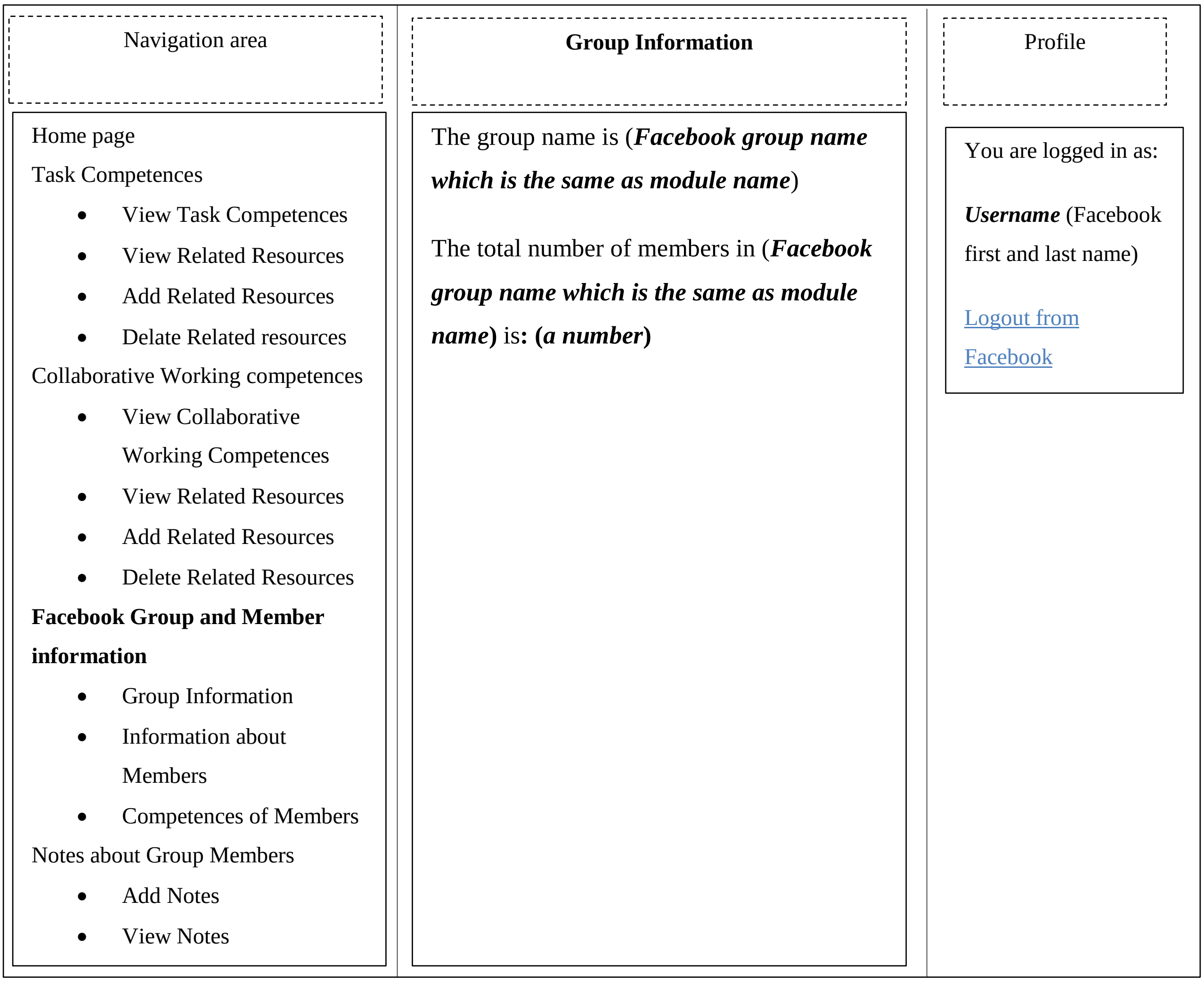


Figure 4-20: Page for generating Facebook Group name and total members of the group

This page in Figure 4-20 indicates the module name and the number of students who are undertaking the module by using Facebook APIs. The design theory behind this interface is to provide students with further, structured content in explicit statements, which in turn reflect knowledge management principles. Without generating this content, information such as the module name and student numbers is omitted. In addition, having explicit statements about the number of students undertaking the module enables students to manage their sub-group's formation in order to undertake the assignment.

Navigation area

Home page

Task Competences

- View Task Competences
- View Related Resources
- Add Related Resources
- Delate Related resources

Collaborative Working competences

- View Collaborative Working Competences
- View Related Resources
- Add Related Resources
- Delete Related Resources

Facebook Group and Member information

- Group Information
- Information about Members
- Competences of Members

Notes about Group Members

- Add Notes
- View Notes

Information about Members

Here is information about Facebook Group Members:

Member Name: (*a name*)
Member Gender: (*a gender*)
Member Bio: (a *bio information*)
Member Contact Email (*an email address*)

Member Name: (*a name*)
Member Gender: (*a gender*)
Member Bio: (a *bio information*)
Member Contact Email (*an email address*)

Member Name: (*a name*)
Member Gender: (*a gender*)
Member Bio: bio *information*)
Member Contact Email (*an email address*)

Member Name: (*a name*)
Member Gender: (*a gender*)
Member Bio: (a *bio information*)
Member Contact Email (*an email address*)

Profile

You are logged in as:

Username (Facebook first and last name)

Logout from Facebook

Figure 4-21: Page for generating social information about members such as name, gender, biographical details and email address from their Facebook profiles

This page in Figure 4-21 allows students to establish further details about potential group members, such as their gender and biographical information. This information could enhance group formation. All information will be retrieved from members' profiles through Facebook APIs. The design theory behind this interface is to provide students with ontologically structured social information in order to enhance group formation. Without this information, students will face difficulties in accessing each student's profile, which would conflict with the principles of knowledge management and ontology.

Navigation area	**Competences of members**	Profile
Home page Task Competences • View Task Competences • View Related Resources • Add Related Resources • Delate Related resources Collaborative Working competences • View Collaborative Working Competences • View Related Resources • Add Related Resources • Delete Related Resources **Facebook Group and Member information** • Group Information • Information about Members • Competences of Members Notes about Group Members • Add Notes • View Notes	Here is all competences that related to your colleagues. Please use Facebook Group messaging service to invite each other in order to form sub groups of five students Student Name: (*a name*) Competences: • … • … • … Student Name: (*a name*) Competences: • … • … • … Student Name: (*a name*) Competences: • … • … • …	You are logged in as: ***Username*** (Facebook first and last name) Logout from Facebook

Figure 4-22: Page for generating students' skills from their Facebook profiles

The page in Figure 4-22 lets students find out about their colleagues' competences, then starts matching these to each task's competences and collaborative working competences in order to form effective groups. Next, students use the Facebook messaging service to undertake further communication or send an invitation to join a group. The page shows the ontologically structured skills of the students in the class in order to compare these to the ontologically structured competences of the subject matter and collaborative work before students proceed to form their group.

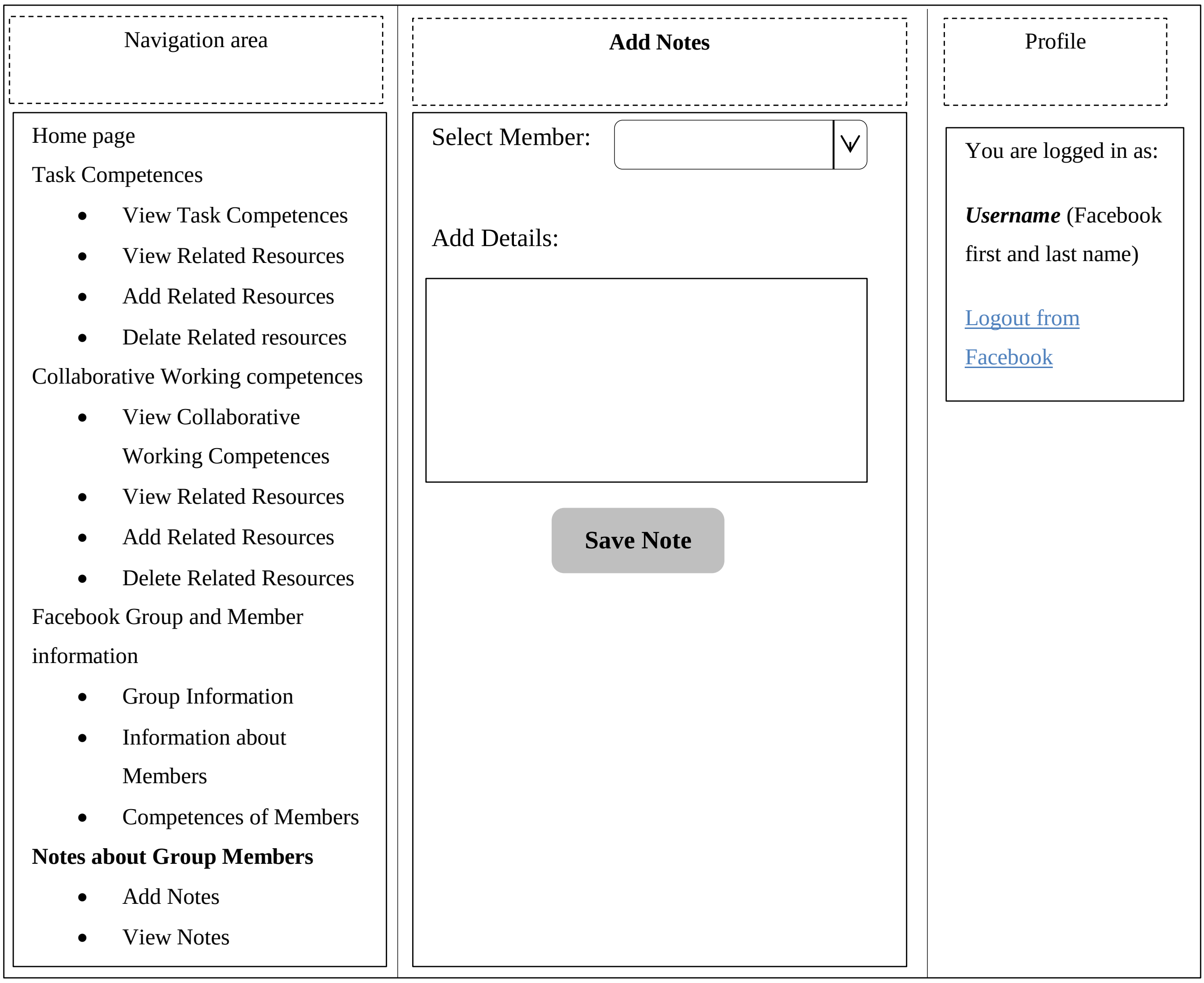


Figure 4-23: Page for writing notes about group members, such as their assigned task, general comment, or work progress

The page in Figure 4-23 allows students to obtain a list of all students undertaking the module from a drop-down list. This list of students comes from Facebook group members through Facebook API, which will be implemented in a drop-down list. After selecting a student from the drop-down list, a student can write notes in a text box and save it. The application will store the selected member, related notes, who added the notes, the date and time. The theory behind this screenshot is to allow students to create structured content, which in turn generates further organised content from the ontology.

Figure 4-24: Page for showing group members with related notes and who added them, with the date and time

There will be a special database for storing notes on group members and people who created those notes, with the date and time, to be checked later or to draw attention to the progress of particular group members. The Facebook API for names of members will be used, along with the current date and time.

4.9 Summary

The analysis and design of the competence structure and its social application are discussed in this chapter. The application requirements are discussed for both the student and the teacher sides as use case diagrams. The application focuses on the student side and how to provide suitable information to complete a specific assignment successfully and to work collaboratively in an effective environment. The application process is then presented. A student needs to establish what is required for the given assignment and collaborative working, then to start to form a group, based on provided information, then compare this with the available students' skills and related social information. It is akin to a forming football team. Constructing a competence structure is a major part of the research. Presenting it ontologically permits it to be populated with the necessary information and then generated to students.

A competence structure consists of a capability verb and subject matter, the content of which fits into four different categories. So, designing the ontology considers the structure of both competence and subject matter. In addition, collaborative working competences have differing roles for each competence, such as someone to plan the work, someone to negotiate and someone to be a leader of the group. These collaborative working competences with their related roles were presented ontologically. Moreover, this chapter considered information from Facebook that will be generated through special APIs, such as their professional skills, gender and biographical details. This information will be used in the developed social application to help to form more effective groups.

The final part of this chapter presents the SMC application activity diagram and storyboard. These details are provided to show the sequence of interactions between the SMC application and students.

The next chapter will illustrate an implementation of the ontologies, processes, retrieval of data from Facebook via APIs, and the development of user interfaces for the SMC application. The implementation is developed using the SMC design outlined in this chapter.

Chapter 5: Implementation of Social Media Competence Application

The previous chapter discussed the design processes of the SMC application and the method of constructing competences ontologically. In addition, it outlined methods of constructing collaborative working competences ontologically. It outlined methods of analysing social media content and selected Facebook as an example, using its APIs to retrieve social data about students who had already joined a Facebook group.

This chapter describes the implementation of the SMC application. It includes four main sections that reflect the developing SMC application. The first presents the implementation of the task competence ontology database with related resources. The second presents the implementation of collaborative working competences with their related resources. The third presents the implementation part of using Facebook APIs to retrieve some social information about students and making them readable through the SMC application in structured way. The last section presents the implementation of making notes on group members.

5.1 Ontology of Task Competence Implementation

This section describes the details of ontology implementation. The methods of constructing competences and design ontology have been described in Chapter 4, sections 4.3 and 4.4.1. Figure 4-9 in Chapter 4 shows the ontology design of learning task, based on competence taxonomy and subject matter categories. In addition, this section explains the method of extracting information from the developed task competence ontology. It presents the methods of adding and viewing additional resources for a specific competence with the ability to delete one's own added resources.

5.1.1 Ontology implementation and extracting data

The ontology as described in Chapter 4 Figure 4-9 was implemented by using RDF as one of the ontology languages. All classes were implemented in an RDF file with related relationships. The ontology repositories for task competence were native stores. These are stores built directly on the file. The file needs then to be populated with desired information in order to be extracted to students. So, Jena Semantic Web Framework was implemented for Java. Jena provides API for extracting data from the RDF file. In addition, Jena is used to write to the RDF ontology file. In this case, Jena will be used to add additional resources to the developed ontology. The type of query language to extract data from ontology, apart from Jena, is the query language SPARQL.

In this research, a SPARQL query was used to extract data from the RDF ontology file. The data are the competence and related subject matter content. The display of competence is in a tree structure. A student needs to click on the main competence first, in order to display (expand) any sub-competences. Sub-competences are also clickable, in order to show any sub-sub-competences. Then the related subject matter is clicked, so that sub-sub-competences appear. By clicking on any open competence, it automatically closes (collapse). The implementation of subject matter is based on the task analysis for each category, as described in Chapter 2 section 2.1.5.1 and Chapter 4 section 4.3.3.

Figure 5-1 shows a sample fragment of the RDF code for the task competence ontology database. It appears in the language used, which is RDF, as seen at the top of the figure against the task of 'Normalisation'. In addition, the figure shows the main competence 'Normalise to First Normal form', sub-competence 'Remove Repeating Group of Data', and sub-sub-competence 'List Repeating group of data characteristics', with their related capability verbs. The competences' ordering is identified with the type of subject matter, which is 'concept'. The complete RDF code of the ontology can be found in Appendix A.1.

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:cm="http://www.cmodel.com/elements/">


<rdf:Description rdf:about="http://www.cmodel.com/elements/task/normalise">
  <cm:task>"Normalization"</cm:task>

<cm:hasCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/1NF">
          <dc:title>"Normalize to First Normal Form"</dc:title>
            <cm:hasOrder>2</cm:hasOrder>


         <cm:hasCapability>Normalise</cm:hasCapability>
         <cm:hasSubjectMatter>
            <rdf:Description rdf:about="http://www.cmodel.com/SubjectMatter1"> <dc:title>"First Normal Form"</dc:title>
            </rdf:Description>
        </cm:hasSubjectMatter>

            <cm:hasSubCompetence>
            <rdf:Description rdf:about="http://www.cmodel.com/comp/RPGD">
                <dc:title>"Remove Repeating Group of Data"</dc:title>
                <cm:hasOrder>1</cm:hasOrder>
                <cm:hasCapability>Remove</cm:hasCapability>
                <cm:hasSubjectMatter>
                     <rdf:Description rdf:about="http://www.cmodel.com/submatter/SubjectMatter2">
                     <dc:title>"Repeating Group of Data"</dc:title>
                     </rdf:Description>
                </cm:hasSubjectMatter>

                                <cm:hasSubCompetence>

                                <rdf:Description rdf:about="http://www.cmodel.com/comp/LRGDC">
                                <dc:title>"List Repeating Group of Data characteristics"</dc:title>
                                <cm:hasOrder>1</cm:hasOrder>

                                <cm:hasCapability>List</cm:hasCapability>
                                <cm:hasSubjectMatter>
                                <rdf:Description rdf:about="http://www.cmodel.com/concept/Concept1">
                                               <cm:SubMatterType>"Concept"</cm:SubMatterType>
```

Figure 5-1: Sample fragment of RDF code for building task competence ontology

Figure 5-2 shows a sample of ‘concept’ as the subject matter category and how it is designed to be populated with information. It can be seen from the Figure 5-2 concept name as ‘Repeating Group of Data’, concept domain ‘Normalisation process for First Normal Form’, and the connection between concept name and domain which is ‘is kind of’. This information is generated to students as ‘Repeating Group of data is kind of Normalisation process for First Normal Form’. This reflects the benefits of ontology in providing explicit statements for a particular knowledge domain. In addition, as ‘concept’ has a number of attributes and values known as characteristics, the code shows all attributes and related values with a connection word, to be read and generated as a sentence to students, for example ‘column values are unique’. Column values are considered as an attribute name, and ‘unique’ is an attribute value, where the link word between the attribute and the value to make it into a useful sentence is ‘are’. The figure shows a new element of each subject matter that provides an example. This is for further explanation of particular content.

```
   <cm:SubMatterType>"Concept"</cm:SubMatterType>
   <cm:hasExample>
es for Table_Product ( Product_ID , Color, Price )
e the [color] column may contain multiple values such as "red" and "green" in the same
 split the table into two tables and now we have the following results. Table_Product_P
olumns on each table hold just one value.

   <dc:title>"Repeating Group of Data "</dc:title>

   <cm:hasDomainConn>is kind of</cm:hasDomainConn>
   <cm:hasDomain>Normalisation Processes for First Normal Form</cm:hasDomain>

   <cm:hasCharactertics>
           <rdf:Description rdf:about="http://www.cmodel.com/concept/CChar1">
                <cm:attributeName>Column values</cm:attributeName>
                <cm:hasConnection>are</cm:hasConnection>
                 <cm:attributeValue>Unique</cm:attributeValue>
           </rdf:Description>
   </cm:hasCharactertics>

   <cm:hasCharactertics>
           <rdf:Description rdf:about="http://www.cmodel.com/concept/CChar2">
                <cm:attributeName>Row identifier</cm:attributeName>
                <cm:hasConnection>is </cm:hasConnection>
                 <cm:attributeValue>Unique</cm:attributeValue>
           </rdf:Description>
   </cm:hasCharactertics>

    <cm:hasCharactertics>
           <rdf:Description rdf:about="http://www.cmodel.com/concept/CChar3">
                <cm:attributeName>field name</cm:attributeName>
                <cm:hasConnection>is </cm:hasConnection>
                 <cm:attributeValue>Unique</cm:attributeValue>
           </rdf:Description>
   </cm:hasCharactertics>

    <cm:hasCharactertics>
           <rdf:Description rdf:about="http://www.cmodel.com/concept/CChar4">
                <cm:attributeName>Broken of data items</cm:attributeName>
                <cm:hasConnection>is </cm:hasConnection>
                 <cm:attributeValue>not permitted</cm:attributeValue>
           </rdf:Description>
   </cm:hasCharactertics>
```

Figure 5-2: Sample fragment of RDF code related to concept, as a subject matter category for task competence ontology

Figure 5-3 shows the ontological structure for ‘procedure’, as a subject matter category. The procedure consists of name, situation and goal. There will be connections between the name of the procedure and situation, and between situation and goal. The procedure name is ‘Normalisation’, the situation is ‘un-normalised form of database table’ and the goal is ‘Third Normal Form’. The connections are ‘applies to’, and ‘to’, in order to generate explicit information for students. This should be generated and read as follows: ‘Normalisation applies to un-normalised form of database table to Third Normal form’.

```
<rdf:Description rdf:about="http://www.cmodel.com/comp/LNS11">
        <dc:title>"List Normalisation Steps"</dc:title>
        <cm:hasOrder>4</cm:hasOrder>
        <cm:hasSubCompetence>
            <rdf:Description rdf:about="http://www.cmodel.com/comp/NSteps1">
                    <dc:title>"Normalisation Steps"</dc:title>
                    <cm:hasSubjectMatter>
                        <rdf:Description rdf:about="http://www.cmodel.com/submatter/procedure1">
                           <cm:SubMatterType>Procedure</cm:SubMatterType>
                           <cm:hasExample></cm:hasExample>
                           <dc:title>"Normalisation "</dc:title>
                           <cm:hasProcNameCon>applies to</cm:hasProcNameCon>
                           <cm:hasSituation>un-normalised form of database table</cm:hasSituation>
                           <cm:hasGoalCon>to</cm:hasGoalCon>
                           <cm:hasGoal>Third Normal Form</cm:hasGoal>

                           <cm:hasProcedureStep>
                                <rdf:Description rdf:about="http://www.cmodel.com/proc/step1">
                                     <cm:stepNum>1</cm:stepNum>
                                     <cm:stepName>Normalise to First Normal Form</cm:stepName>
                                </rdf:Description>
                            </cm:hasProcedureStep>

                           <cm:hasProcedureStep>
                                <rdf:Description rdf:about="http://www.cmodel.com/proc/step2">
                                    <cm:stepNum>2</cm:stepNum>
                                     <cm:stepName>Normalise to Second Normal Form</cm:stepName>
                                </rdf:Description>
                            </cm:hasProcedureStep>

                        <cm:hasProcedureStep>
                                <rdf:Description rdf:about="http://www.cmodel.com/proc/step3">
                                     <cm:stepNum>3</cm:stepNum>
                                     <cm:stepName>Normalise to Third Normal form</cm:stepName>
                                </rdf:Description>
                        </cm:hasProcedureStep>
```

Figure 5-3: Sample fragment of RDF code related to ‘procedure’ as a subject matter category for task competence ontology

Figure 5-4 shows the ontological structure for ‘fact’ as a subject matter category. There are both a fact name and a fact pair, with connections between them. A definition is kind of subject matter content that fits into the fact category. For example, in the definition of a primary key, the fact name is ‘primary key’ and the fact pair is ‘whole stated definition’. There should be connections between the fact name and pair, to be read and generated as an understandable statement. Thus, students should see it as ‘primary key is a key that uniquely identifies each record in a table'. The word 'is' is the connection between the fact name and the fact pair. The chosen domain for this research does not have any principles, so there was no ontological structure for 'principle'. If there was one, the methods would be the same in terms of stating the principle's name and cause with effect on connection, as discussed in Chapter 2 section 2.1.5.1 and Figure 2-10. The whole RDF code of task competence ontology with full related information and relationship can be found in Appendix A.1.

```
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/DPK">
<dc:title>"Define Primary Key"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>Define</cm:hasCapability>
<cm:hasSubjectMatter>

            <rdf:Description rdf:about="http://www.cmodel.com/submatter/Fact1">
               <dc:title>"Primary Key"</dc:title>
               <cm:SubMatterType>Fact</cm:SubMatterType>
               <cm:hasExample></cm:hasExample>
               <cm:hasFactPair>
                    <rdf:Description rdf:about="http://www.cmodel.com/fact/factpair1">
                         <cm:factName>Primary Key</cm:factName>
                         <cm:hasConnection>is</cm:hasConnection>
                         <cm:factValue>" a key that uniquely identifies each record in a table"</cm:factValue>
                       </rdf:Description>
               </cm:hasFactPair>
        </rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
```

Figure 5-4: Sample fragment of RDF code related to 'fact' as a subject matter category for task competence ontology

Figures 5-5 to 5-7 show the using Jen API and programming codes for extracting data from the ontology. The full programming code can be found in Appendix A.2.

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>


<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
```

Figure 5-5: Sample fragment of programming code to set Java and Jena, in order to extract data from ontology

```
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>

    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
      </script>
</head>
<body>
<center>
    <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>

<%

String AccessTokenJS, UserName,AccUserName;
String testStr=null;
AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
    response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
```

Figure 5-6: Sample fragment of programming code to authorise sign in before generating ontological competences

```
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");

    Query  qry;;
    QueryExecution qe ;
    ResultSet rs ;
    Literal ttl,compExample;
    Literal cap;
    Literal sm;
    QuerySolution soln;
    Resource r;

    File f = new File(fileName);
    InputStream in = new FileInputStream(f);
    if ( in == null )
    { throw new IllegalArgumentException("File is not found" );}
       //else {outt.println(" File successfully openned\n");  }

    Model model = ModelFactory.createDefaultModel();
    model.read(in,null);
    // read the model from the file
    //"?T cm:topic ?topicStr.FILTER regex (?topicStr, \""+ content+"\", \"i\"). "+
    //"?competence dc:title ?ttl. "+

    String queryString =     "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                             "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                             "PREFIX cm:<http://www.cmodel.com/elements/> "+
                             "SELECT DISTINCT ?ttl ?competence ?orderNo ?compExample WHERE { "+
                                 "?T cm:hasCompetence ?competence. "+
                                 "?competence dc:title ?ttl. "+
                                 //"?competence cm:hasExample ?compExample. "+
                                 "?competence cm:hasOrder ?orderNo. "+
                             " } ORDER BY ?orderNo";
```

Figure 5-7: Sample fragment of programming code for extracting data from ontology via a SPARQL query

5.1.2 Interface implementation for task competence ontology

Figures 5-8 to 5-12 show the user interface for extracted data from the ontology. All competences are designed to be extracted from the ontology in a tree structure. The tree structure is clickable (expand and collapse) in order to show sub- and sub-sub-competences, if applicable, with related subject matter content. The navigation between competences on the same page and the tree structure has the ability to be opened and closed in a single page and at the same time. In order to make structures of competences more understandable, the font size and colour are different when navigating between main competences, sub-competences, or sub-sub-competences until related content is obtained.

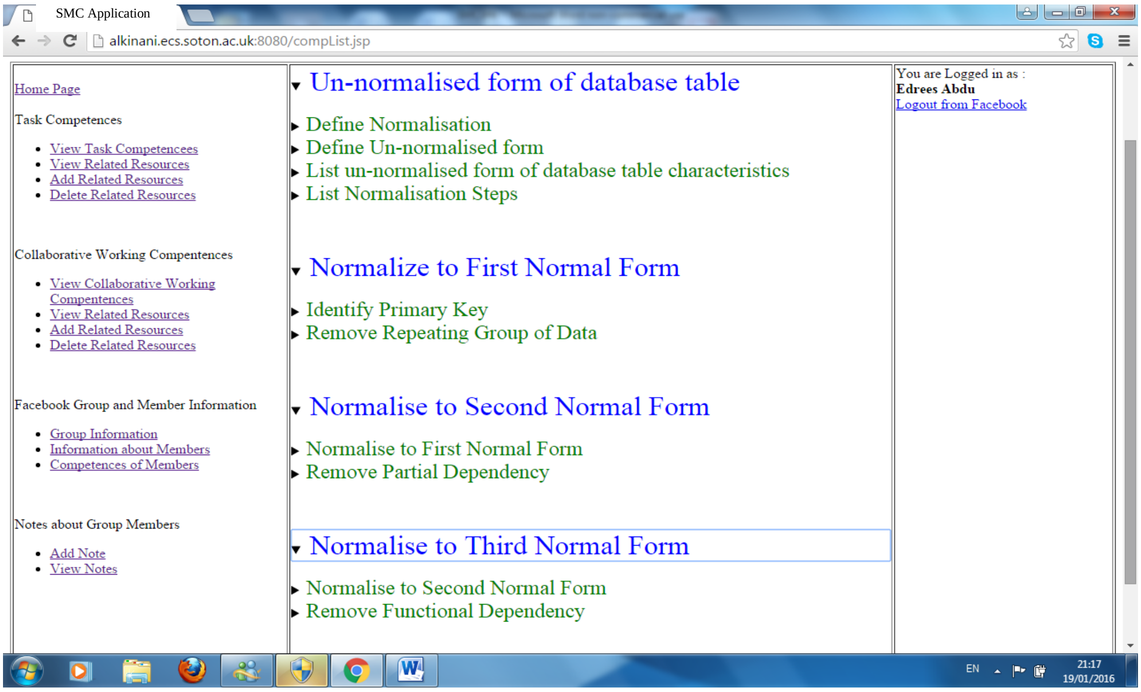


Figure 5-8: Screenshot of clickable tree structure that shows main and sub-competences extracted from ontology

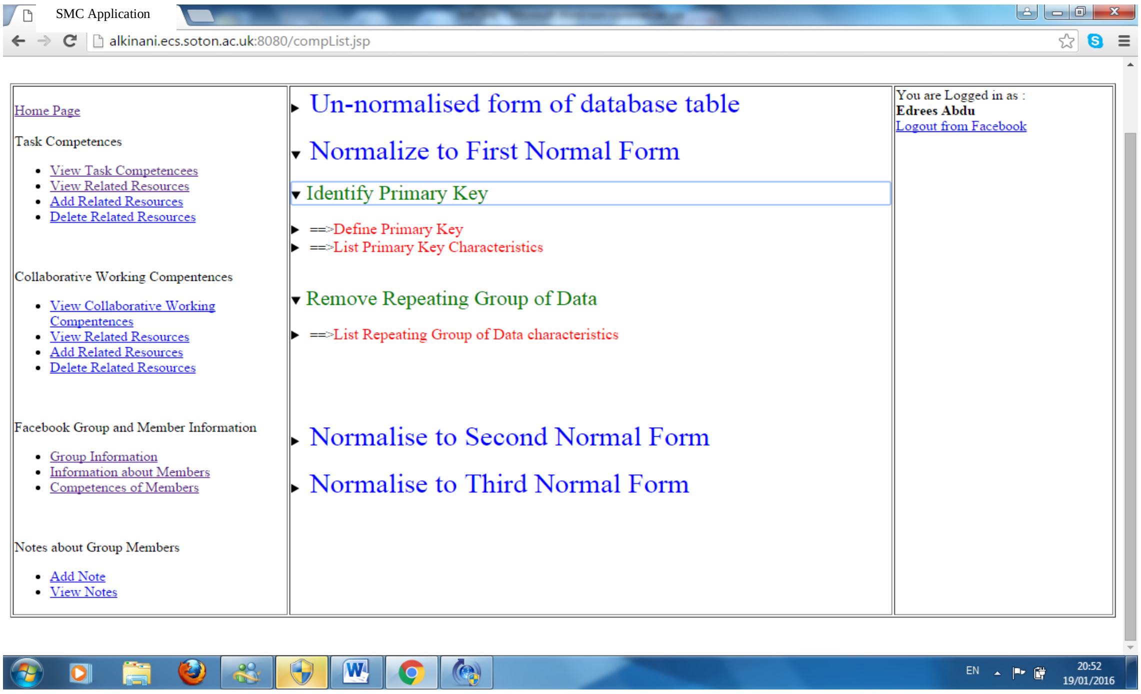


Figure 5-9: Screenshot of clickable tree structure which shows sub-sub-competences extracted from ontology

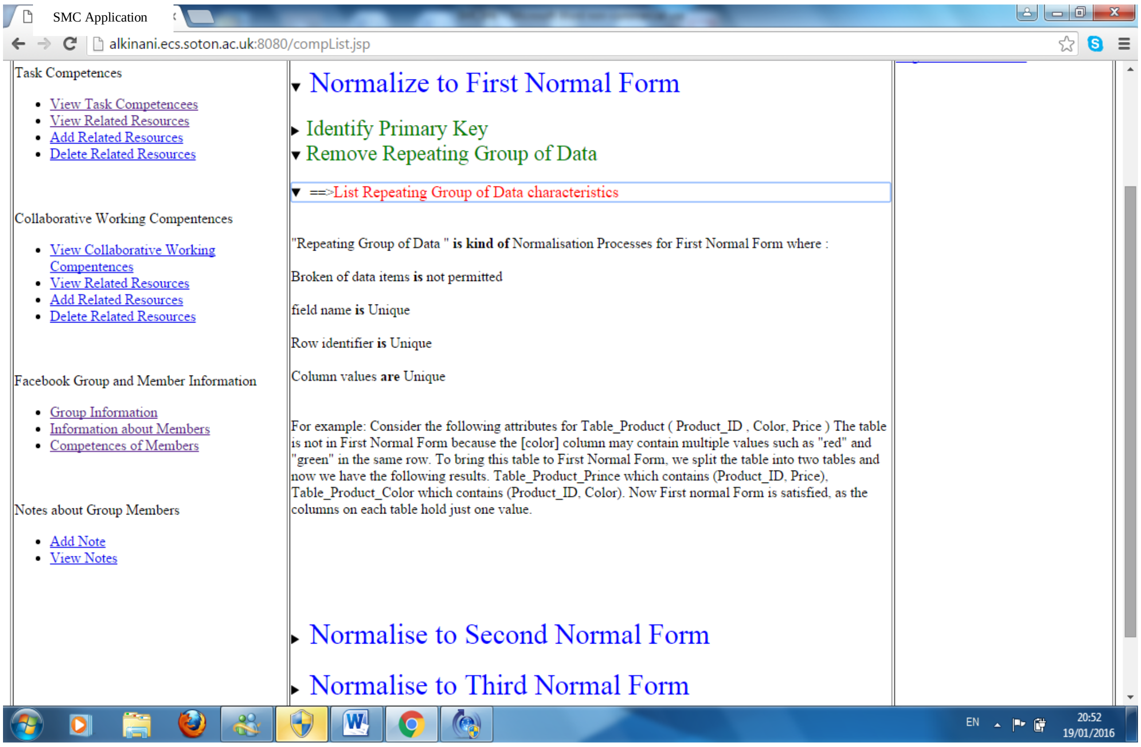


Figure 5-10: Screenshot of clickable tree structure that shows subject matter (concept) related to a competence

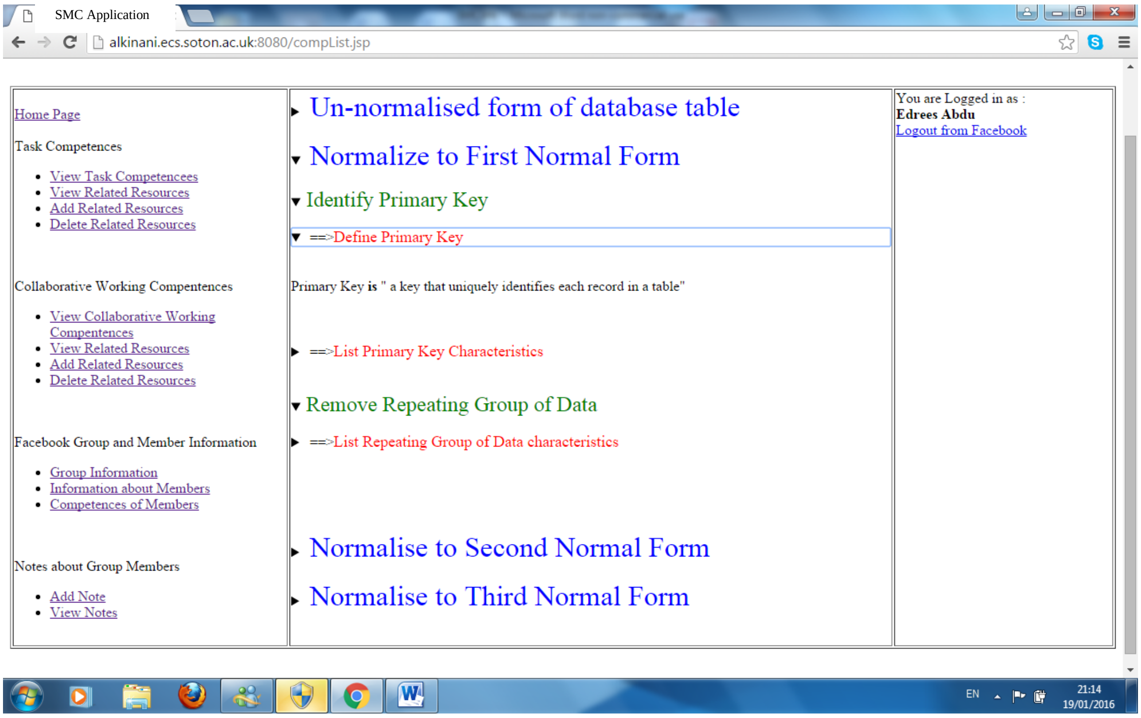


Figure 5-11: Screenshot of clickable tree structure which shows subject matter (fact) related to a competence

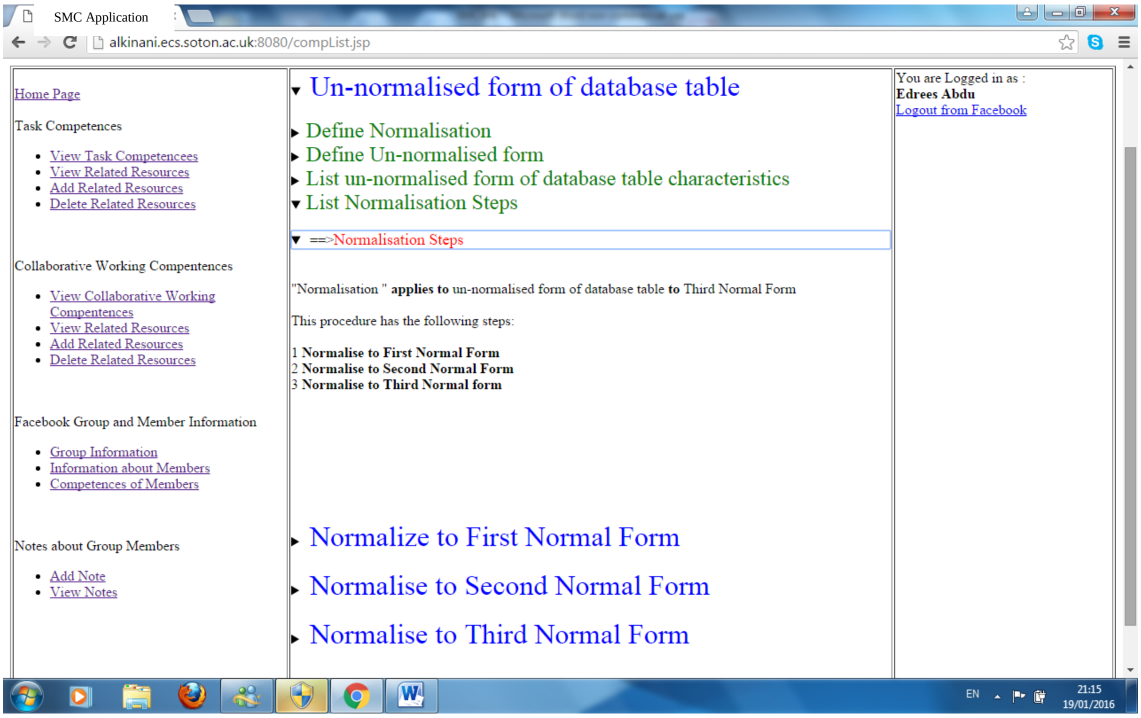


Figure 5-12: Screenshot of clickable tree structure which shows subject matter (procedure) related to a competence

5.1.3 Interfaces implementation of viewing, adding, and deleting resources

As the developed SMC application is considered to be a social application, students can contribute to the knowledge base by adding additional resources when working collaboratively. This could help explain further a specific competence. The teacher can also add resources if they see that students are experiencing difficulties with a particular task. All competences in the ontology of task competences will be generated in a drop-down list. A student needs to select a particular competence to view any added resources, with mention of who added the resources and when. In addition, the student can add resources to a specific competence as a URL and it will be tagged automatically with that selected competence in the new RDF file, with mention to who added the resource and when. The reason for having a new RDF file for storing resources is to avoid having too much data in the main ontology file, as recommended in ontology design. However, any changes in competences in main ontology will be appear in a drop-down list. Furthermore, the application allows students to delete only their own added resources. This can be verified by logging into the application and using the Facebook information profile. Figures 5-13 to 5-20 illustrate the adding, viewing and deleting processes. The full Java programming codes for viewing, adding, and deleting resources can be found in Appendix A.3.

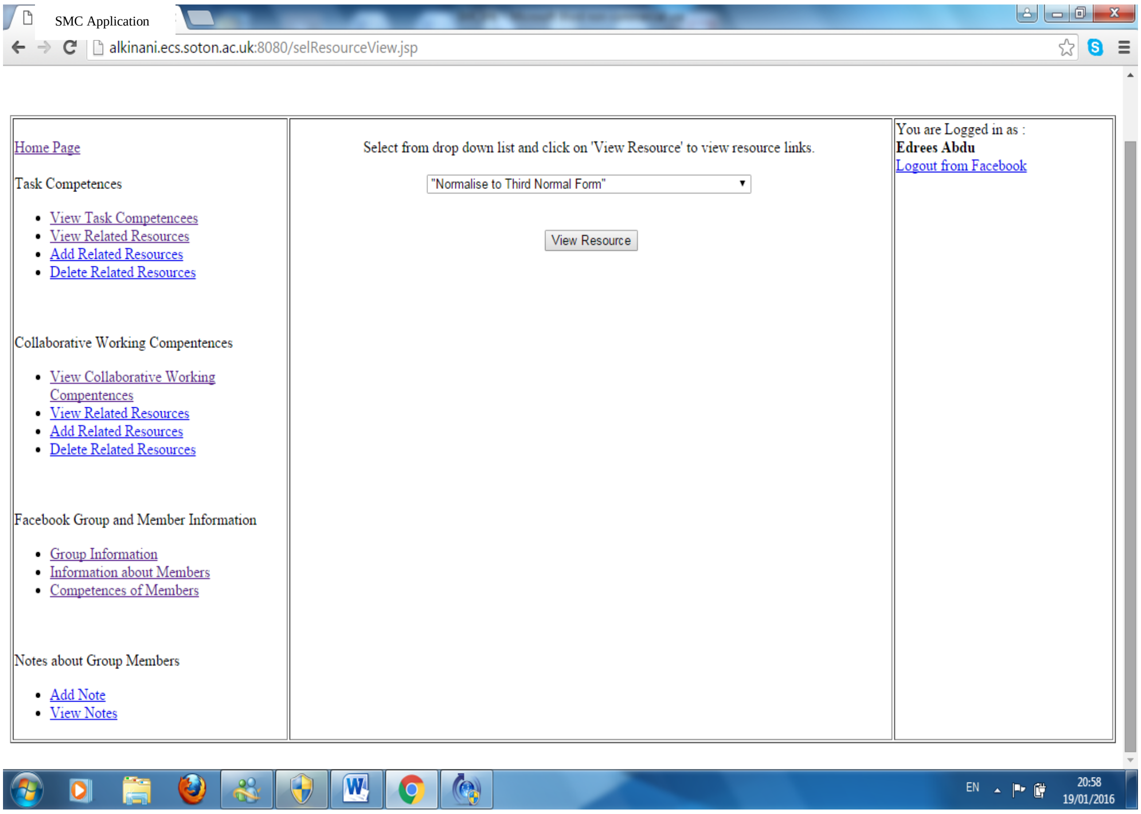


Figure 5-13: Screenshot of page for viewing resources related to a specific competence

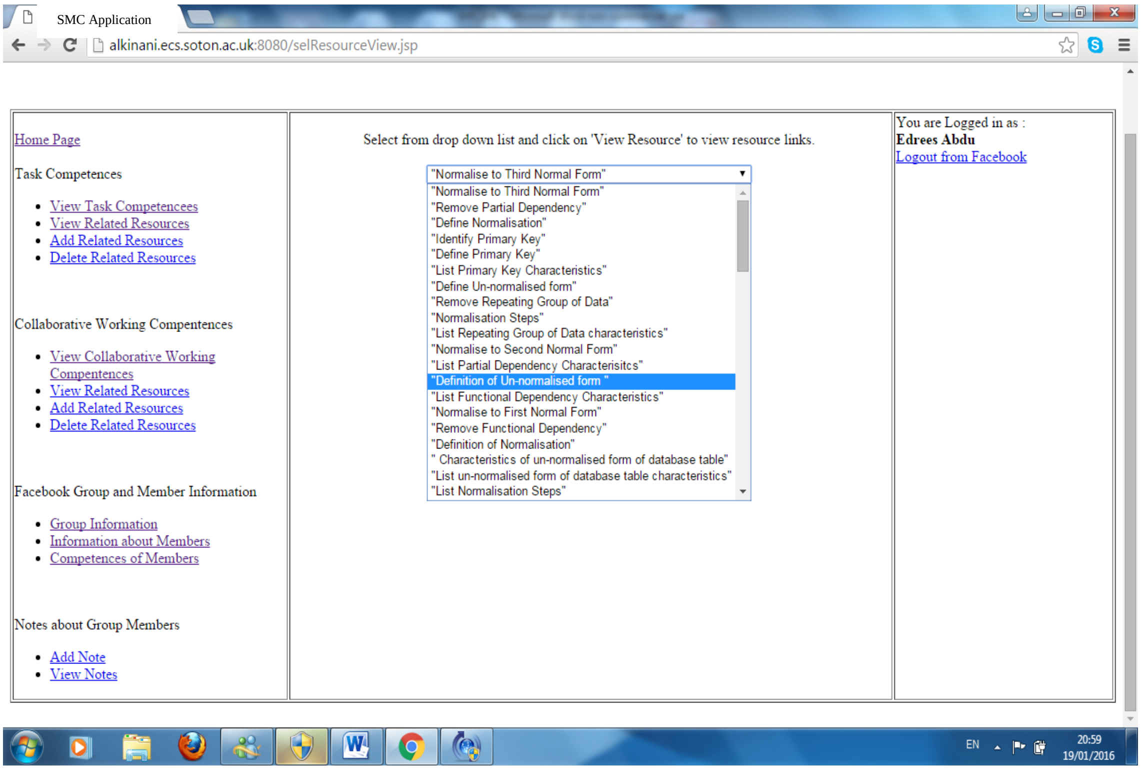


Figure 5-14: Screenshot of the drop-down list that contains all competences in the main ontology

Figure 5-15: Screenshot of obtaining additional resources for a selected competence, with mention of who added the resource, the date and time

Figure 5-16: Screenshot of page for adding a resource that will be ontologically tagged with the selected competence

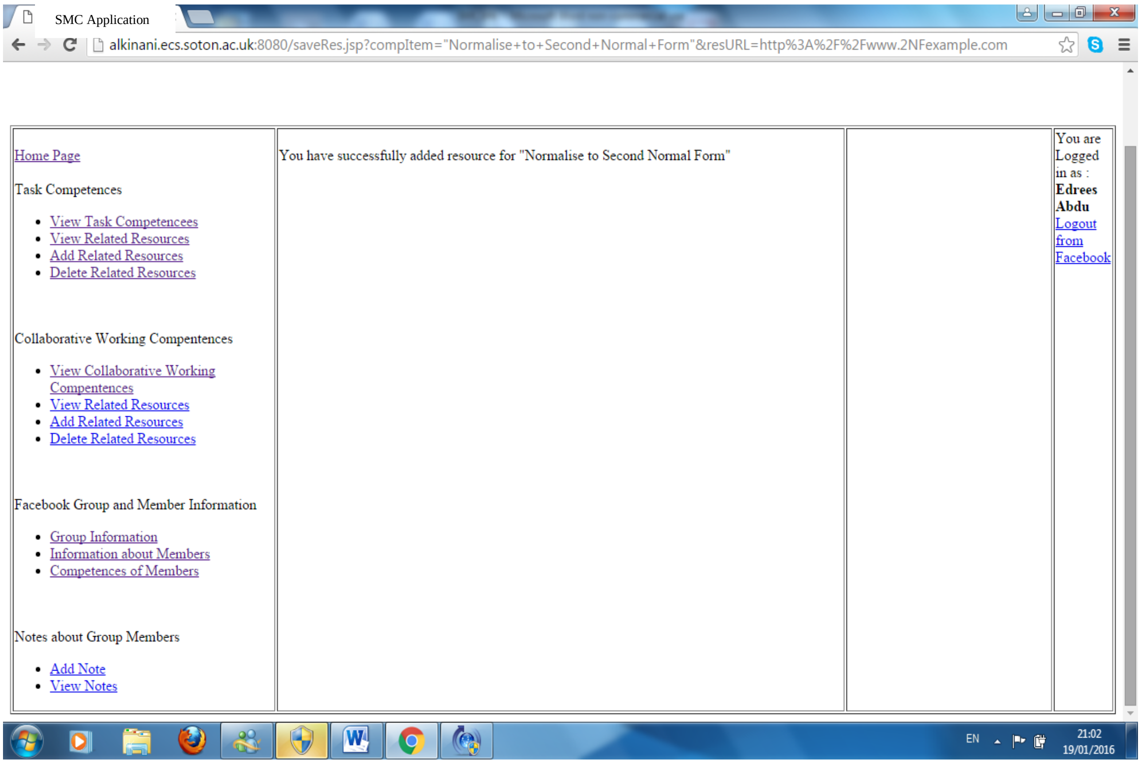


Figure 5-17: Screenshot of confirmation of adding a resource successfully to a specific competence from the drop-down list

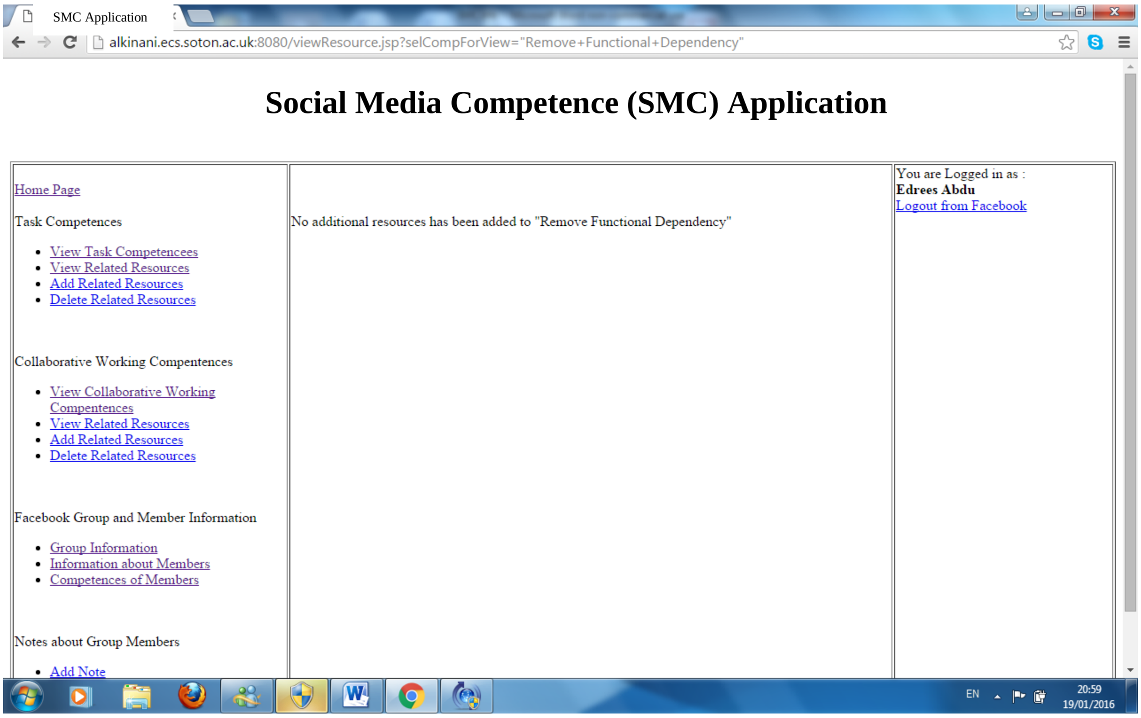


Figure 5-18: Screenshot confirming that no resources have been added to a selected competence on the drop-down list

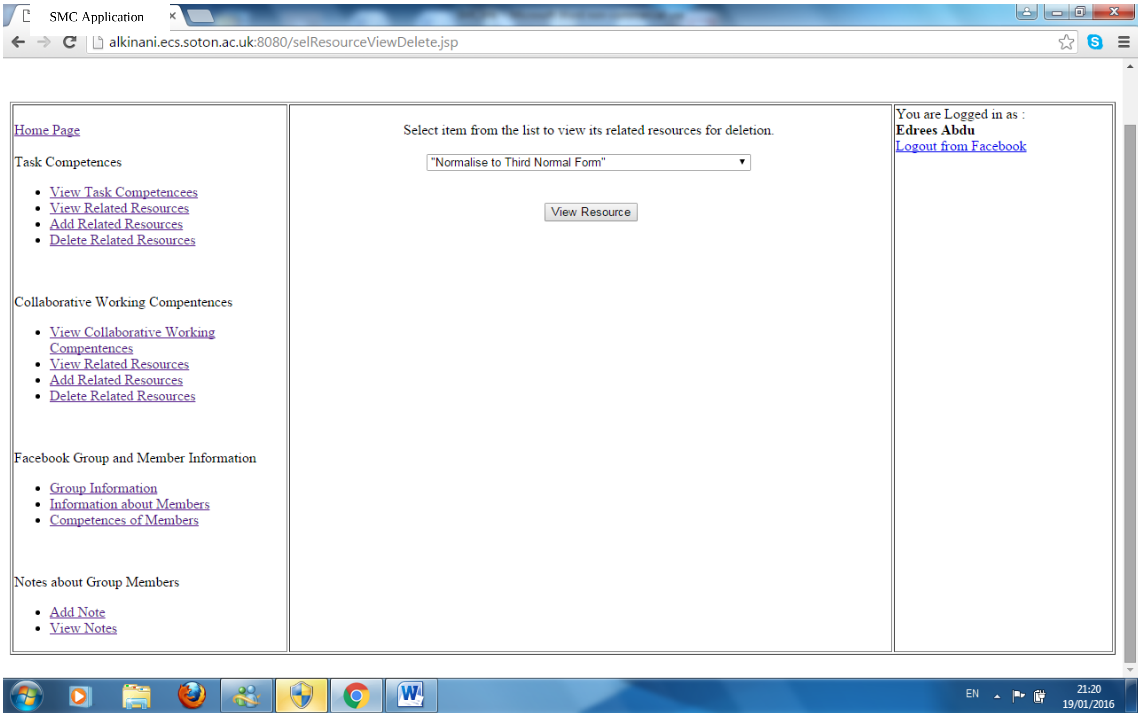


Figure 5-19: Screenshot of page for deleting resources for a selected competence from the drop-down list

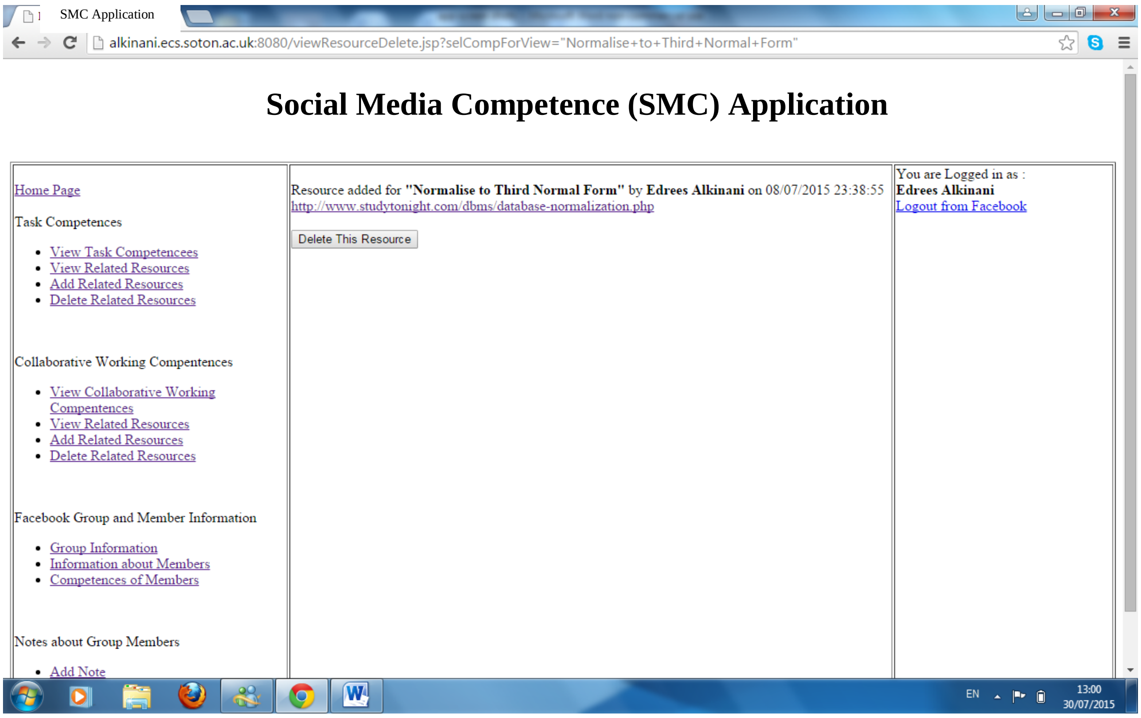


Figure 5-20: Screenshot of example of deleting one's own added resources for a selected competence. If there are a number of resources added by different users, the 'delete' button will not appear under links from others

5.2 Ontology of Collaborative Working Competences Implementation

This section describes the details of collaborative working ontology implementation. The methods of constructing collaborative working competences and design ontology have been described in Chapter 4, sections 4.5 and 4.5.1. Figure 4-11 in Chapter 4 shows the ontology design for collaborative working. The ontology will be designed on the basis of a number of collaborative competences and related roles. In addition, this section explains the method of extracting information from developed collaborative working competence ontology. It presents the methods of adding and viewing additional resources to a specific collaborative working competence with the ability to delete one's own added resources.

5.2.1 Ontology implementation of collaborative working and extracting data

The same methods of implementation as described in section 5.1.1 for implementing collaborative working competences were used for task competences ontology. All classes were implemented in an RDF file with related relationships. The ontology repositories for collaborative working competence were native stores. These are stores are built directly on the file. The file needs to be populated with the desired information in order for it to be extracted by students. So, the Jena Semantic Web Framework was implemented for Java. Jena provides API for extracting data from RDF file. In addition, Jena is used to write to an RDF ontology file. In this case, it will be used to add additional resources to develop the collaborative working competence ontology. The type of query language to extract data from ontology beside Jena is the query language, SPARQL.

In this research, the SPARQL query was used to extract data from the RDF ontology file of collaborative working. The data are of competence and related roles. The competences are displayed in a tree structure. A student needs to click on a collaborative working competence in order to display its related roles. By clicking on any open competence, the competence automatically closes the related roles.

Appendix H.2 shows a sample fragment of RDF code from the collaborative working competence ontology database. The language used, which is RDF, appears at the top of the figure. In addition, the figure shows the two collaborative working competences with their related roles. Appendix H.2 show the Jen API used and the programming codes for extracting data from the ontology. The full programming code can be found in Appendix B.1 and B.2.

5.2.2 Interfaces implementation of collaborative working competences

Figures 5-21 to 5-23 show the user interface of extracted data from the collaborative working ontology. All competences are designed to be extracted from the ontology in a tree structure. The tree structure is clickable (expand/collapse) in order to show all collaborative working competences and their related roles. The navigation between competences within the same page and the tree structure has the ability to be opened and closed in a single page and at the same time. In order to make the structure of the collaborative working competences more understandable, the font size and colour are different when navigating between competences and related roles, or activities that must be performed.

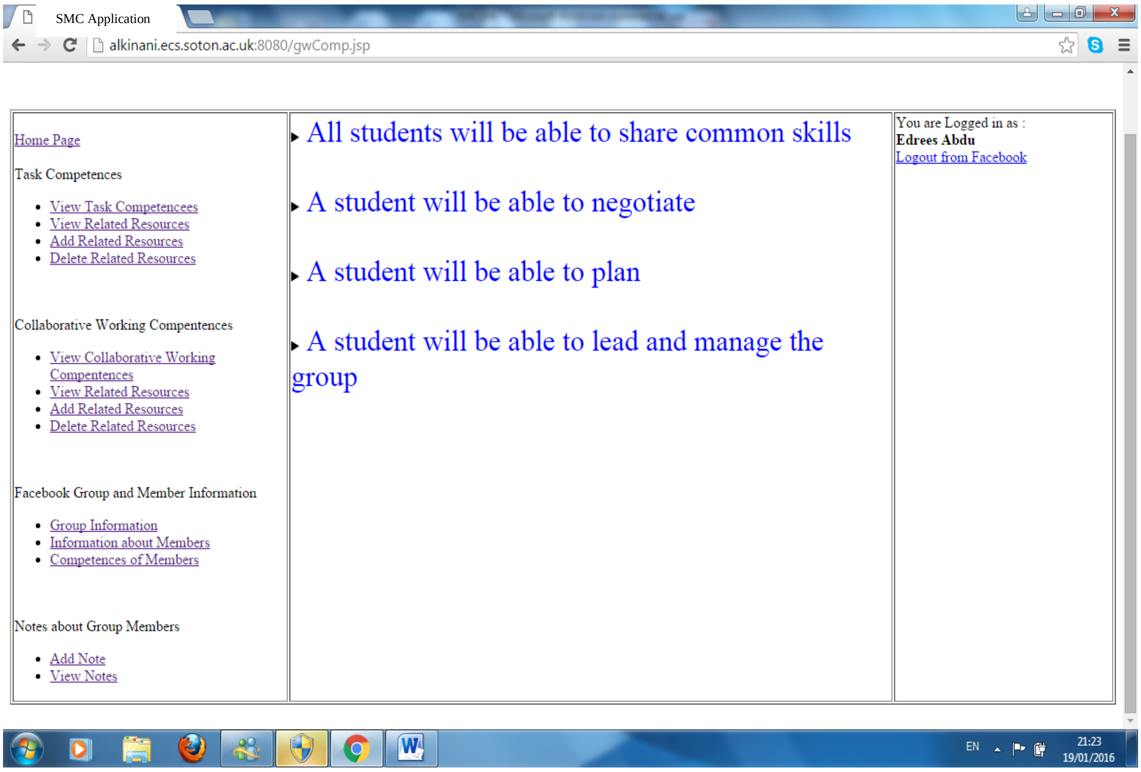


Figure 5-21: Screenshot of clickable tree structure showing all extracted collaborative working competences from the ontology

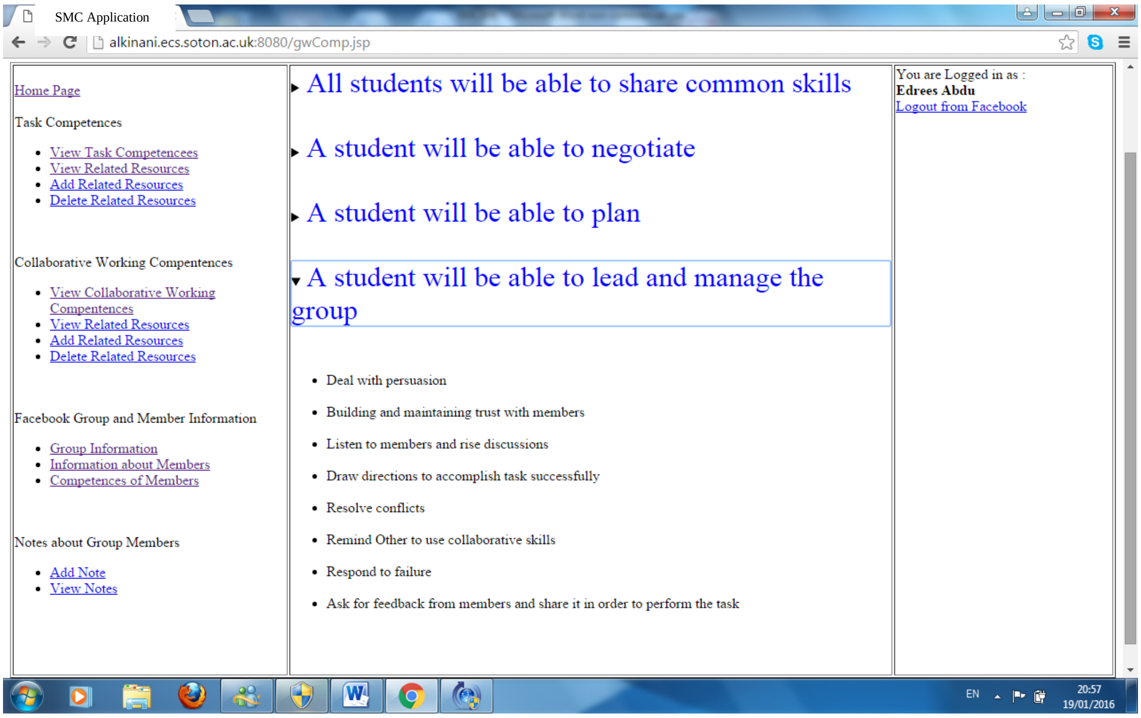


Figure 5-22: Screenshot of clickable tree structure showing extracted roles related to the leader of the group

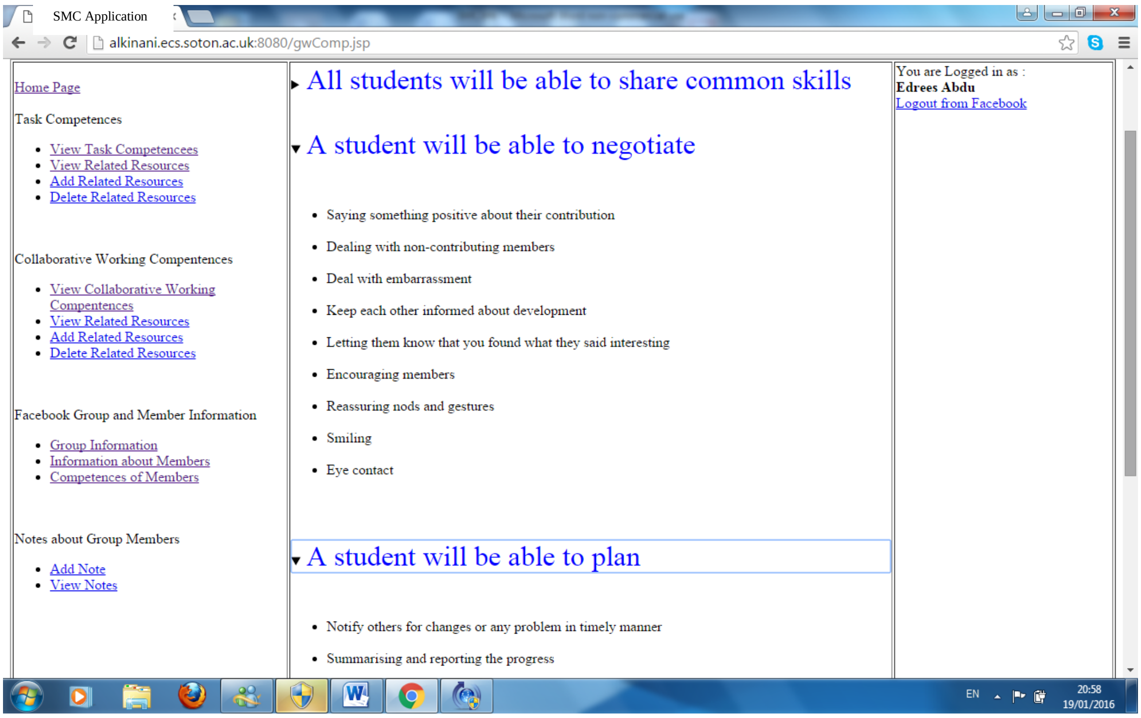


Figure 5-23: Screenshots of the clickable tree structure showing roles related to the negotiator and planner of the group

5.2.3 Interfaces implementation of viewing, adding, and deleting resources of collaborative working ontology

The same implementation methods and techniques for task competence resources will be the same for collaborative working competences. As the developed SMC application is considered to be a social application, students can contribute to the knowledge base by adding resources when working collaboratively. This can help them to understand further specific collaborative working competences and related roles. The teacher can also add resources for particular competences or roles. All competences in the ontology of collaborative working competences will be generated in a drop-down list. A student needs to select a particular competence to view any added resources, with mention of who added the resources and when. In addition, a student can add resources to a specific collaborative working competence as a URL and it will be tagged automatically with the selected competence in a new RDF file, with mention of who added the resource and when. The reason for having a new RDF file to store resources is to avoid too much data in main ontology file as recommendation for ontology design. However, any changes in competences in main ontology will appear in the drop-down list. Furthermore, the application allows student to delete only their own added resources. This can be verified by logging into application and use Facebook information profile. Figures 5-24 to 5-82 illustrating adding, viewing and deleting processes. The full Java programming codes for viewing, adding, and deleting resources can be found in Appendix B.3.

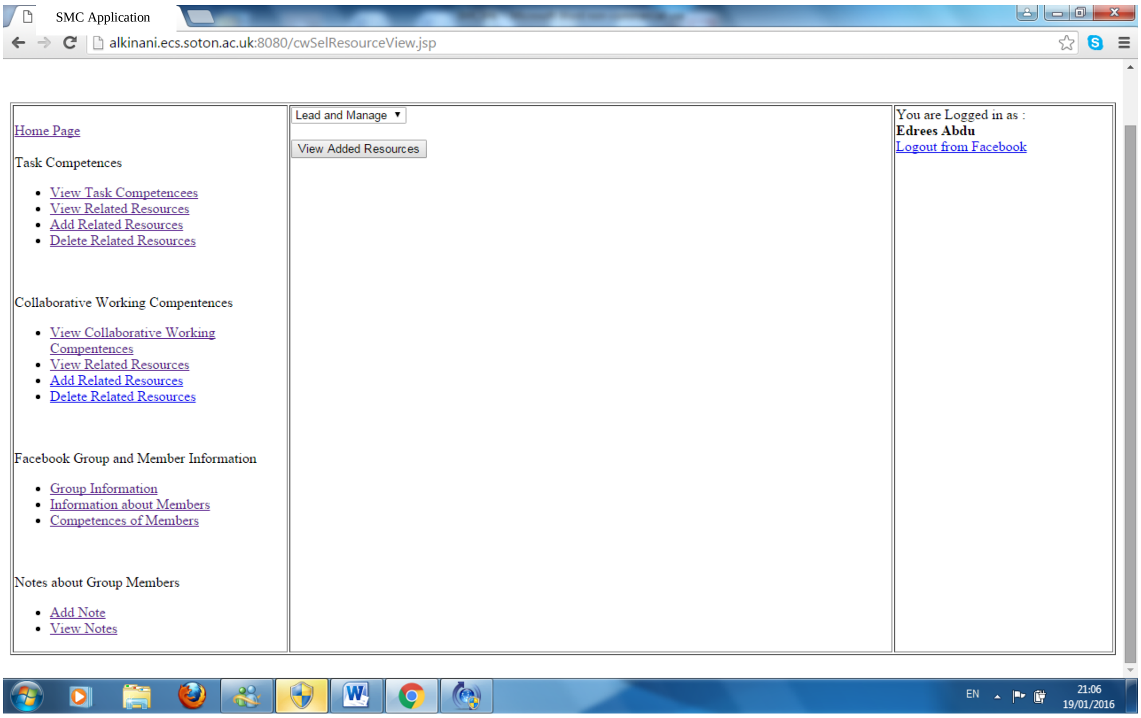


Figure 5-24: Screenshot of viewing resources added to specific collaborative working competences

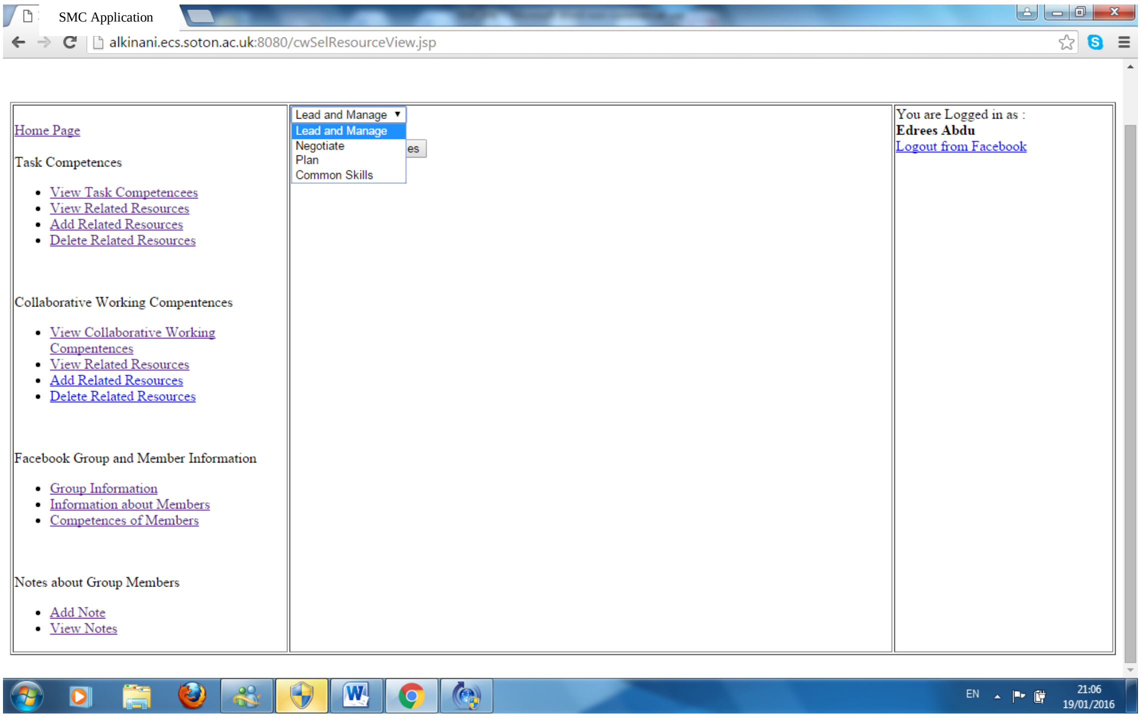


Figure 5-25: Screenshot of generated list of collaborative working competences in a drop-down list in order to view resources for a particular competence or to delete one's own added links

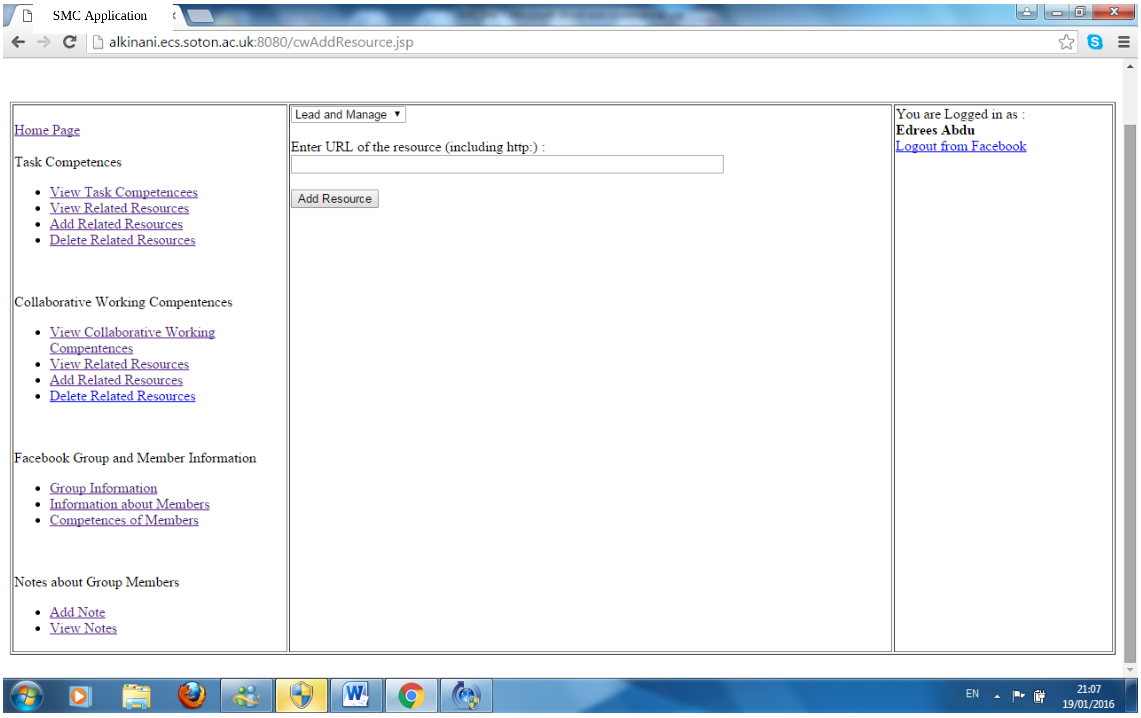


Figure 5-26: Screenshot of adding resources as URLs to a particular collaborative working competence, storing who added what and when

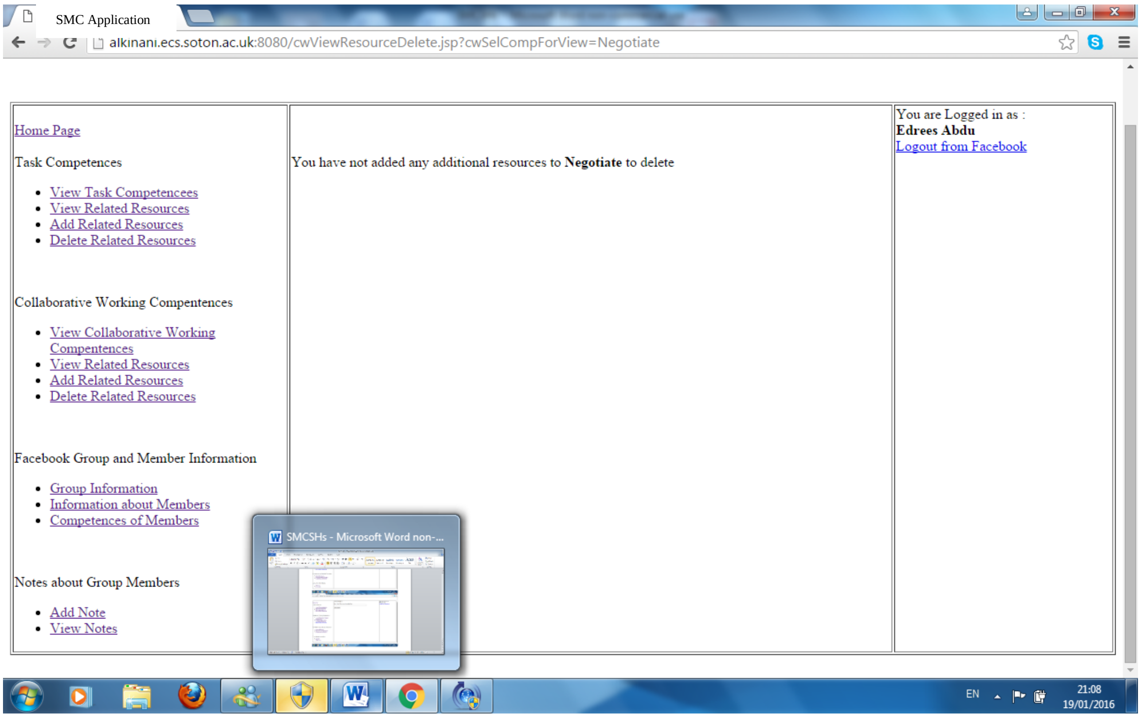


Figure 5-27: Screenshot of confirmation of not having any added resources to delete for a particular collaborative working competence

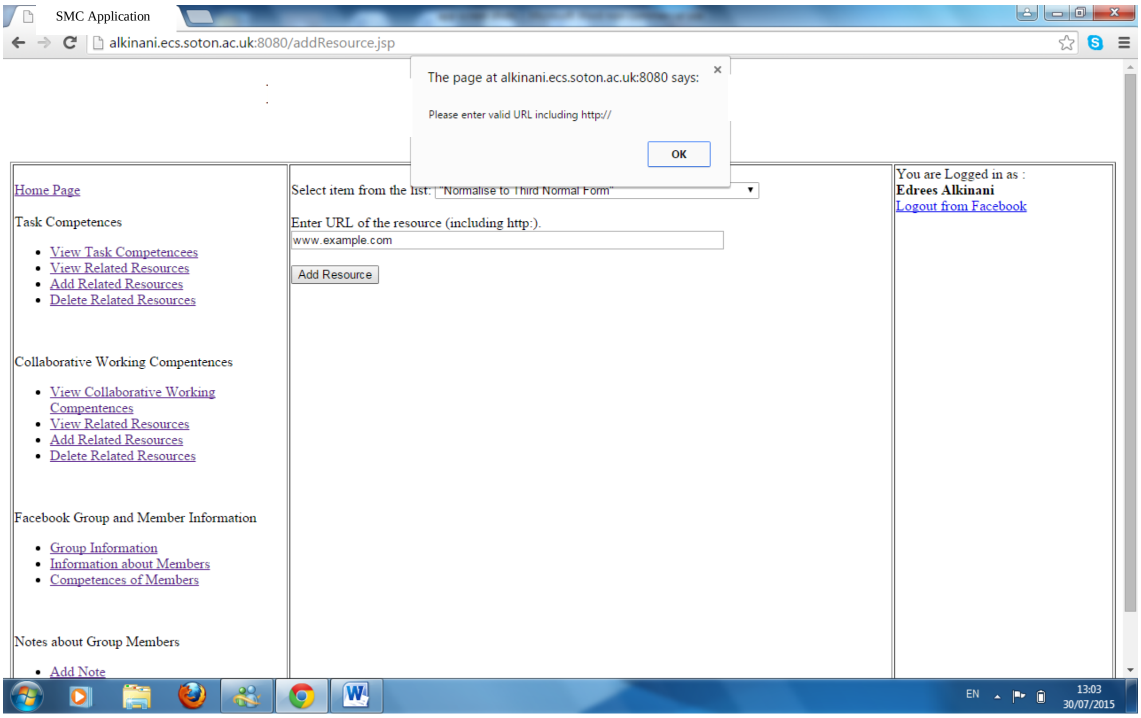


Figure 5-28: Screenshot of message informing user to include ‘http://’ in any URL in order for it to be stored in the ontology

5.3 Implementation of Extracting Students' Social Information from Facebook

The analysis of social media content, and in particular Facebook, has been discussed in Chapter 4 section 4.6. This section highlights the implementation methods of using Facebook API to generate specific content from a created Facebook group, and extracting members' personal profiles using the SMC application. The following sub-sections provide further details.

5.3.1 Creating a Facebook group

Facebook allows its users to create groups, as shown in Figure 5-29. The researcher has created a Facebook group in order to gather together potential members, all of whom are students undertaking a particular module. The name of the Facebook group will be the same as the name of the module, which is Database and Database Applications. Figure 5-30 shows the created Facebook group with the added members.

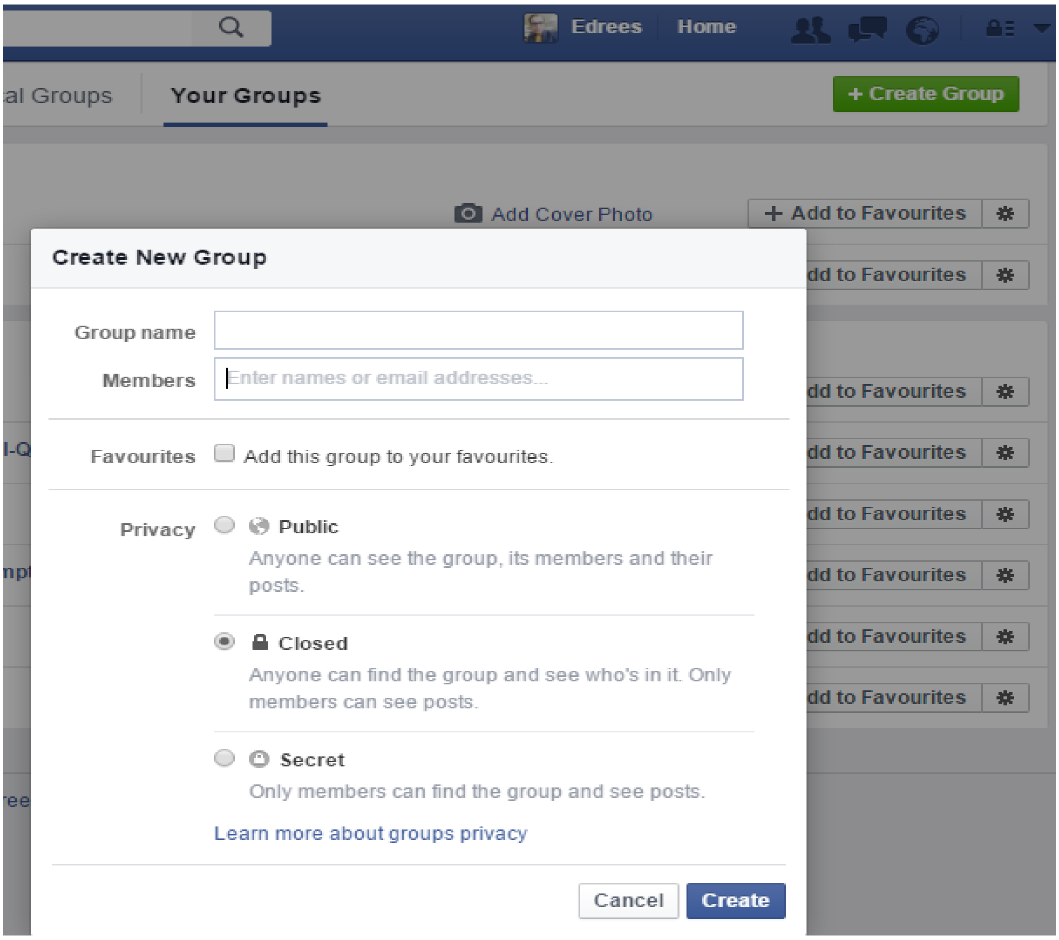


Figure 5-29: Screenshot of creating a Facebook group, after defining the name of the group and adjusting privacy settings and adding at least two members

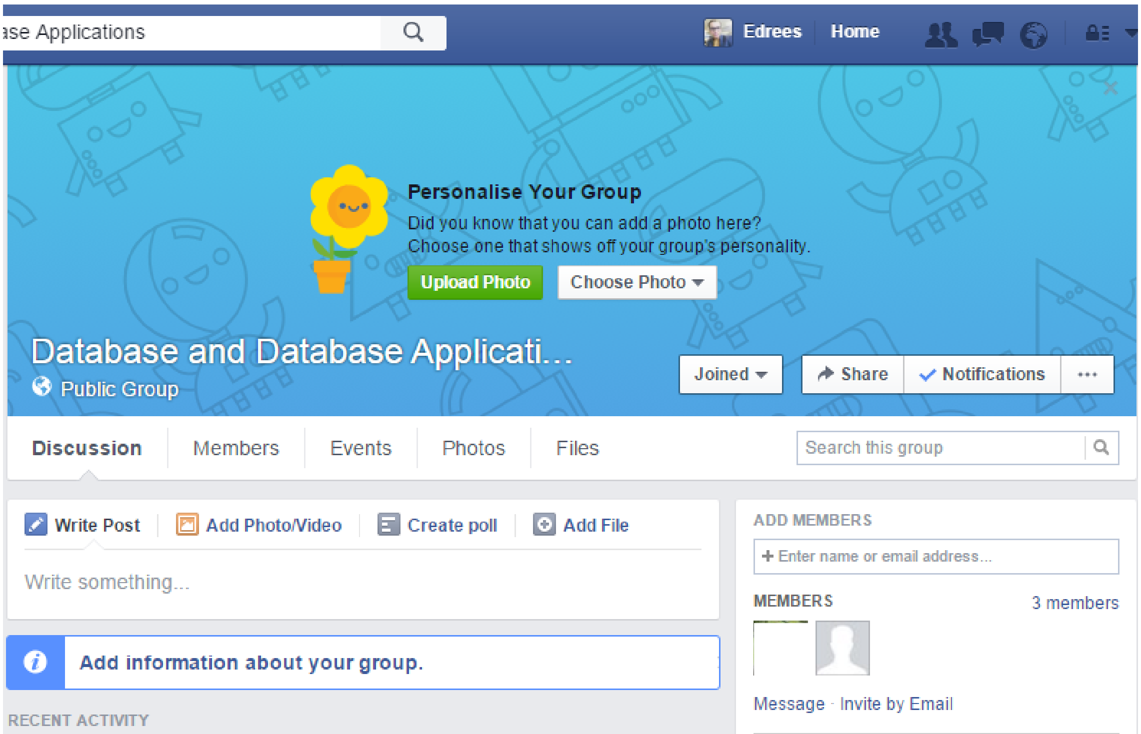


Figure 5-30: The created Facebook group under the name Database and Database Applications, with added members

5.3.2 Implementation of created Facebook group content by SMC application

Facebook APIs for groups must be used in programming the code to retrieve Facebook group content using the developed application,. Students can click on a link in the SMC application to display the name of the module and the total number of students undertaking the module. The full Java programming code, including APIs through the code, can be found in Appendix C.1. Figure 5-31 shows the name of the group, which is the same as the module name, and the total number of members of the group. This information was generated from Facebook Groups after clicking on 'Group Information' in the SMC application.

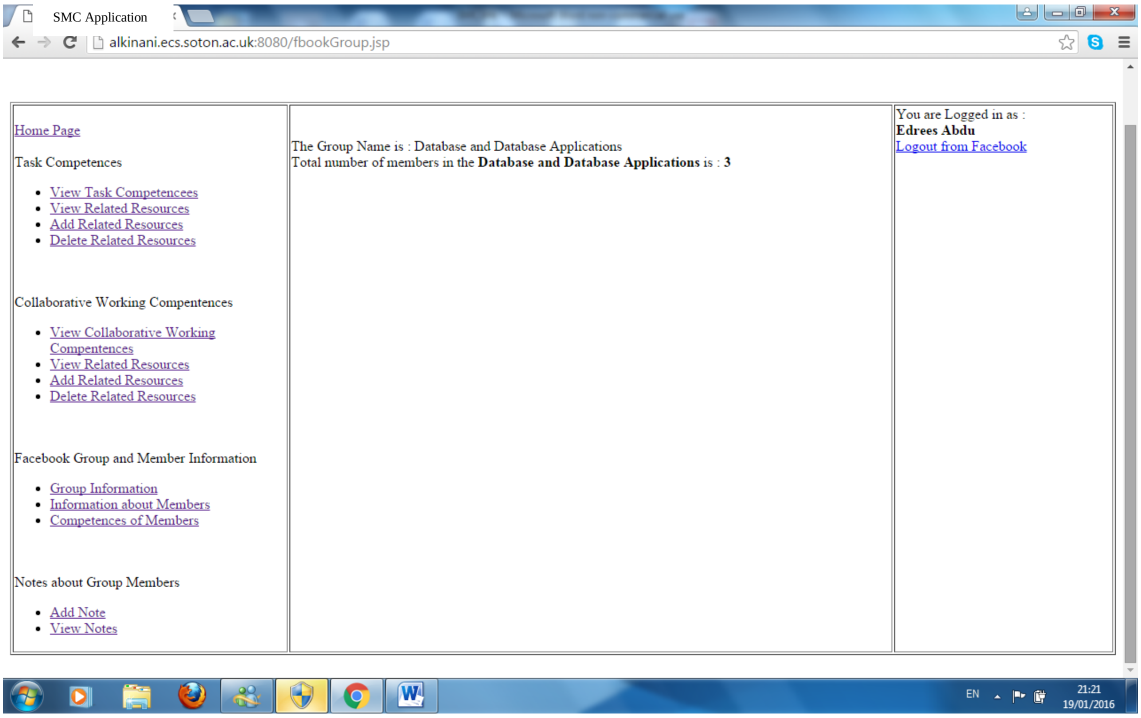


Figure 5-31: Screenshot of group information, retrieved from Facebook Groups by the SMC application

5.3.3 Implementation of extracting students' social information from Facebook profiles

Students may need to find out social information about potential group members, such as their biographical content and gender. The SMC application can only read the profiles of those members who have both joined the Facebook group for this module and given permission for their profile content to be made public. If the user has not populated the profile with the necessary information, the application generates 'null' for that field in the SMC application. Figure 5-32 shows the list of group members against their social information, such as biographical detail, email address and gender.

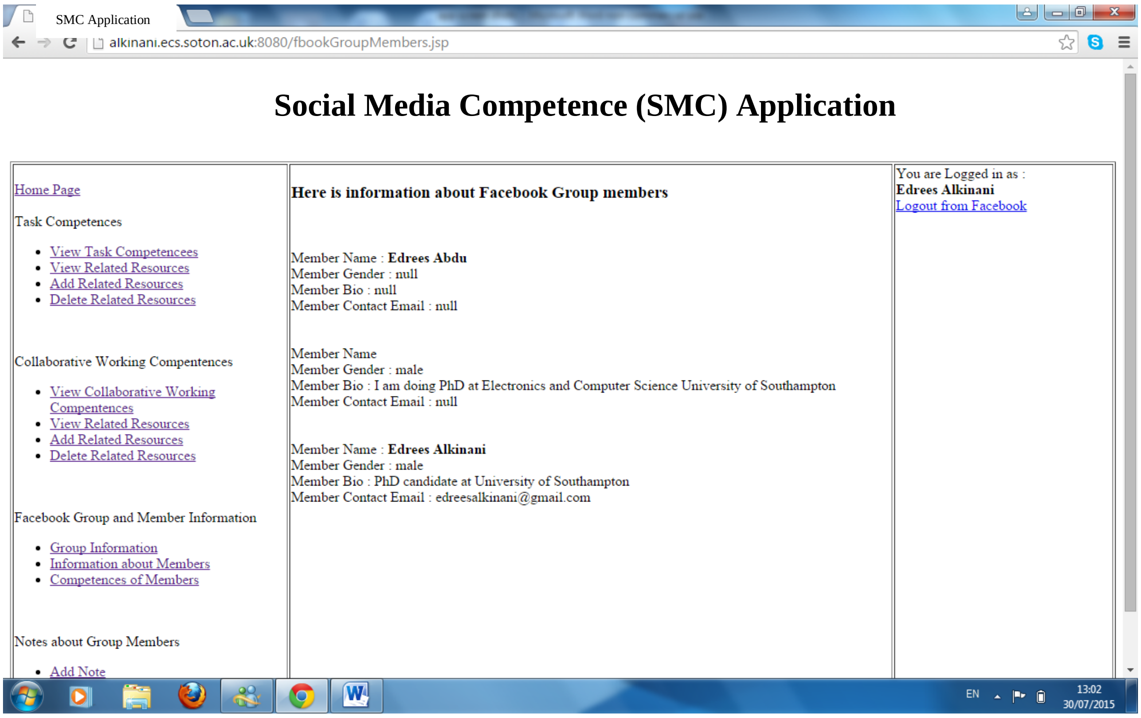


Figure 5-32: Screenshot of extracting social information on group members from their Facebook profiles

5.3.4 Implementation of Facebook group members' competences

There is a special field in each user's Facebook profile for professional skills to be populated with information. Unfortunately, Facebook does not provide an API for this service to be read by external applications or tools. The researcher has communicated with Facebook Company in order to request authorisation for any field in the profile, such as the biographical detail, to be able to accept skills and be generated by the developed SMC application, instead of the professional skills field. Facebook has refused the request and provides biographical detail for its desired content exclusively. The plan was to develop an independent ontology that simulates the real field of professional skills for each Facebook profile, as shown in Figure 5-33. Instead, the researcher will ask each student to fill in a field of professional skills on Facebook as normal, then will update the ontology in the SMC application after checking each student profile content.

The full RDF code and Java programming language to extract data from the ontology can be found in Appendix C.2. Figure 5-34 shows the page for all students' names against their skills or competences. An empty field means that the student has not updated their profile with their related professional skills.

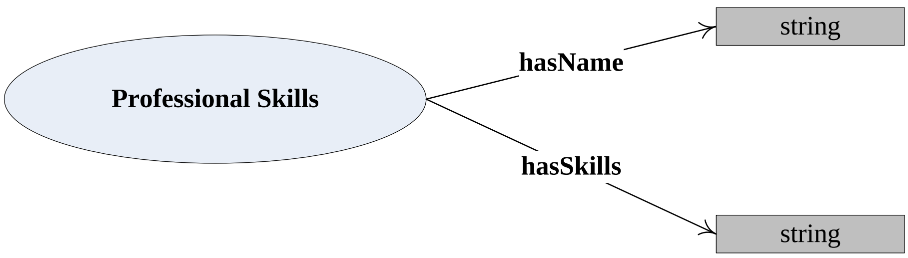


Figure 5-33: Ontological structure of professional skills to simulate the real field on a Facebook profile

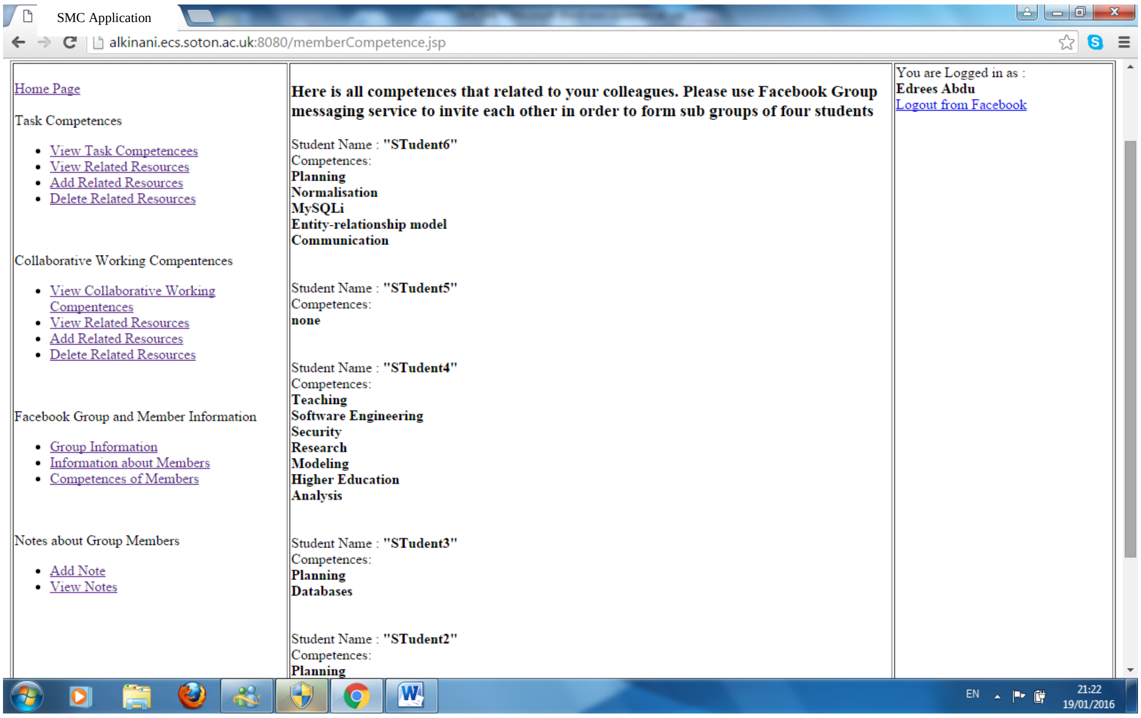


Figure 5-34: Screenshot of students' skills or competences written to each students' Facebook profile and updated in special ontology database to be readable

5.4 Implementation of Making Notes about Group Members

One a group is formed, students may need to define their own groups. In addition, they can annotate any assigned task with any member for further progress or comments. In order to implement this feature, a Facebook API is needed in order to generate all Facebook members in a drop-down-list. Then a text box is provided for writing any notes. Once the student has clicked to save the note about the member, the text and the name of the person with the date and time will be reordered in the RDF file. The students can make notes about themselves when forming their group. Figure 5-35shows a list of Facebook members in a drop-down list with box text. Figure 5-36 shows a list of students with their related notes on who created the notes, with the date with time. The complete code can be found in appendix C.3.

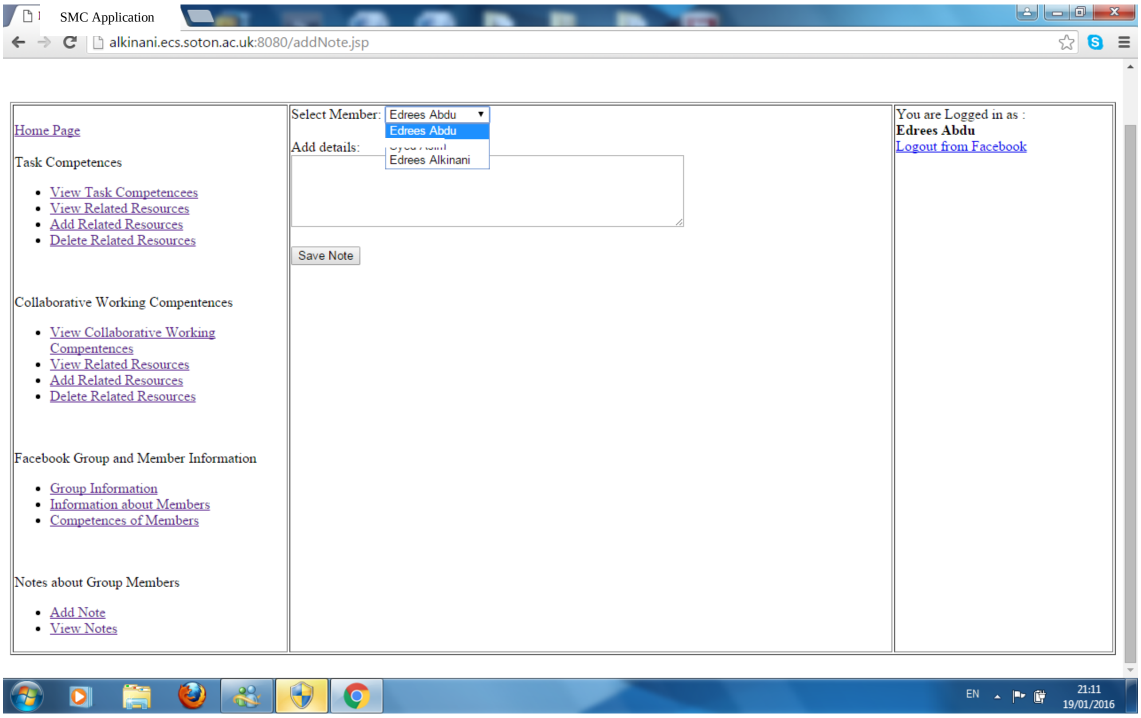


Figure 5-35: Screenshot of retrieving all Facebook Group members in drop-down list with box text

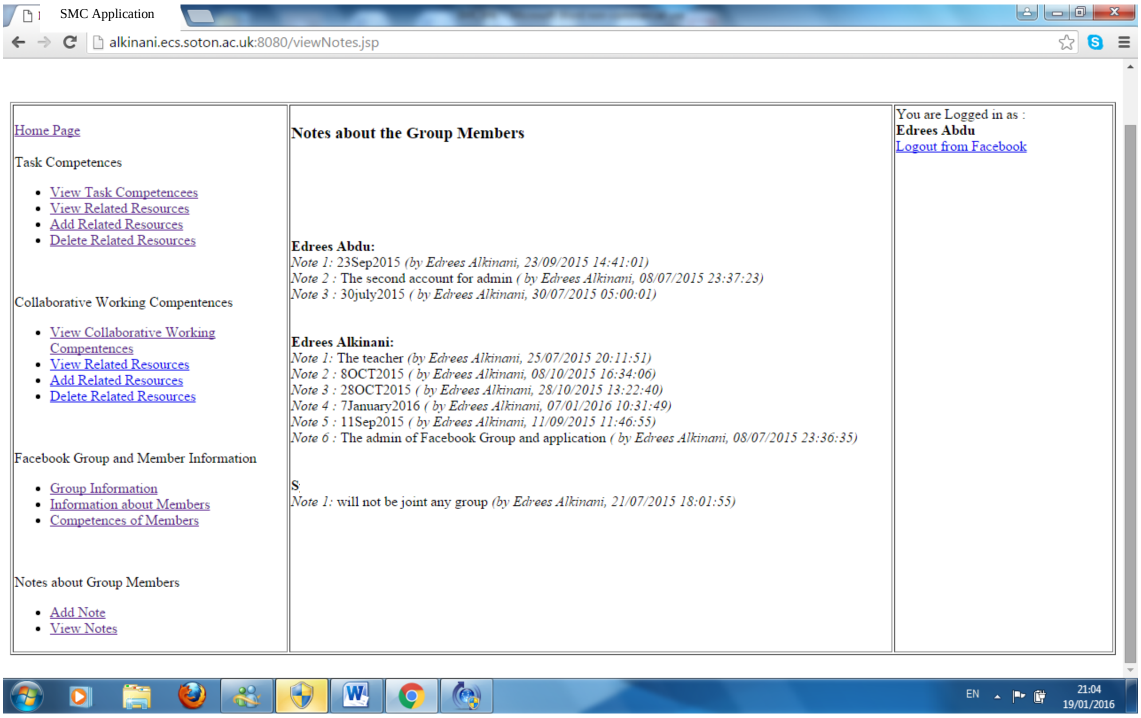


Figure 5-36: List of members and related notes, mentioning who created the notes and when

5.5 Implementation of Logging into SMC Application via Facebook Account

Every group member in Facebook Groups has an account with Facebook. In order to enable students to use SMC application and explore its content, the log in details of an actual Facebook account will be authorised via Facebook itself. Once the log in is successfully, students can proceed to the SMC application. Facebook provides a service for applications to be logged in via actual Facebook account details. There is a special API that can be used to integrate such applications through Facebook, using log in details for authorisation. Figure 5-37 shows the main log in page of the SMC application that asks users to log in by using their Facebook account. The student needs to click on the Facebook log in icon, then enter the username and password of their Facebook account, as shown in Figure 5-38. Once the log in is successfully authorised, the page will show the first and last name of the Facebook user and ask them to proceed to the SMC application by clicking on a button provided, as shown in Figure 5-39. Figure 5-40 shows the home page, which has details about the application usage and its content. The full Java programming code can be found in Appendix D.1.

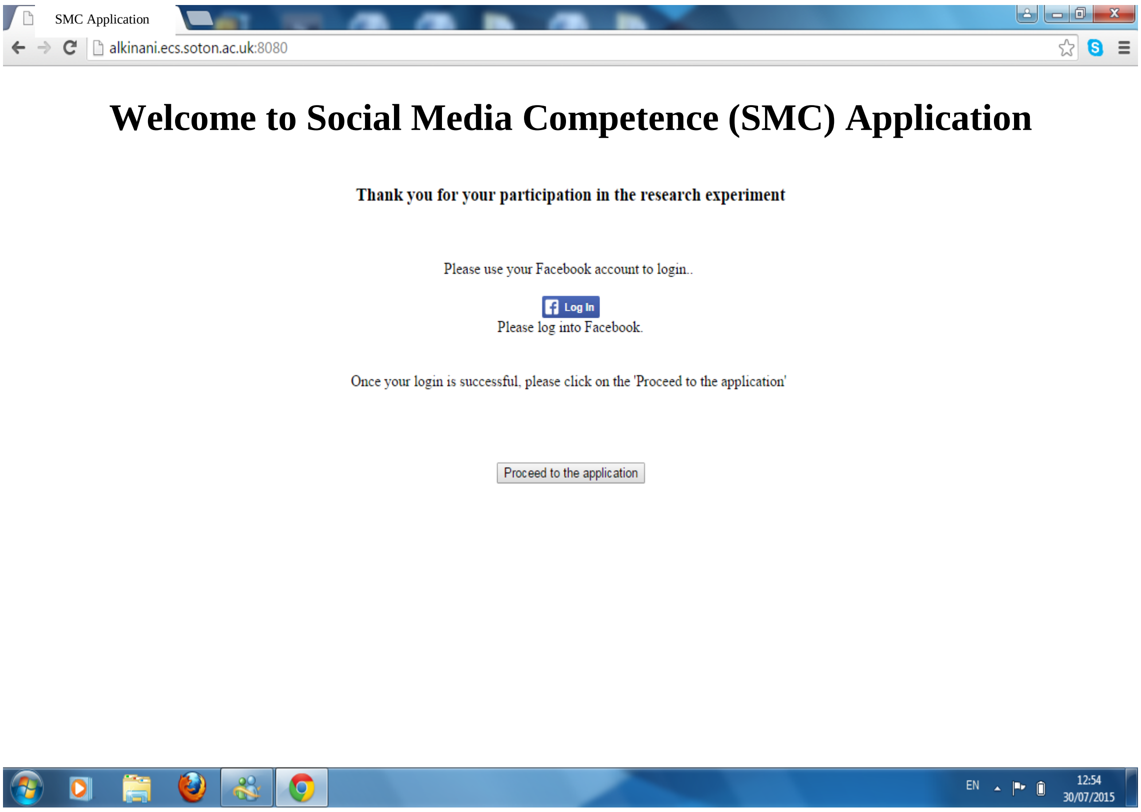


Figure 5-37: Screenshot of log in page of SMC application through Facebook account

Figure 5-38: Screenshot of logging via Facebook account after clicking on Facebook log in sign

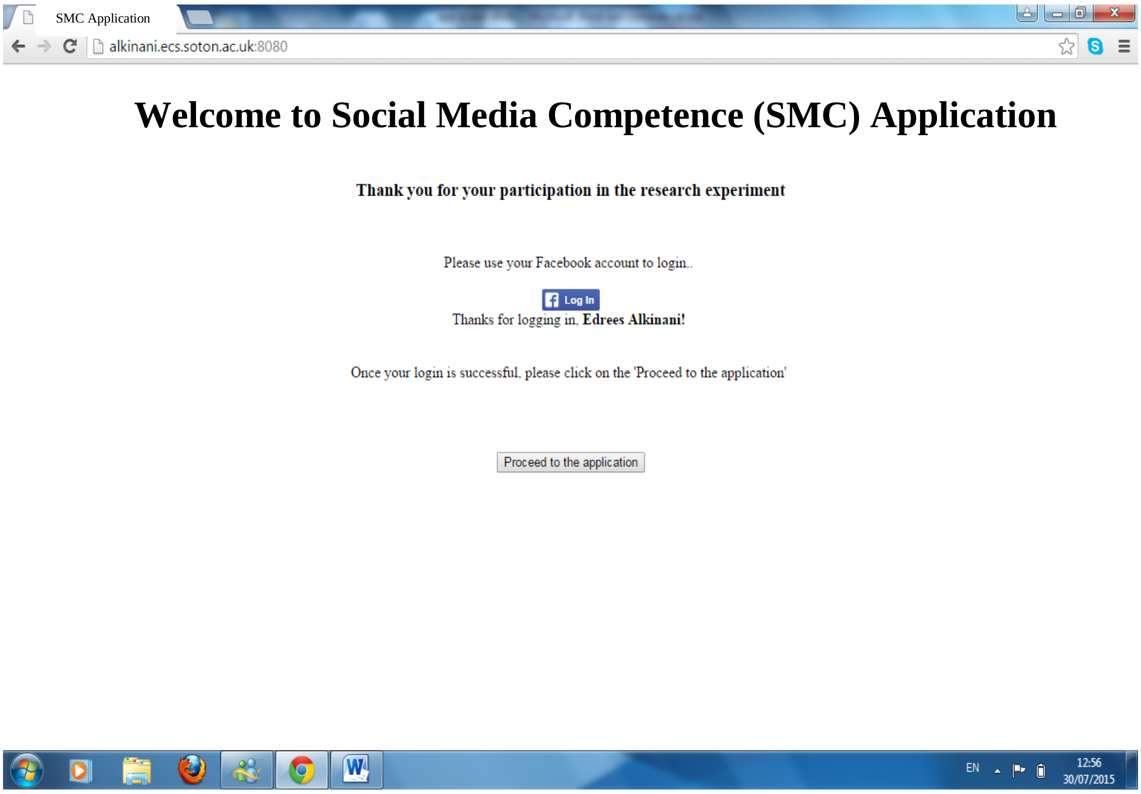


Figure 5-39: Screenshot of successfully logging in by entering first and last name of Facebook user

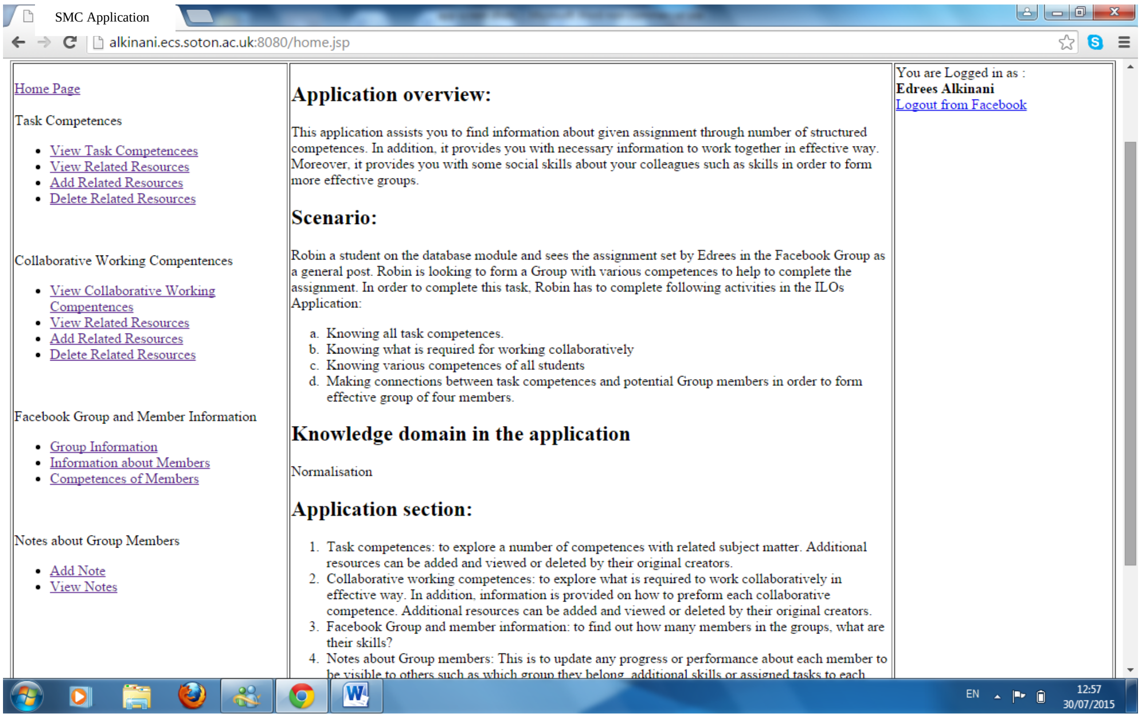


Figure 5-40: Screenshot of the homepage that appears after clicking the proceed button into the application

5.6 Registering the Application with Facebook

As described in Chapter 4 section 4.6.4, in designing the SMC application any application that uses Facebook content must be registered with Facebook. The registration of an application can be undertaken through the developer pages. Facebook will provide user identification for an application, to be used in the programming code in order to retrieve content from Facebook profiles or Facebook Groups. Figure 5-41 shows the information required to create an integrated Facebook application. Once the application has been successfully created, it will appear in the Facebook application section and is able to be used just as any application.

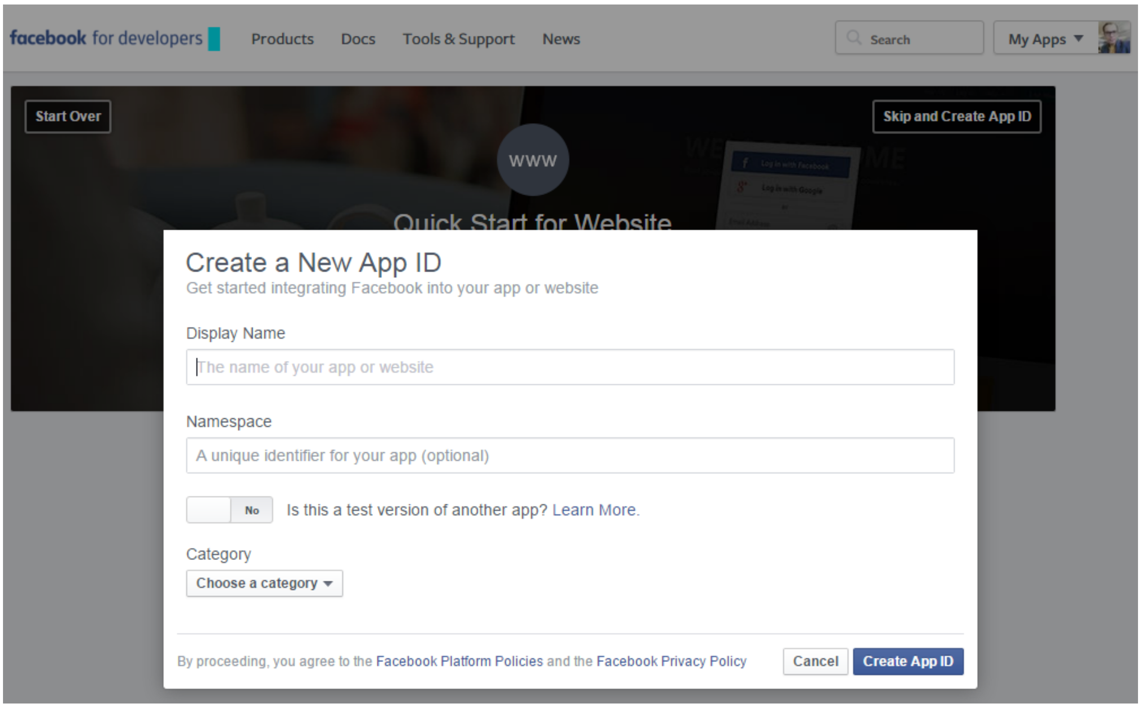


Figure 5-41: Screenshot of creating a Facebook application in order to register it and use it on Facebook through the application ID

5.7 Arranging a Server and Installing SMC Application

A virtual machine was requested from the University of Southampton in order to install the application and make it public to the world. A URL was provided for this research under http://alkinani.ecs.soton.ac.uk:8080/. The created virtual machine containing the SMC application requires special external settings. It needs a server to read the content of Java pages of programming code and ontologies. Tomcat was installed in order to deliver the content of this application successfully: 'Tomcat is an application server from the Apache Software Foundation that executes Java servlets and renders Web pages that include Java Server Page coding' (Rouse, 2005). Once the server had installed and copied all the pages to the virtual machine, the application worked successfully.

5.8 Testing the SMC application

The application was tested by postgraduate students in the Electronic and Software System (ESS) research group at the University of Southampton, plus an academic lecturer. The purpose of testing is to ensure that the application is working without crashing. In addition, partcipants were practising with the application by exploring and adding content in order to test the flow of the application. They found that the application worked smoothly without any issues. Another reason to test the application is to make sure that the ontology content that is shown in the application is clear to users. It was found some parts in the task ontology competences were not clear enough. As a result, the researcher modified the ontology, taking partcipants' comments into account.

The major change that was made after conducting the pilot study was modifying the ontology. The participants had found difficulties in understanding the content generated by the ontology. For example, when presenting fact content such as definitions, there was no connection between the name of definition and the statement of the whole definition. Neither was there was any connection with the concept content. The content generated by the ontology was just listed, without providing any explicit sentences to make it more understandable for users. Moreover, participants needed further examples of subject matter content to be provided.

The researcher modified the ontology to include properties that link the content together in simple and explicit sentences, such as 'is' to link the name of the definition and the statement of the whole definition. The procedure classes were modified in order to generate a list of steps and to tell the users the name or goal of the steps in explicit sentences with a connection property between the name and the goal or situation of the procedure. The researcher introduced an additional property, that of an example of provided content, in order to allow a greater understanding of the content generated by the ontology. Figure 5-42 shows the ontology that was used during the pilot study. Figure 4-9 shows the latest and improved ontology that was used in the experiments.

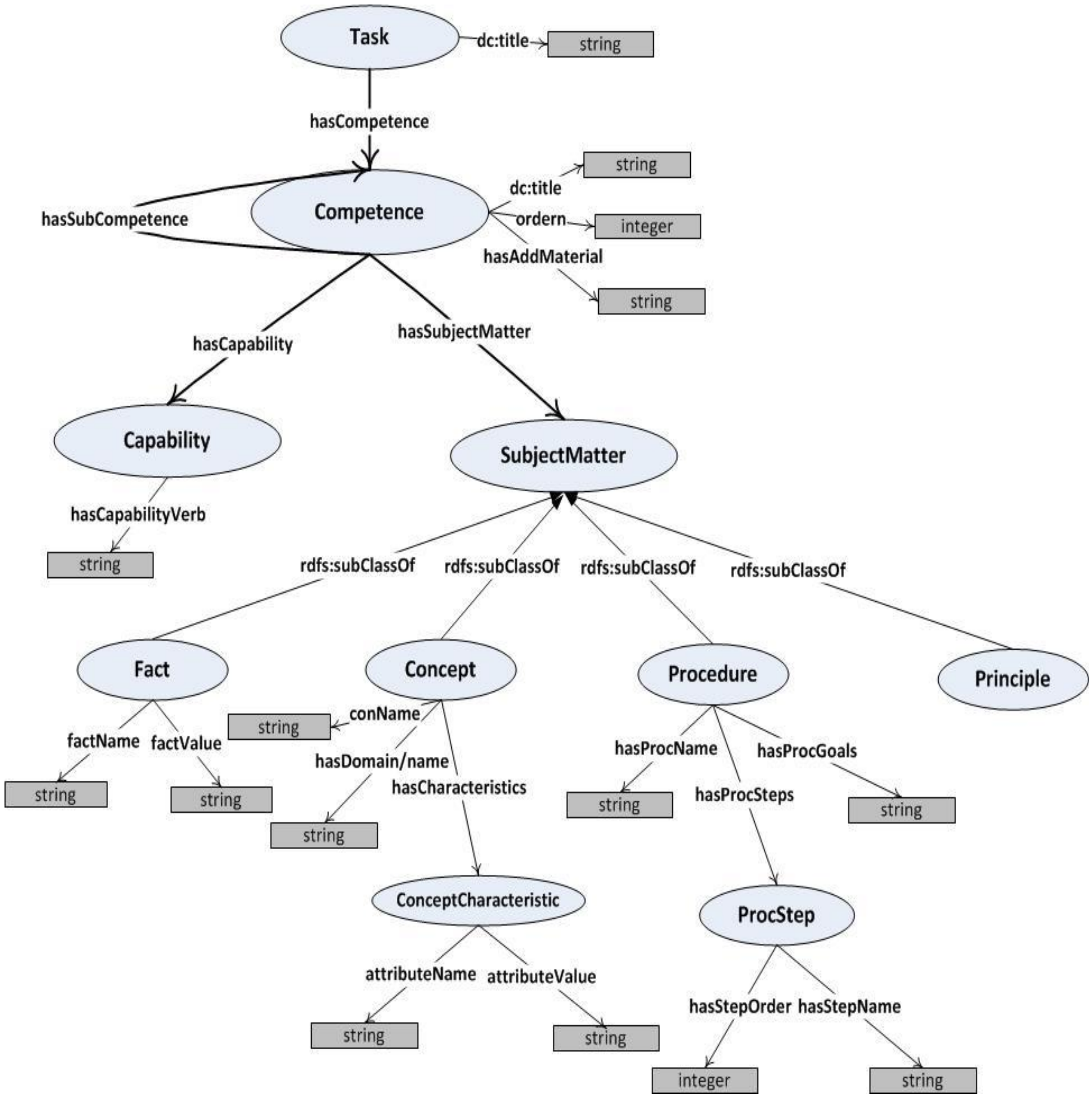


Figure 5-42: Ontological structure of learning task during pilot study

5.9 Summary

This chapter provides information on the application's implementation. This is followed by the design of the ontologies of: the task competences; the collaborative working competences; and retrieving social information about students from a particular social media component. In addition, it details how to produce a social media application based on ontology content and generated social information, with the ability to contribute to the knowledge bases by adding resources or making notes about group members in a systematic way. There are four main sections in the implementation process that are described for the developed social competence application: explore task competences with the ability to add and delete resources; explore collaborative working competences with the ability to add and delete resources, extract social information about students – such as their name, biographical detail, email address, skills, and gender; and the ability to make notes about group members. The programming language for implementing the ontologies is RDF, with Jena API to read the content by using the Java programming language. In addition, it uses Facebook APIs in the Java programming language to read the Facebook profile content of each student, with some content from Facebook Groups. Moreover, it installs the developed application and uses the server to read Java programming pages. The chapter displays all the user interfaces of SMC application. The application has been tested by postgraduate students and an academic lecturer. All necessary changes in design matter have been taken into account.

The next chapter is on the evaluation methodology.

Chapter 6: Evaluation Methodology

In the previous two chapters, the design and implementation of the Social Media Competence (SMC) application were introduced and discussed. In this chapter, the methodology will be described to answer the research questions. The first experiment will be described in order to determine whether the SMC application can contribute to better learning results. It has five main research questions. The second experiment will be described in order to investigate whether Ontologically Structured Competences (OSC) can lead to better teaching performance. Moreover, a further study survey will be described in this chapter regarding enhancing the teaching and learning environment through using a Facebook group for modules activities.

The first experiment, consisting of eight sections, was conducted in order to evaluate the effectiveness of the SMC application and its content. These sections are the pre-test, an assignment on normalisation, an assignment on group work, a questionnaire about rating normalisation competences according to different categories, a questionnaire about rating group work competences according to different categories, a questionnaire about rating actual group working, a questionnaire about rating social information and, finally, a post-test.

The second experiment and the study survey were conducted in order to explore teaching performance and enhancing the teaching and learning environment. The objective of the second experiment was to investigate the possibility of using Ontologically Structured Competences (OSC) as part of the SMC application to achieve better teaching performance. This focuses on the teaching side and involves instructors as participants. The study survey investigated the enhancement of the teaching and learning environment through using a Facebook group for modules. This study also involves instructors, specifically those who are familiar with Facebook and Facebook Groups, as participants. Both the experiment and the study survey required participants to answer two questionnaires on improving teaching performance by using OSC, and enhancing the teaching and learning environment by using Facebook Group for modules.

6.1 First Experiment Using the SMC application to Improve Learning Results

The main aim of this research is to evaluate a social application in terms of learning, through two different assignments that require group working. In addition, a number of questionnaires aim to evaluate the ontological content of the SMC application, based on various categories and the retrieval of professional skills information from Facebook, to enhance group formation for both assignments and collaborative working. This experiment, consisting of eight sections, highlights five main research questions. These will be combined and described in the following sections.

6.1.1 Ethical Approval and Estimated Number of Participants

The experiment received Ethics Committee approval under reference number ERGO/FPSE/1533. The number of participants required for this study was estimated by using G*Power tool (Faul, Erdfelder, Lang, & Buchner, 2007). G*Power is a software analysis program for computing sample sizes by defining a statistical test and calculating the effect size, alpha level of significance and statistical power value. The effect size indicates the size of difference between two groups. Thus, the larger the effect size, the easier it is to see that there is a difference between the two means being compared. Typical exploratory research study sets the effect size between 1 and 2. For this experiment, the effect size was 1, with 5% of level of significance (critical P-Value) and 0.90 statistical power. As a result, the total required sample size for this experiment was at least (N = 46).

6.1.2 Pilot study

A pilot study was conducted before recruiting participants to perform the actual experiment. The volunteers were postgraduate students in Electronic and Software System (ESS) research group at the University of Southampton and an academic lecturer. All necessary changes were made to both the application design and the manner of asking questions in the assignments and the questionnaires.

6.1.3 Types of participants

This research was looking for undergraduate students of computer science, in general. The participants had to be unfamiliar with the chosen knowledge domain. The reason behind choosing undergraduate students was that most assignments that require group work are seen at this stage of study. So, the type of participants was undergraduates from the School of Computing. The participants had not to be familiar with normalisation.

6.1.4 Research questions related to improve learning results

This section of experiment answered the following main research question and sub research question:

1. Do ontologically structured competences enable students to achieve better learning results using the social media SMC application collaboratively?
    - Is there a relationship between the levels of Bloom's taxonomy and students' learning results?

6.1.4.1 Step 1: Pre-test and dividing participants into two conditions

There were 58 students who agreed to take part in the experiment and were not familiar with normalisation. The participants gathered in one place to take the individual pre-test in order to ensure that they were not familiar with the chosen topic. The duration of the pre-test was just five minutes. The researcher went to each participant to check the answers and, at the end of the session, the researcher excluded eight participants who scored four and above of the seven available marks. The researcher split the remaining participants randomly into two equal groups of 25 participants each (conditions), one to be application users and the other to be paper-based (not application users). The pre-test questions can be found in Appendix E.1.

6.1.4.2 Step 2: Answering assignments

Students under both conditions were required to answer given assignments collaboratively. There were two assignments. The first relates to the chosen knowledge domain of normalisation. It consists of five different questions. Each corresponds to a level on Bloom's taxonomy. The same procedure was followed for the second assignment, with the difference being the knowledge domain, which in this case is collaborative working. There are five questions that correspond to a specific level on Bloom's taxonomy. Both assignments had to be completed collaboratively. Thus, each group was to submit two different assignments under the assigned conditions, namely as application users or as non-application users.

The aim was to investigate the students' learning results when using competences as a facilitator of completing and answering assignments on a specific task and on collaborative working as a group. The aim of this study was to compare the two visualisation styles of competences; namely, a traditional list of competences, expressed as plain text documentation, and ontologically structured competences using the SMC application. The students' learning results, as groups, were measured by marking their assignments.

6.1.4.3 Marking assignments

In order to measure the learning results under both conditions, both assignments were marked blind by an independent marker, and were allocated a total of 20 marks each. On each script, the group name and condition under which the assignment was completed were hidden. The marker was given marking schema supported by model answers (Appendix E.2). The background of the marker was in computer science and he was familiar with databases in general, specifically normalisation.

The normalisation assignment consisted of five questions. The first, corresponding to the knowledge level on Bloom's taxonomy, was allocated one mark. The second, equal to comprehension, was allocated three marks. The application level of Bloom's taxonomy's corresponding question was allocated five marks. The fourth question, corresponding to the analysis level, had six marks. The last, equal to the evaluation level, had five.

The group work assignment also consisted of five questions. The first, corresponding to the knowledge level on Bloom's taxonomy, was allocated three marks. The second question, equal to the comprehension level on Bloom's taxonomy, had two marks. The application level of Bloom's taxonomy's corresponding question had three. The fourth and fifth questions, corresponding to the analysis and evaluation levels of Bloom's taxonomy respectively, had six marks each.

The allocation of marks for the group work did not follow the same pattern as the normalisation assignments. Differences were due to the level of difficulty of each question; some consisted of two or three parts and required additional examples or further explanation. For example, the first question in the group work required students to state three important skills, where in the normalisation assignment students only had to state a very short definition. Conversely, for Question 2, the normalisation task required an explanation of the requirements besides stating the steps, whereas the group work only required an explanation. In addition, a major difference in marks between the two assignments was in Question 3. In order to normalise the given table, students had to go through three important steps and break the table into four different tables, each of which had a unique identified primary key as a second additional requirement, whereas in the group work Question 3 required only one action to solve the given issues. Moreover, the last question in the group work consisted of three parts, compared to two parts in the normalisation assignment. Tables 6-1 and 6-2 show both the normalisation and the group work assignments' questions, alongside the corresponding level on Bloom's taxonomy and the assigned marks.

Table 6-1: Assignments questions (experiment criteria) for Normalisation with corresponding Bloom's taxonomy level to each question and assigned mark

Normalisation Questions (NMQ)	Variables/Bloom's Taxonomy level	Mark
Give the definition of normalisation	NMQ1 (Knowledge)	1
Summarise the steps of normalisation by explaining requirements of each	NMQ2 (Comprehension)	3
Normalise the un-normalised database table below to Third Normal Form	NMQ3 (Application)	5
Compare partial dependency and functional dependency, giving examples	NMQ4 (Analysis)	6
Critically evaluate whether the following two tables fit Third Normal Form, and identify any elements that do not meet the requirements	NMQ5 (Evaluation)	5

Table 6-2: Assignments questions (experiment criteria) for Group Work with corresponding Bloom's taxonomy level to each question and assigned mark

Group working Questions (GWQ)	Variables/Bloom's Taxonomy level	Mark
Name three important skills essential in all group work	GWQ1 (Knowledge)	3
Explain how to act responsibly when working as part of a group	GWQ2 (Comprehension)	2
Imagine that you have the role of negotiator in a group in which some members of the group are not taking their work seriously, and that this is presenting difficulties. Identify two or three steps that you would take to address this issue.	GWQ3 (Application)	3
Compare the role of leader and planner in undertaking effective group work	GWQ4 (Analysis)	6
Imagine there are a few members in your group who do not complete their tasks by the deadline. Some ideas have been suggested by the group to address the issue: • Ignore them by being less friendly and reducing communication • Discuss and establish timeline on which ALL members agree • Level a criticism at these members and withhold group finding until they have something to contribute. • At each meeting ask each member to present a progress report on what they have completed since the previous session. Critically evaluate these ideas and explain what could be done to improve the performance of members who do not meet deadlines. In addition, identify a better way to address the issue.	GWQ5 (Evaluation)	6

6.1.5 Step 3: Rating questionnaires

Once groups submitted their assignments, four questionnaires were handed out for the purposes of establishing an evaluation and a level of satisfaction with each condition. The conditions are application users and non-application users. The ratings questionnaires were completed individually by each participant, making mention of which group they belong to. The following sections show remaining research questions for first experiment.

6.1.6 Research question related to evaluation of Normalisation competences

This section of experiment answered the following research question:

2- Do ontologically structured competences of subject matter through SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding, and attitude toward representing competences?

6.1.6.1 Evaluation of Normalisation competences

The aim of this questionnaire was to evaluate the given competences under both conditions and the related subject matter content. There were five groups that used the application, and another five groups that used paper-based documentation. Each group consisted of five students. All groups were asked to evaluate the task competences of normalisation in four different categories based on Likert scales (Trochim, 2006). These categories are navigation, consistency, understanding, and attitude toward representing competences. Each consisted of a number of variables. The average has been taken in order to calculate the ratings of those categories for each group.

6.1.6.2 Measurement

The groups of students' satisfaction were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') under four categories of criteria: navigation, consistency, understanding, and attitude toward representing competences and related resources. There were 25 questions, which were mapped to these four categories and they are listed in Table 6-3. The rating was done individually by each group member, then the average of four metrics of subjective criteria was taken for each group in order to compare the SMC application with the plain-text documentation.

Table 6-3: Normalisation competences statements

Navigation	Variable
Using competences allowed you to plan your learning activities	NM1
Using competences structure allowed you to know which sub and sub-sub competences to access	NM2
Using competences allowed you to explore the content of normalisation quickly	NM3
Using competences provided you with a logical sequence to perform the assignment	NM4
Using competences structure allowed you to return easily to the previous point in the competences structure	NM5
Using competences allowed you to know where is your current situation in the assignment	NM6
Consistency	Variable
Using competences provided you with steps on how to accomplish the assignment	CM1
Using competences allowed you to know what is required to achieve each competence	CM2
Using competences structure enabled you to distinguish between the main competence, sub-competences and sub sub-competences	CM3
Using competences allowed you to know what specific subject matter is related to a competence	CM4
Using competences enabled you to find specific resources for a competence	CM5
Understanding	Variable
It is clear how to use competences	UM1
Competences need further explanation from a teacher	UM2
The structure of the subject matter of normalisation is clear	UM3
The subject matter needs further explanation from the teacher	UM4
The structure of competences is difficult to follow	UM5
Attitude toward representing competences and related resources	Variable
Representing competences is a good idea	AM1
identifying competences makes an assignment interesting	AM2
A student will be able to add resources to specific competence in a structured way	AM3
It is easy to find additional resources for a competence	AM4
Resources are structured according to a competence	AM5
A student will be able to find out who added resources and when, after a while	AM6
It is useful to know who added resources and when	AM7
Resources added by students are helpful	AM8
Students will be able to track the performance of their colleagues	AM9

6.1.7 Research question related to evaluation of Group Work competences

This section of experiment answered the following research question:

3- Do ontologically structured competences of collaborative working through the SMC application meet with satisfaction of groups of students in terms of navigation, consistency, understanding, and attitude toward representing competences of group working?

6.1.7.1 Evaluation of Group Work competences

The aim of this questionnaire was to evaluate the given group work competences under both conditions and related roles. There were five groups who used the application, and another five groups who used the paper-based documentation. Each group consisted of five students. All groups were asked to evaluate the competences of collaborative working in four different categories, using Likert scales (Trochim, 2006). These categories are navigation, consistency, understanding, and attitude toward representing group working competences. Each category consisted of a number of variables. The average has been taken in order to calculate the ratings of those categories for each group.

6.1.7.2 Measurement

The groups of students' satisfaction were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') under four categories of criteria: navigation, consistency, understanding, and attitude toward representing competences and related resources. There were 24 questions which were mapped to these four categories, and they are listed in Table 6-4. The rating was done individually by each group member, then the average was taken for each group for the four metrics of subjective criteria in order to compare the SMC application with the plain-text documentation.

Table 6-4: Group Work competences statements

Navigation	Variable
Using group working competences allowed you to plan your learning activities	NW1
Using structure of group working competences allowed you to know which competence and related explanation to access	NW2
Using group working competences allowed you to explore the content of collaborative working quickly	NW3
Using group working competences provided you with a logical sequence to work as a group effectively	NW4
Using group working competences allowed you to return easily to the previous point in the competences structure	NW5
Using group working competences allowed you to know where is your current situation in collaborative working	NW6
Consistency	Variable
Using group working competences provided you with steps on how to work as a group effectively	CW1
Using group working competences allowed you to know what is required to perform each competence	CW2
Using group working competences enabled you to distinguish between the main competence and related activities	CW3
Using group working competences allowed you to know how specific activities relate to a competence	CW4
Using group working competences enabled you to find specific resources to a competence	CW5
Understanding	Variable
It is clear how to use collaborative working competences	UW1
Group working competences need further explanation from a teacher	UW2
The structure of activities for each collaborative working competence is clear	UW3
The structure of activities relating to each collaborative working competence needs further explanation from the teacher	UW4
The structure of group working competences is difficult to follow	UW5
Attitude toward representing competences and related resources	Variable
Representing group working competences is a good idea	AW1
Identifying group working competences makes collaborative working interesting	AW2
A student is able to add additional resources to specific group working competences	AW3
It is easy to find additional resources for specific group working competence	AW4
Resources are structured according to specific group working competences	AW5
It is useful to know who added resources for group working and when	AW6
Resources added by students for group working competences are helpful	AW7
Groups are able to track the performance of their members	AW8

6.1.8 Research questions realted to evaluation of actual groups collaborative working

This section of experiment answered the following main research question and sub research question:

4- Does the SMC application support better collaborative working for groups of students using social media?
   - Is there a relationship between communication, information sharing, and conversation and social skills while groups work collaboratively?

6.1.8.1 Evaluation of actual groups collaborative working

The aim of this questionnaire was to evaluate the actual group working or collaborative working among groups under both conditions. There were five groups that used the application, and another five that used the paper-based documentation. Each group consisted of five students. All groups were asked to evaluate their group working in three different categories, based on Likert scales (Trochim, 2006). These categories are communication, information sharing, and conversation and social skills. Each category consisted of a number of variables. The average has been taken in order to calculate the ratings of those categories for each group.

6.1.8.2 Measurement

The groups of students' evaluations were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') in three categories of criteria: communication, information sharing, and conversation and social skills. There were 36 questions, which were mapped to these three categories and they are listed in Table 6-5. The rating was done individually by each group member, then the average was taken for each group of three metrics of subjective criteria in order to compare the SMC application with the plain-text documentation, in terms of supporting and leading better collaborative working among groups of students.

Table 6-5: Actual groups' collaborative working statements

Communication	Variable
The group has identified someone to plan the tasks between all members	CM1
I was notified of any changes or problems	CM2
I was given an estimate of the time to finish the task	CM3
I summarised progress	CM4
The group was tracked and monitored by someone	CM5
The group identified someone to lead and mange	CM6
The leader listened to each member	CM7
The leader asked for feedback from members	CM8
The leader responded to any failure in the group or resolved any conflict	CM9
The leader suggested directions to accomplish the task successfully	CM10
The leader reminded group members to use collaborative skills	CM11
The leader created a trusted environment between members	CM12
I was encouraged by others/someone	CM13
There was someone to deal with non-contributing members	CM14
I had positive support about my contribution	CM15
The group exchanged messages	CM16
The group scheduled meetings	CM17
Information sharing	Variable
Members asked each other for help	IS1
Members responded to each other	IS2
Members contributed by adding additional resources	IS3
Members held discussion	IS4
Members shared findings with each other	IS5
Members paid attention to the information or resources given	IS6
Members checked their understanding of given task with each other	IS7
Members explained their achievements to each other	IS8
Conversation and social skills	Variable
Members listened to each other	CSK1
Members criticised ideas, not people	CSK2
Members apologised to each other for any mistakes or misunderstandings	CSK3
Members expressed their opinions	CSK4
Members said Yes, No	CSK5
Members accepted/confirmed Yes, No	CSK6
Members avoided trouble with each other	CSK7
Members took their turn and treated their responsibilities seriously	CSK8
Members supported each other	CSK9
Members enjoyed working together	CSK10
Members ignored distractions and focused on their work	CSK11

6.1.9 Research questions related to evaluation of retrived social information

This section of experiment answered the following main research question and sub research questions:

5- Does the SMC application facilitate group formation using social media?
    - Does groups of students' prior knowledge influence learning results?
    - Does retrieved related social information meet with satisfaction of groups of students?

6.1.9.1 Evaluation of retrieved social information

The aim of this questionnaire was to evaluate the professional skills of students from the information on their Facebook profiles. There were five groups that used the application, and another five groups that used the paper-based documentation. Each group consisted of five students. All groups were asked to evaluate their social information in three different categories, based on Likert scales (Trochim, 2006). These categories are the usefulness of prior knowledge, ease of use information about students, and attitude toward representing social skills. Each category consists of a number of variables. The average has been taken in order to calculate the ratings of those categories for each group.

6.1.9.2 Measurement

The groups of students' evaluations were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') in three categories of criteria: usefulness of prior knowledge, ease of use social information, and attitude toward representing social information about students from social media. There were 23 questions, which were mapped to these three categories and they are listed in Table 6-6. The rating was done individually by each group member, then the average was taken for each group of the three metrics of subjective criteria in order to compare the SMC application with the plain-text documentation.

Table 6-6: Statements of retrieved related social information about students in the module

Usefulness of prior knowledge	Variable
My sub-group members were appropriated based on their skills	USI 1
The skills of sub-group members are relevant to normalisation task	USI 2
The skills of sub-group members are relevant to databases in general	USI 3
The skills of sub-group members are relevant to collaborative working skills	USI 4
The sub-group members’ skills are relevant to both task and collaborative working	USI 5
Skills of sub-group members did not match skills in either normalisation or collaborative working	USI 6
Members’ prior skills contributed to assignment (normalisation)	USI 7
Members’ prior skills contributed group work (collaborative working)	USI 8
Members’ prior skills did not help with both assignment (normalisation) and group work	USI 9
The content of assignment and group work were enough, so we did not depend on members’ prior skills	USI 10
The content of assignment and group work were useful, so we updated our skills based on them and simulated the written activities	USI 11
Ease of use information about students	Variable
It was easy to compare the requirements of the normalisation task, collaborative working and students skills in order to form a sub-group	EIS1
It was easy to select potential sub-group members	EIS2
It was quick to formulate our sub-group	EIS3
Members skills were understandable	EIS4
Attitude toward representing social skills	Variable
It is good idea to represent students’ skills	ATSK1
Representing students’ skills makes assignment interesting	ATSK2
Representing students’ skills is useless	ATSK3
Representing students’ skills is helpful to form a group	ATSK4
Represent students’ skills enhances the decision to choose potential group members	ATSK5
Representing other social information such as bio, educational and work information could help to form more effective groups	ATSK6
I considered gender in forming sub-groups	ATSK7
I considered what has been written in notes section about each member before choosing potential group members	ATSK8

6.1.10 Step 4: Post-test

Once the participants under both conditions had completed the evaluation, a post-test was conducted. The post-test was identical to the pre-test's questions and its duration. The types of questions are matching and multiple choices questions that had to completed in five minutes. The post-test was completed individually, making mention only of the conditions – app or non-app. There were 25 participants in each condition. The post-test questions can be found in Appendix E.1.

6.1.11 Experimental Materials

There were five sets of materials given to participants in both conditions: a training document; a scenario; instructions; assignments; and questionnaires. In addition, participants had to have a Facebook account and to join an especially created Facebook Group.

The training document (Appendix E.3) was given to participants so that they had a clear understanding of the following items:

- General introduction to experiment
- Definition of competence
- Competence structure
- Definition of subject matter

The scenario Appendix E.4 provides an overview of the experiment and how participants should interact with Facebook and the given application, if applicable. By following the instructions in Appendix E.5, they could update their information on Facebook, join an existing group and see how to use the application, if applicable.

The assignments Appendix E.6 needed to be answered as a group, after forming suitable groups using the scenario and instructions provided.

The questionnaires Appendix E.7 were designed to ask participants to rate each question on a 5-point Likert scale (Trochim, 2006). A Likert scale measures the extent to which a person agrees or disagrees with questions or statements. They are 'Strongly Disagree', 'Disagree', 'Neither Agree nor Disagree', 'Agree', and 'Strongly Agree'. The ratings for each scale are 1, 2, 3, 4, and 5, respectively.

The groups of students who used the paper-based documentation had the same information on normalisation and group work competences as in SMC application but in a plain text format. This can be seen in appendix E.8.

6.1.12 Experimental Procedure for Application Users

Immediately after finishing the pre-test and dividing the two groups randomly, the researcher went to a computer lab with the participants to run the experiment. The experimental procedure involved the following steps:

1- Participants were welcomed and thanked for agreeing to be involved in the experiment.
2- They were given participant information about the experiment in terms of the research description, the reason for their being chosen, any involved risk, the benefit of taking part, data confidentiality, that they could change their mind and withdraw from experiment at any time, and contact information, should anything untoward happen or go wrong.
3- Participants were given a consent form to sign and return to the researcher.
4- Before the experiment was conducted, all participants received training in order to have clear understating of the terms and definition used.
5- Assignments were posted on Facebook group in order to be visible to all members of the group.
6- The participants were asked to read the scenario and follow instructions on interacting with Facebook and integrated applications.
7- Participants were asked to form sub-groups of five students, based on instructions and how to communicate with others in order to form suitable sub-groups. The instructions tell participants to join a Facebook group and update their skills on their Facebook profiles in order to be read by the application.
8- Once groups had been formed and noted in the application in alphabetical order, the researcher handed out a hard copy of both assignments to each group.
9- Participants were given as much time as they required to answer both assignments, as groups, with the option of submitting their answers either electronically, through Facebook, or physically, to the researcher in the session.
10- After each group had submitted the answers physically, the researcher asked participants to evaluate the application and its content through questionnaires. The evaluation was individual, and included mention of the group name.
11- The participants had an individual five-minute post-test, without application support.
12- The researcher made notes of all the activity on Facebook group and the application, then deleted the entire contents of the application only. The participants deleted their activity in Facebook Group, then left the group and the experiment.

6.1.13 Experimental Procedure for Non-Application Users

The day after the pre-test and splitting the two groups randomly, the researcher arranged with participants to run the experiment in one of computer labs. The experiment procedure involved the following steps:

1- Participants were welcomed and thanked for agreeing to be involved in the experiment.
2- They were given participant information about the experiment in terms of research description, the reason for their being chosen, any involved risk, the benefit of taking part, data confidentiality, that they could change their mind and withdraw from the experiment at any time, and contact information, should anything untoward happen or go wrong.
3- They were given a consent form to sign and return to the researcher.
4- Before the experiment was conducted, all participants received training in order to have clear understating of the terms and definition used.
5- The assignments were posted on Facebook group in order to be visible to all members of the group.
6- Participants were all given the required paper-based materials to enable them to complete both assignments. (Refer to Appendix E.8).
7- The participants were asked to read the scenario and follow the instructions on interacting with Facebook only.
8- Participants were asked to form sub-groups of five students according to the instructions on how to communicate with others, in order to form suitable sub-groups. The instructions tell participants to join a Facebook group and update their skills on their Facebook profiles.
9- Once groups were formed and noted in Facebook Groups as a general post in alphabetical order, the researcher handed out hard copies of both assignments to each group.
10- Participants were given as much time as they required to answer both assignments as groups, with the option to submit their answers electronically, through Facebook, or physically, to the researcher in the session.
11- After each group submitted the answers physically, the researcher asked participants to conduct an evaluation through a number of questionnaires. The evaluation was individual, and made mention only of the group name.
12- The participants had an individual five-minute post-test, without paper-based documentation support.

13- The researcher made notes of all activities in Facebook group. The participants deleted their activities in Facebook group, then left the group and the experiment.

6.1.14 Summary of First Experimental Structure and Procedure

Figure 6-1 summarises the main experiment structure and procedure.

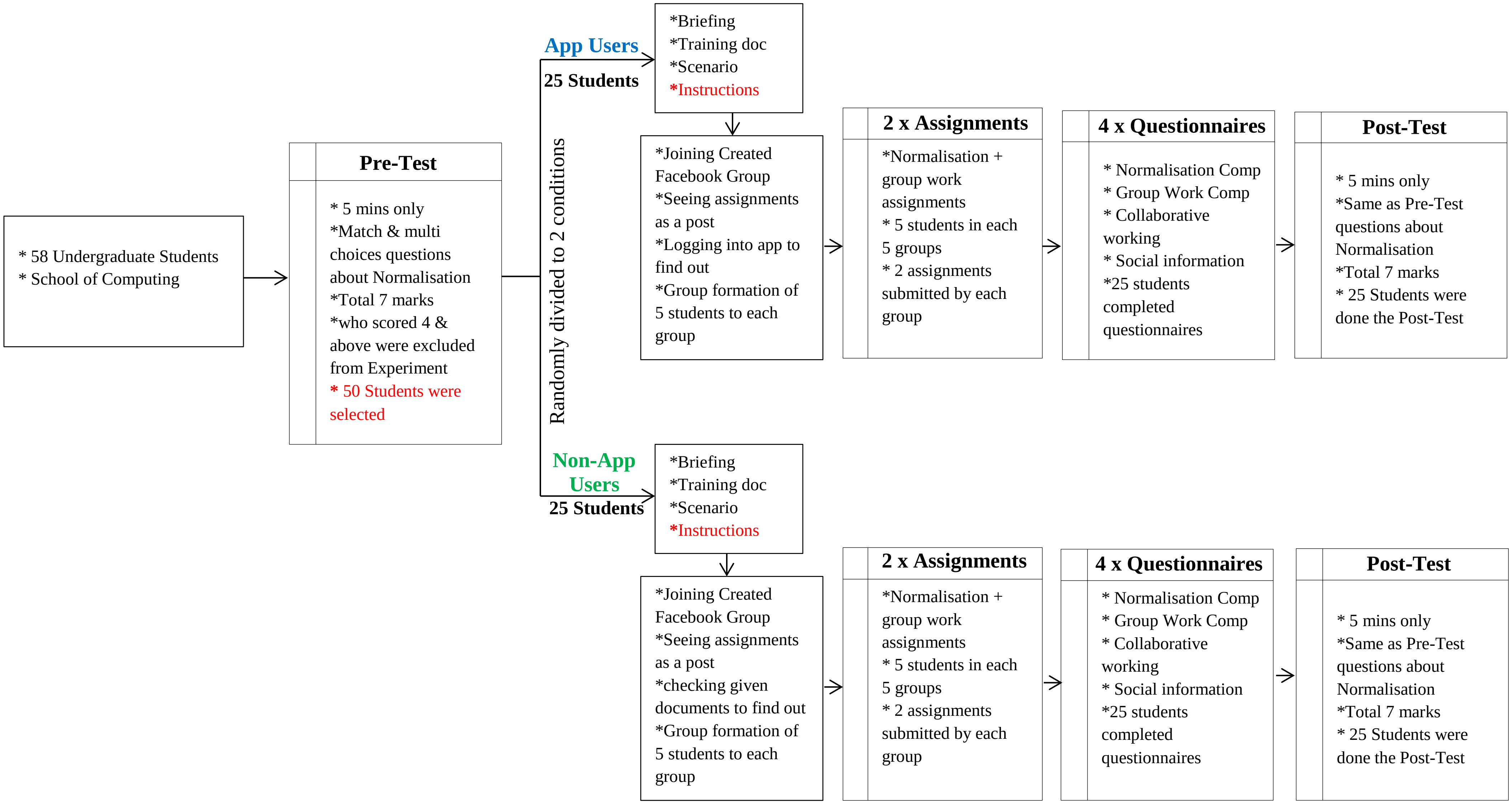


Figure 6-1: Structure of the first experiment

6.2 Second Experiment of Applying Ontologically Structured Competences to Improve Teaching Performance

Once the learning side, based on the SMC application, had been analysed by setting the assignments and asking students to complete them in order to measure their learning results, the teaching side of learning and teaching situation was investigated. The aim of this experiment was to investigate the possibility of improving teaching performance through OSC. OSC was part of SMC application for Normalisation as a knowledge domain.

6.2.1 Ethical approval and estimated number of participants

This study received Ethics Committee approval under reference number ERGO/FPSE/19364. The number of participants for this study was estimated by using G*Power tool (Faul et al., 2007). For this study, the effect size was 0.5, with 5% of level of significance (critical P-Value), and 0.95 of statistical power. As a result, to take part in this study the required total sample size was at least (N = 54).

6.2.2 Types of participants

The participants involved were academic lecturers from the School of Computing. The participants had to be familiar with normalisation. The participants were invited to come to a pre-arranged venue where the researcher gave a presentation about structured competences in teaching for ten minutes only. Then, participants were asked to complete a questionnaire regarding structured competences in teaching, stating their teaching experience. In total, from all sessions, there were 84 participants in this study who responded and indicated their opinion on using OSC to improve teaching performance.

6.2.3 Research question related to second experiment

The second experiment answered the following research questions:

6- Do instructors think that using ontologically structured competences leads to better teaching?

6.2.3.1 Presentation of two styles of competences

If instructors apply OSC to their teaching, will the teaching performance improve? The instructors' thinking and opinion are important to this study. A presentation was devised by the researcher to feature the two styles of competences for the knowledge domain of normalisation. This was shown to a number of academic teachers, who were then asked to fill out a questionnaire on using OSC instead of traditional competences in their teaching. The presentation can be found in Appendix F.1.

6.2.3.2 Measurement

The academic lecturers' opinion were measured by using a 5-point Likert-type scale ('strongly agree' to 'strongly disagree') for nine statements relating to OSC instead of list of competences, and improving the teaching performance. Table 6-7 shows the questionnaire statements that made given after the presentation, with corresponding variables.

Table 6-7: Second experiment statements of applying OSC to teaching

Using Structured Competences (Style 2) when I teach a topic, instead of list of Competences (Style 1);	**Variable**
Will give me clearer goals in my teaching	**T1**
Will give me a clear sequence in my teaching	**T2**
Will enable me to determine at which level of knowledge I should start teaching	**T3**
Will enable me to review regularly my students' acquired knowledge before moving to new points	**T4**
Will enable me to deliver to my students subject matter that is better matched to competences	**T5**
Will enable me to deliver to my students subject matter in greater depth	**T6**
Will allow me to set assignments that link more directly to taught competences	**T7**
Will allow my students to obtain timely feedback on their performance	**T8**
Will make my teaching innovative	**T9**

6.2.3.3 Experimental Materials

The participants were given information about this study, along with an invitation to attend a pre-arranged venue. The researcher gave a presentation of two styles of competences. The first style is traditional competences as a list of all competences that are required in teaching the topic of normalisation. The second style is OSC, which requires teaching topic of normalisation. Before showing these participants OSC, the researcher introduced them to the concept of ontology. Once the presentation finished, the researcher handed the questionnaires to participants for them to indicate their opinion on using OSC to improve their teaching performance, rather than the traditional list of competences. In summary, there were four sets of materials, namely participant's information (Appendix F.2), invitation letters (Appendix F.3), a presentation as PowerPoint slides (Appendix F.1) and the questionnaires (Appendix F.4).

6.2.3.4 Experimental Procedure

The experiment procedure involved the following steps:

1- Participants were welcomed and thanked for coming to the session.
2- Participants were given a consent information to read. They had the right to exit from the study at any time they wished.
3- The researcher gave a presentation on 'Structured Competences in Teaching'.
4- The researcher handed out a questionnaire for participants to complete.
5- The participants returned the questionnaires to the researcher, and left the session and study with the researchers' thanks.

6.3 A Study of Using Facebook Group as an Enhancement to the Teaching and Learning Environment

This study aimed to investigate academic lecturers' opinions on using Facebook Groups to enhance the learning and teaching environment through using it in their module activities. In addition, it investigated the academic lecturers' usage of social media in general, and Facebook specifically. Moreover, it established their current status of using social media to support teaching and the types of activities that usually take place within the social media tools used.

6.3.1 Ethical approval and estimated number of participants

The study received Ethics Committee approval under reference number ERGO/FPSE/19364. The number of participants for this study was estimated by using G*Power tool (Faul et al., 2007). For this study, the effect size was 0.5, with 5% of level of significance (critical P-Value), and 0.95 of statistical power. As a result, at least a total sample size of (N = 54) was required to take part in this study.

6.3.2 Types of participants

The participants were academic lecturers from the School of Computing. The participants had to be familiar with Facebook and Facebook Groups. The questionnaire for this study was handed out along with another questionnaire about OSC to improve teaching performance. Participants were told that, if they were familiar with Facebook and Facebook Groups, they were allowed to complete this second questionnaire about Facebook. In total, there were 80 participants in this study who responded and indicated their opinion on using Facebook Groups to enhance the teaching and learning environment.

6.3.3 Research question related to study of using Facebook Group

This study answered the following research questions:

7- Do instructors think that Facebook Group enhances students' teaching and learning environment?

6.3.3.1 Opinion about Using Facebook Group

A Facebook group has been used in the learning side of education in a number of ways, such as enhancing group formation, sharing resources and conducting discussions between students in the class. There was a concern about investigating the enhancement of teaching and learning environment by using a Facebook group for module activities. The opinions of instructors who are familiar with Facebook are highly important to this research. Instructors were assumed to have a Facebook roup for their modules and were required to answer a number of questionnaire statements. This questionnaire was given out after the OSC questionnaire and asked the participants not to continue to answer the statements unless they were familiar with Facebook.

6.3.3.2 Measurement

The academic lecturers' opinions were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') for six statements relating to a Facebook group in order to enhance teaching and learning environment. Table 6-8 shows the questionnaire statements given to participants who are familiar with Facebook, with corresponding variables.

Table 6-8: Study statements on using a Facebook group to enhance the teaching and learning environment

	Variable
A Facebook group for my module allows me to increase interaction with my students about the topic in a less formal environment	**F1**
A Facebook group increases the engagement with my course for my students	**F2**
A Facebook group gives me an indication of students' difficulties with taught topics, especially when raising questions on specific points	**F3**
A Facebook group encourages my students to conduct effective discussions	**F4**
A Facebook group increases my students' motivation to learn	**F5**
A Facebook group allows my students to pay more attention to the teaching topics	**F6**

6.3.3.3 Study Materials

As this study was integrated with the previous experiment in section 6.2, there was only one questionnaire. It required participants to indicate their opinion of using Facebook Groups as part of their module activity to enhance the teaching and learning environment. The questionnaire can be found in Appendix F.5.

6.3.3.4 Study Procedure

The procedure is part of the previous experiment and involves the following steps:

1- Participants were welcomed and thanked for coming to the session.
2- Participants were given a consent information to read. All had the right to exit from the study at any time they wished.
3- The researcher gave a presentation on Structured Competences in Teaching.
4- The researcher handed out a questionnaire about OSC to participants to be answered.
5- The researcher included the questionnaire about Facebook as part of the OSC questionnaire.
6- Participants were told that if they were familiar with Facebook and Facebook Groups, they were allowed to complete the second questionnaire about Facebook, otherwise to leave the questions unanswered and to continue to the questions on the background of social media in general.
7- Participants returned the questionnaires to the researcher, and left the session and the study with researchers' thanks.

6.4 Summary

This chapter presented the experiments methodology, together with that of further study survey. For the first experiment, there were two conditions, namely application users and non-application users. Each condition operated on equal groups of students. Each group completed two different assignments, on normalisation and collaborative working, then proceeded to evaluate them as individuals, yet making mention only of the name of the group to which they belonged. After that, a post-test was conducted with participants. The post-test was the same as pre-test and was used to exclude any participant who seemed to have knowledge of the technical assignment, that is, normalisation.

In addition, the chapter presented a second experiment on improving teaching performance according to ontologically structured competences rather than the conventional list of competences. The experiment aimed to gather academic teachers in one place to see and hear a presentation to illustrate a comparison of ontologically structured competences and conventional list of competences, then asked academic lecturers whether they would lead to a better teaching performance.

The chapter presented another study survey on using Facebook Groups as a social media tool to enhance the teaching and learning environment, through integrating a Facebook Group into module activities. The academic lecturers needed to be familiar with Facebook in order to answer related questions for this study. The methodology for this research investigated both the teaching and learning sides regarding the possibility of enhancing the pedagogical environment.

The next chapter gives further details about each component of the experiments and the other study survey, with statistical analysis.

Chapter 7: Experimental Results of Using the SMC Application to Improve Learning Results

The previous chapter describes the methodology for conducting the experiments and additional study survey. This chapter provides further explanation of the first experiment and the statistical results of data derived from those main research questions, of which there were five. In addition, the pre and post-tests are presented. The statistical analysis of each main research question of experiment is presented separately.

7.1 Pre-Test Results

As discussed in section 6.1.4.1, there were 58 participants who took the pre-test in order for the researcher to ensure that they had no knowledge of normalisation. The pre-test consisted of two questions with a number of sub-questions. The total mark for the pre-test was seven, and only five minutes was allowed for its completion. The researcher made a quick tour of participants at the end to check their answers. Those who scored four and above were excluded from the experiment, so there was a total of eight participants. Next, participants were randomly split by the researcher into two equal groups to perform assignments using either the SMC application (app users) or the paper-based documentation (non-app users). This is called condition.

There was a slight difference in the means for the app users and the non-app users (paper-based documentation) when performing the pre-test. The standard error and deviation remain the same under both conditions. Table 7-1 shows the mean, standard deviation and standard error of the pre-test scores, and Figure 7-1 shows the profile of the mean test scores in the pre-test with standard error. Further, analysis results from using a two-way ANOVA test with a level of significance, and the interaction between subjects and effects, can be found in section 7.7, on conducting a post-test as a final stage of this experiment for comparison with the pre-test scores.

Table 7-1: Mean, standard deviation, and standard error mean for pre-test scores

Test type	Condition	Mean	Std. Deviation	Std. Error Mean	N
Pre-test	App users	1.4	.8	0.1	25
	Non-app users	1.1	.8	0.1	25

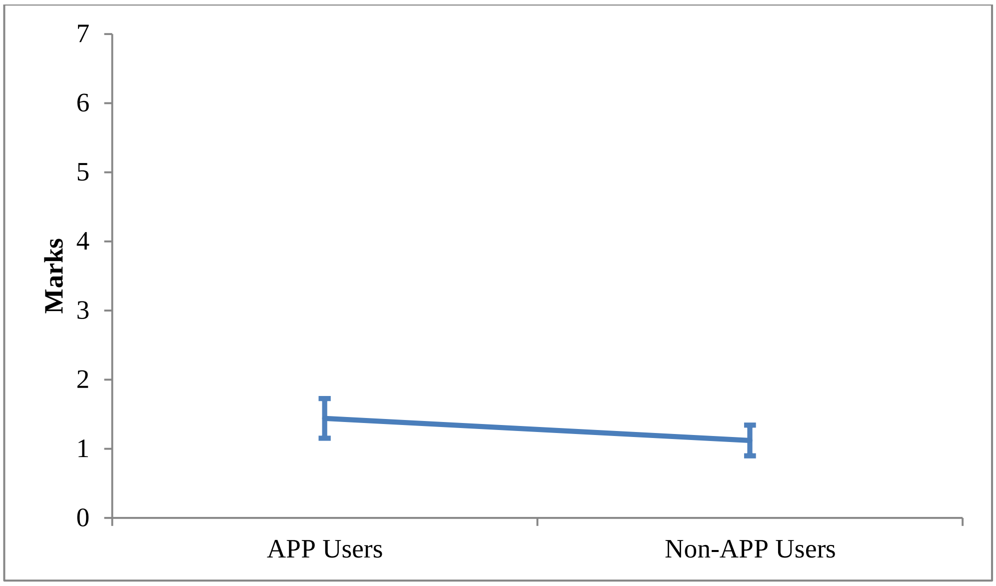


Figure 7-1: Profile of mean test scores of pre-tests with standard error

7.2 Assignments Results

As discussed in section 6.1.4.2, there were two assignments about normalisation (NM) and group working (GW). Both contained five questions. Each corresponds to a specific level on Bloom's Taxonomy. The assignment had to be answered by group of students under two conditions. The first used the SMC application (app users) to answer each assignment. The second used paper-based documentation in plain text format (non-app users) to answer each assignment. Both the application and paper-based documentation contained the same information to accomplish the given assignments. There were ten groups, all of which consisted of five students. Five groups used the SMC application to answer the assignments, while the other five used the paper-based documentation. Table 7-2 shows the conjecture, the purpose of experiment, the experiment's independent and dependent variables, the number of participants and related research question for this section.

Table 7-2: Purpose, number of participants, independent and dependent variables, conjecture, and related research questions of assignments section of Experiment

Purpose	To investigate whether competences including collaborative working, expressed through the SMC application or as plain text, can yield better student learning results while using social media
Number of participants	50 students in School of Computing - 25 students used the SMC application (5 groups of five students each) - 25 students used paper-based documentation (5 groups of five students each)
Independent variable	• Ontologically structured competences through the SMC app (app users) • List of traditional competences through the paper-based documentation as plain text (non-app users)
Dependent variables	Five questions on each assignment that correspond to specific levels on Bloom's taxonomy • Q1= knowledge/remember level • Q2= comprehension/Understand level • Q3= application/apply level • Q4= analysis level • Q5= evaluate There is no question for the synthesis or create level.
Conjecture	*If competences, including collaborative working, are ontologically structured through a social media application, then the students would achieve better learning results.*
Research questions being addressed	Do ontologically structured competences enable students to achieve better learning results using the social media SMC application collaboratively? • Is there a relationship between the levels of Bloom's taxonomy and students' learning results?

7.2.1 Marking Results

As discussed in section 6.1.4.3, both assignments were marked blind by an independent marker, and were allocated a total of 20 marks each. The total marks for normalisation (NM) and group working (GW) assignments as groups are presented in table 7-3. Both assignments questions with corresponding Bloom's taxonomy level and assigned marks can be seen in tables 6-1 and 6-2.

Table 7-3: Marking for groups of both assignments Normalisation (NM) and Group Work (GW)

Conditions					
App Users			Non-App Users		
Group Name	Assignment	Groups Marks	Group Name	Assignment	Groups Marks
A	NM	20	F	NM	8
	GW	20		GW	12
B	NM	20	G	NM	5
	GW	20		GW	5
C	NM	19	H	NM	3.75
	GW	20		GW	7
D	NM	10.75	I	NM	7.75
	GW	14		GW	12
E	NM	16.5	J	NM	18
	GW	18		GW	20

7.2.2 Experiment Analysis Results for Groups Total Marks

In order to look at differences between means of application users and non-application users for both assignments, the independent sample T-Test was used. There were five groups of five students in each group that used the SMC application to answer the two assignments. There were the same number of groups and participants as those that used the paper-based documentation to answer the assignments. The total marks for each group is presented in Table 7-3. The statistical t-test analysis is shown in Tables 7-4 and 7-5.

Table 7-4: Mean and standard deviation with error of total marks for both assignments

Condition		N	Mean	Std. Deviation	Std. Error Mean
Normalisation Marks (NM)	App users	5	17.2	3.9	1.7
	Non-app users	5	8.5	5.6	2.5
Group Work Marks (GW)	App users	5	18.4	2.6	1.1
	Non-app users	5	11.2	5.8	2.5

The results indicate that the mean of the total marks for both assignments for the application users was statistically significantly higher than that of the non-application users. For normalisation, the mean was 17.2 for application users and 8.5 for non-application users. For the group work assignment, the mean was 18.4 for application users and 11.20 for non-application users. Means of the group work assignment under both conditions were higher than for the normalisation assignment. The standard deviation and error are shown in Table 7-4 for both conditions and both assignments. The t-test for equality of means is shown in Table 7-5.

Table 7-5: Independent sample t-test for equality of means and level of significance

		t-test for Equality of Means				
		t	df	p	Mean Difference	Std. Error Difference
Normalisation Marks	Equal variances assumed	2.863	8	.021	8.7	3.0
Group Work Marks	Equal variances assumed	2.530	8	.035	7.2	2.8

The p value in t-test for equality of mean is less than 0.05 for both assignments. That means that the assumption is met and the results show a statistically significant difference between application users and non-application users for both the normalisation and the group work assignments. The p value for normalisation assignment was 0.021 and for group work assignment 0.035. Figures 7-2 and 7-3 show the profile graphs with the standard error of mean for each test as total marks for groups under both conditions.

Both assignments were marked by the researcher with no blind. For normalisation, there was slight difference between the means under both conditions. The mean was 16.9 for application users and 8.4 for non-application users. For the group work assignment; the means were stable for application users and slightly different for non-application users at 11.5. The p value for the researcher marking was less than the level of significance. The detailed analysis results can be found in Appendix G.1

So, the two individual markers were strongly correlated. When one teacher’s group marks increased, the other teacher’s group marks increased as well. The Pearson Correlation test was 0.983 for the normalisation assignment and 0.974 for the group work assignment, which is a positive correlation very close to one as seen in tables 7-6 and 7-7. The p values were <0.001, which is less than the level of significance. This means that there was a very strong relationship between the marking of the two individuals. More details about the graphs can be found in Appendix G.2

Table 7-6: Correlation between researcher marks and independent marker marks for normalisation assignments

Normalisation Assignments		Researcher Marks	Independent marker Marks
Researcher Marks	Pearson Correlation	1	.983
	P		<.001
	N	10	10
Independent marker Marks	Pearson Correlation	.983	1
	P	<.001	
	N	10	10

Table 7-7: Correlation between researcher marks and independent marker marks for group work assignments

Group Work Assignments		Researcher Marks	Independent marker Marks
Researcher Marks	Pearson Correlation	1	.974
	P		<.001
	N	10	10
Independent marker Marks	Pearson Correlation	.974	1
	P	<.001	
	N	10	10

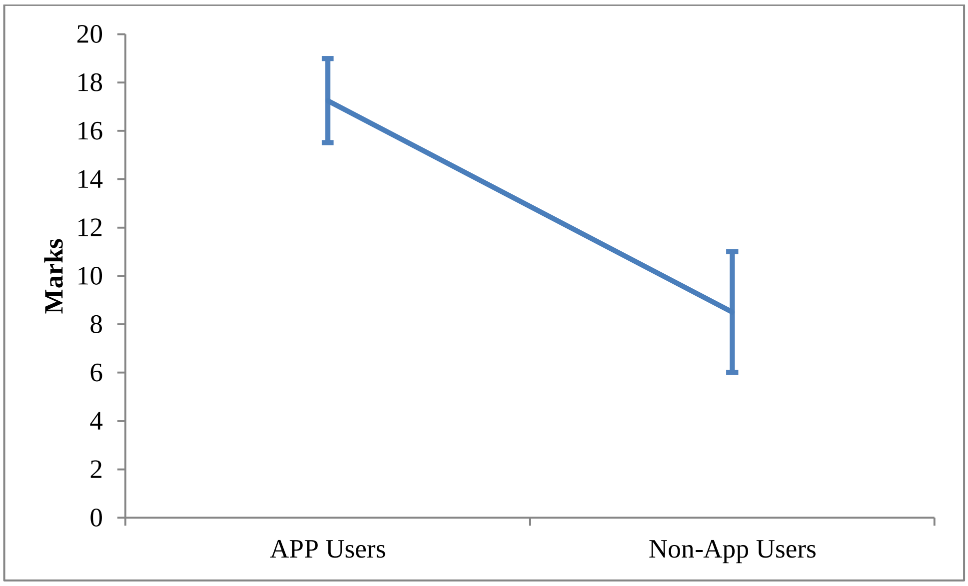


Figure 7-2: Profile of mean for normalisation assignment as total marks for groups in both conditions with standard error

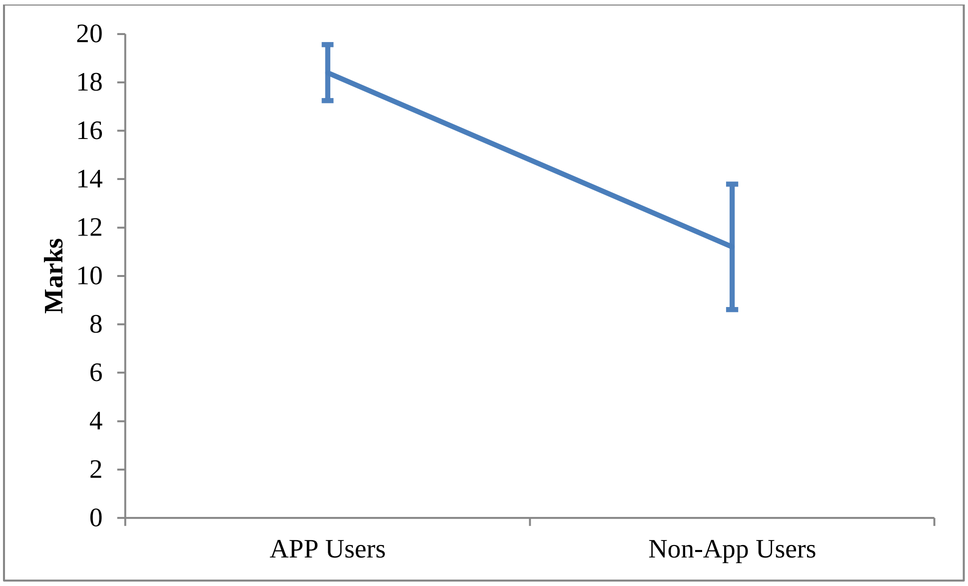


Figure 7-3: Profile of mean for group work assignment as total marks for groups in both conditions with standard error

7.2.3 Results of Each Question

As mentioned in section 6.1.4.3, the questions in both assignments correspond to specific levels in Bloom's taxonomy. The marking results for each question are presented in appendix G.3. This section will present the statistical analysis of each question for both normalisation and group work assignments. The conditions are application users and the non-application users. This section addressed the sub research question which stated in table 7-2.

Tables 6-1 and 6-2 showed the each question for normalisation and group work assignments with correspond level of Bloom's taxonomy. In addition, the tables showed exact assigned mark for each question in both assignments. The assigned mark for each question depends on number of requirements for each question such as giving examples and providing more explanation.

7.2.4 Experiment Analysis Results of Bloom's Taxonomy Levels

The multivariate test (MANOVA) between the mean results of each question was used to analyse the data obtained for 10 groups under both conditions. Table 7-8 shows the mean and standard deviation of all dependent variables for the normalisation assignment. The mean of the app users' marks for Questions 2, 3, 4 and 5 were statistically significantly higher than those of the non-app users. The first question showed no difference between the two conditions. Table 7-9 shows the multivariate test of significance between the mean results for each question in the normalisation test, while. Table 7-10 shows the mean and standard deviation of all dependent variables for the group work assignment. The mean marks of the app users for Questions 2, 3, 4, and 5 were statistically significantly higher than those for the non-app users. The first question showed no difference between the conditions. The multivariate test of significance between the mean results for each question for the group work assignment is shown in Table 7-11.

For the normalisation questions, the p value of Pillai's Trace test in table 7-9 is .19 when the independent marker had marked the assignments. This means that the p value is higher than 0.05, so the difference between the app users' marks and the non-app users' marks for the normalisation questions is not statistically significant. Every question in the normalisation assignment was allocated a different number of marks, so all questions were converted to a percentage, as shown in Table 7-12. NMQ1 has been excluded, because the mean showed no difference between the app and non-app users, with zero standard deviation. The multivariate test was repeated between the four questions in order to present any significance between application and non-application users for every question in normalisation assignment. Unfortunately, the p value of Pillai's Trace test in Table 7-13 is still the same, at .19. The p value is larger than 0.05, which means there was no statistically significant different between the application and the non-application users in terms of the normalisation questions that correspond to specific levels in Bloom's taxonomy.

For the group work questions, the p value of Pillai's Trace test, shown in Table 7-11, is .38 when independent marker had marked the assignments. This means that the p value is higher than 0.05, so the difference between the application users and the non-application users is not statistically significant for group work questions. Every question in the group work assignment was allocated a different number of marks, so all were converted to a percentage, as shown in Table 7-14. GWQ1 has been excluded because the mean showed no difference between the application and non-application users, with zero standard deviation. The multivariate test was repeated between the four questions in order to present any significance between application and non-application users for every question in the group work assignment. Unfortunately, the p value of Pillai's Trace test in Table 7-15 is still the same, at.38. The p value is larger than 0.05, which means there was no statistical significant difference between the application and non-application users in terms of group work questions that correspond to specific levels in Bloom's taxonomy.

Table 7-8: Mean and standard deviation of all questions for normalisation assignments

	Condition	Mean	Std. Deviation	N
NMQ1	App users	1.0	.0	5
	Non-app users	1.0	.0	5
NMQ2	App users	3.0	.0	5
	Non-app users	1.5	1.0	5
NMQ3	App users	4.0	1.6	5
	Non-app users	1.5	2.0	5
NMQ4	App users	5.5	.8	5
	Non-app users	3.0	2.0	5
NMQ5	App users	3.7	2.1	5
	Non-App users	1.5	1.5	5

Table 7-9: Multivariate test (MANOVA) for all normalisation questions

Effect		Value	F	Hypothesis df	Error df	p	Partial Eta Squared
Condition	Pillai's Trace	.65	2.32	4.00	5.00	.19	.65

Table 7-10: Mean and standard deviation of all questions for group work assignments

Condition		Mean	Std. Deviation	N
GWQ1	App users	3.0	.0	5
	Non-app users	3.0	.0	5
GWQ2	App users	2.0	.0	5
	Non-app users	1.7	.6	5
GWQ3	App users	3.0	.0	5
	Non-app users	1.6	1.5	5
GWQ4	App users	6.0	.0	5
	Non-app users	2.5	2.8	5
GWQ5	App users	4.4	2.6	5
	Non-app users	2.4	2.2	5

Table 7-11: Multivariate test (MANOVA) for all Group Work Questions

Effect		Value	F	Hypothesis df	Error df	p	Partial Eta Squared
Condition	Pillai's Trace	.50	1.29	4.00	5.00	.38	.50

Table 7-12: Mean and standard deviation for all normalisation questions after conversion to %

Condition		Mean	Std. Deviation	N
NMQ2	App users	100.0	.0	5
	Non-app users	50.0	35.3	5
NMQ3	App users	81.0	32.4	5
	Non-app users	30.0	41.0	5
NMQ4	App users	91.6	14.4	5
	Non-app users	50.0	33.3	5
NMQ5	App users	74.0	43.3	5
	Non-app users	30.0	30.8	5

Table 7-13: Multivariate test (MANOVA) for all normalisation questions after converted to percentage

Effect		Value	F	Hypothesis df	Error df	p	Partial Eta Squared
Condition	Pillai's Trace	.65	2.32	4.00	5.00	.19	.65

Table 7-14: Mean and standard deviation for all group work questions after conversion to %

Condition		Mean	Std. Deviation	N
GWQ2	App users	100.0	.0	5
	Non-app users	85.0	33.5	5
GWQ3	App users	100.0	.0	5
	Non-app users	53.3	50.5	5
GWQ4	App users	100.0	.0	5
	Non-app users	41.6	47.1	5
GWQ5	App users	73.3	43.4	5
	Non-app users	40.0	36.9	5

Table 7-15: Multivariate test (MANOVA) for all group work questions after conversion to %

Effect		Value	F	Hypothesis df	Error df	p	Partial Eta Squared
Condition	Pillai's Trace	.50	1.29	4.00	5.00	.38	.50

7.2.5 Correlation between Assignments Questions (Bloom's Taxonomy Levels)

Since the multivariate test did not show any statistically significant difference, the correlation test was used in order to highlight the relationships between assignment's questions for all groups under both conditions. Table 7-16 illustrates the correlation between the normalisation questions. These showed a very strong correlation between questions 2 and 3, questions 3 and 5, and questions 4 and 5. The p values were less than 0.05 which is the level of significance. The other three correlations were higher, and close to the level of significance. The Pearson Correlation test results were close to one, for most of the questions. The correlation between normalisation questions that equate to specific levels of Bloom's taxonomy were positively correlated and show a strong relationship between those questions and levels of Bloom taxonomy. The scatter charts in Figures 7-4 to 7-9 illustrate the correlation between the normalisation questions for both application and non-application users. All scatter charts have been dithered in order to show all the plots for each question.

In addition, Table 7-18 illustrates the correlation between group work questions that showed a very strong correlation between question 2 and 3, and question 3 and 4 only. The p values were less than 0.05, which is the level of significance. The other four correlations were greater, and above the level of significance. Also, the correlation between question 2 and 4 was greater and close to the level of significance. The Pearson correlation test results for questions 2 and 3, 2 and 4, and 4 and 3 were close to one and were positively correlated. The scatter charts in Figures 7-10 and 7-11 illustrate the correlation between group work questions for both application and non-application users. All scatter charts have been dithered in order to show all the plots for each question.

The scatterplots in Figures 7-4 to 7-11 reveal that the SMC application supports a higher level on Bloom's taxonomy when performing questions relating to that level. Thus, there are very strong relationships between normalisation and group work assignment questions that correspond to specific levels on Bloom's taxonomy. When the Bloom's taxonomy level increases, so do the students' results. Thus, students obtained higher marks for higher-level questions, for instance those that correspond to apply, analyse and evaluate.

Table 7-16: Correlation between normalisation questions as a percentage

		NMQ2	NMQ3	NMQ4	NMQ5
NMQ2	Pearson Correlation	1	.722	.581	.593
	p		.01	.07	.07
	N	10	10	10	10
NMQ3	Pearson Correlation	.722	1	.590	.886
	p	.01		.07	.00
	N	10	10	10	10
NMQ4	Pearson Correlation	.581	.590	1	.709
	p	.07	.07		.02
	N	10	10	10	10
NMQ5	Pearson Correlation	.593	.886	.709	1
	p	.07	.00	.02	
	N	10	10	10	10

Table 7-17: Correlation between group work questions as a percentage

		GWQ2	GWQ3	GWQ4	GWQ5
GWQ2	Pearson Correlation	1	.646	.566	.266
	p		.04	.08	.45
	N	10	10	10	10
GWQ3	Pearson Correlation	.646	1	.833	.470
	p	.04		.00	.17
	N	10	10	10	10
GWQ4	Pearson Correlation	.566	.833	1	.457
	p	.08	.00		.18
	N	10	10	10	10
GWQ5	Pearson Correlation	.266	.470	.457	1
	p	.45	.17	.18	
	N	10	10	10	10

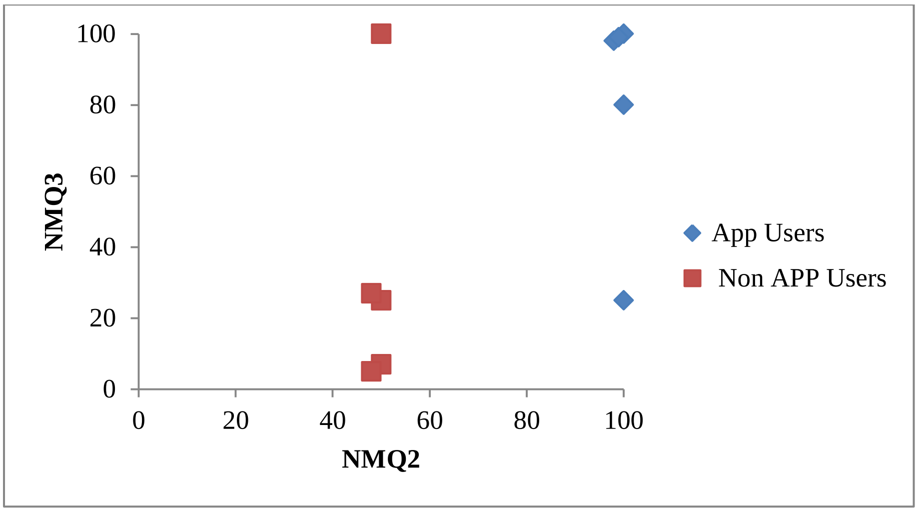


Figure 7-4: Scatter chart illustrating correlation between Questions 2 and 3 for the normalisation assignment under both conditions. The actual data results have been dithered to at least one decimal place from the original value in order to show data points for each groups

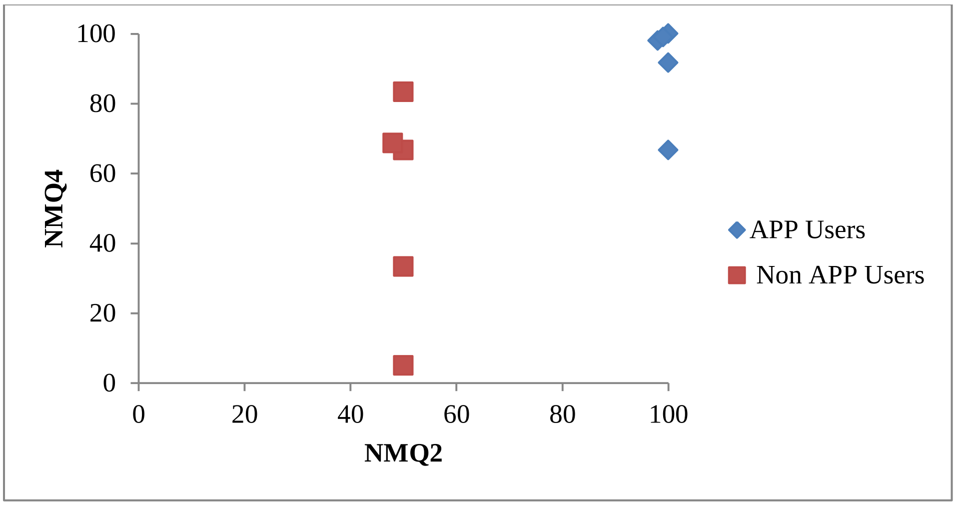


Figure 7-5: Scatter chart illustrating correlation between Questions 2 and 4 for the normalisation assignment under both conditions. The actual data results have been dithered to at least one decimal place from the original value in order to show data points for each groups

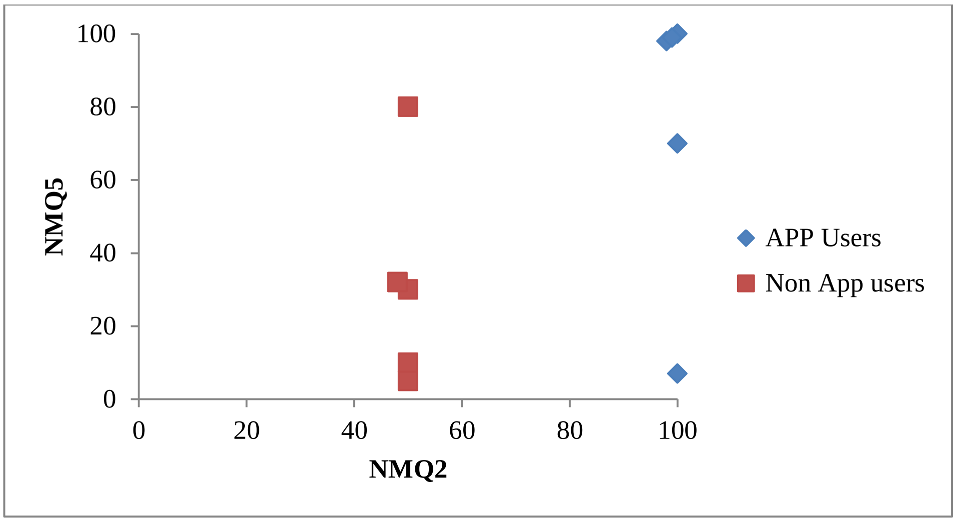


Figure 7-6: Scatter chart illustrating correlation between Questions 2 and 5 for the normalisation assignment under both conditions. The actual data results have been dithered to at least one decimal place from an original value in order to show data points for each groups

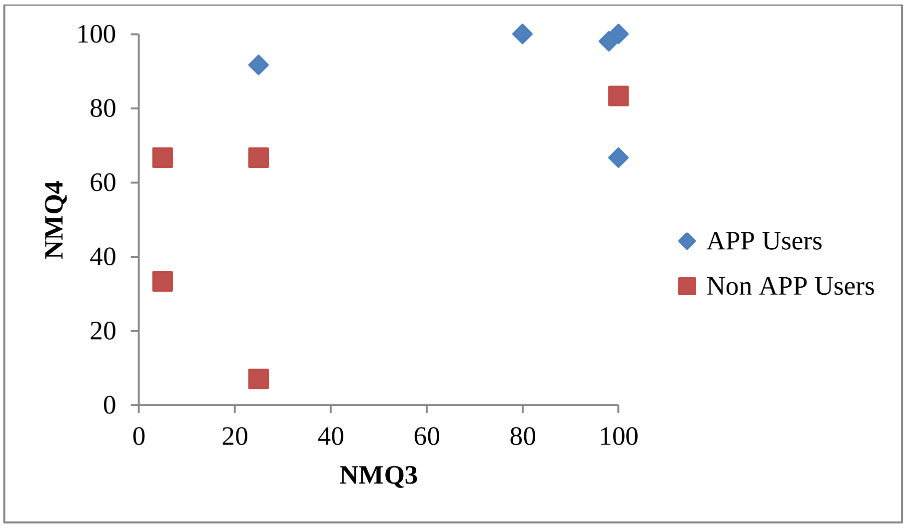


Figure 7-7: Scatter chart illustrating correlation between Questions 3 and 4 for the normalisation assignment in both conditions. The actual data results have been dithered to at least one decimal place from an original value in order to show data points for each groups

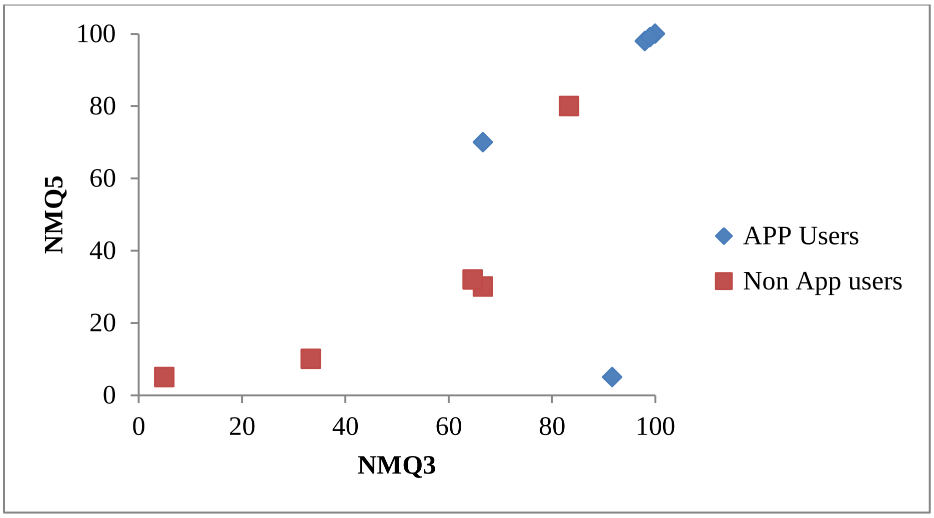


Figure 7-8: Scatter chart illustrating correlation between Questions 3 and 5 for the normalisation assignment in both conditions. The actual data results have been dithered to at least one decimal place from an original value in order to show data points for each groups

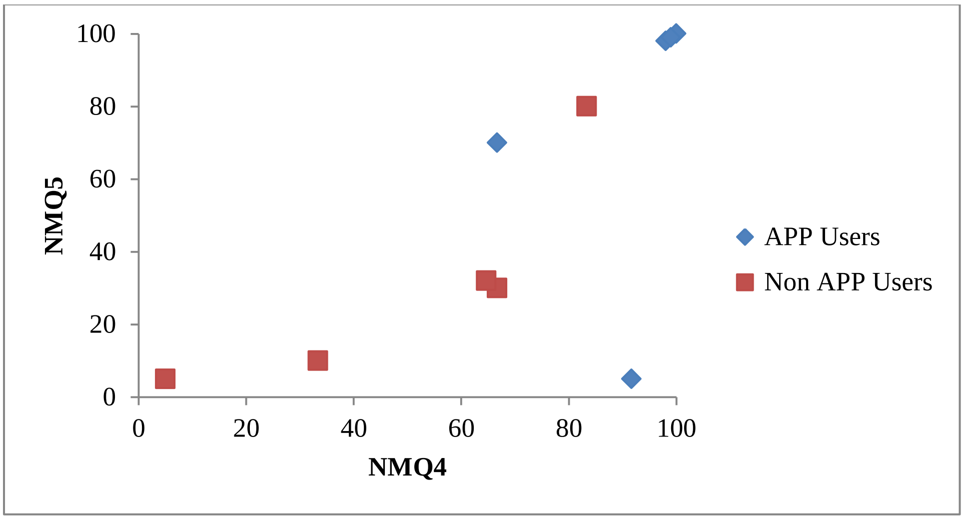


Figure 7-9: Scatter chart illustrating correlation between Questions 4 and 5 for the normalisation assignment under both conditions. The actual data results have been dithered to at least one decimal place from an original value in order to show data points for each groups

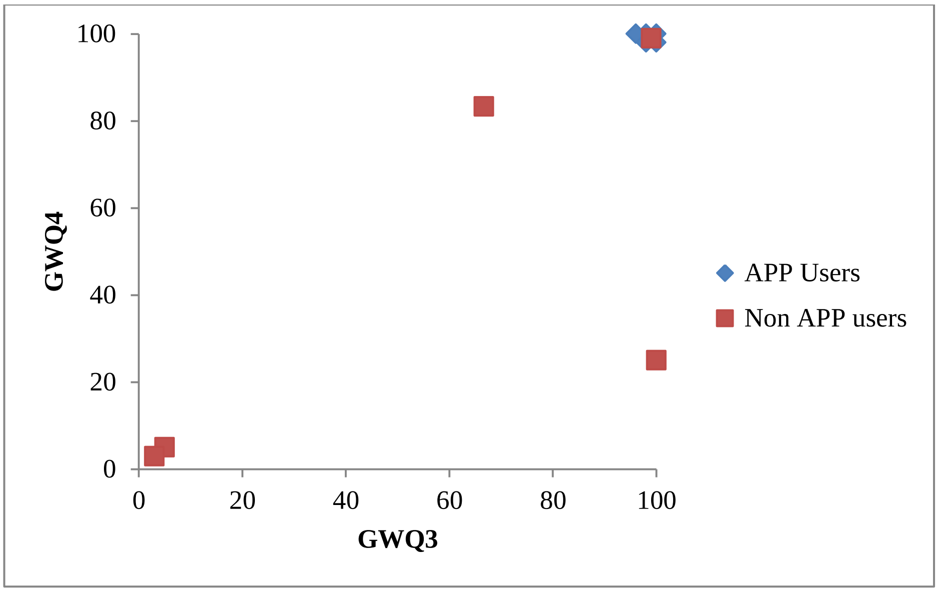


Figure 7-10: Scatter chart illustrating correlation between Questions 3 and 4 for the group work assignment under both conditions. The actual data results have been dithered to at least one decimal place from an original value in order to show data points for each groups

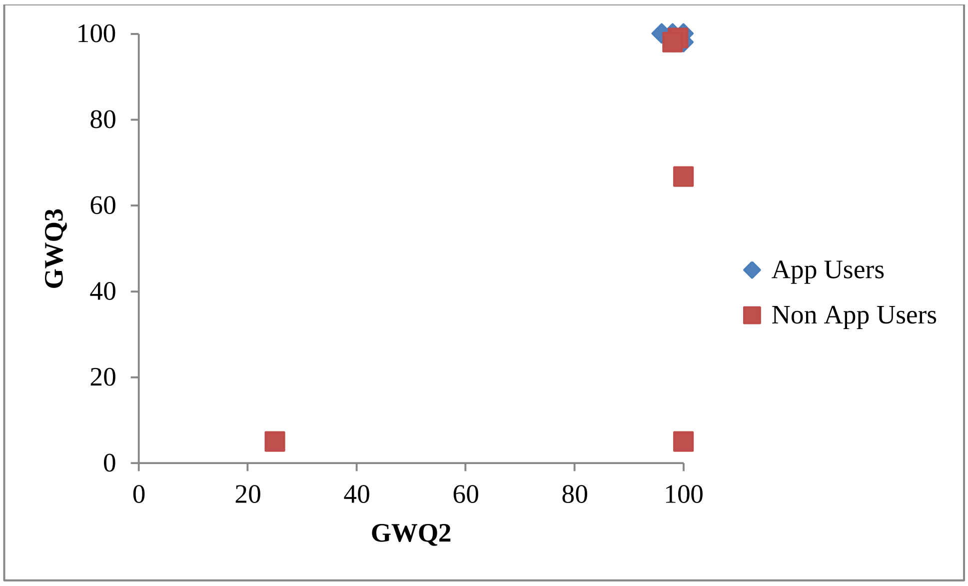


Figure 7-11: Scatter chart illustrating correlation between Questions 3 and 2 for the group work assignment under both conditions. The actual data results have been dithered to at least one decimal place from an original value in order to show data points for each groups

7.3 Results of Evaluation of Normalisation Competences

As discussed in section 6.1.6, this section of the experiment aims to evaluate the given competences under both conditions and the related subject matter content. The groups of students' satisfactions were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') under four categories of criteria: navigation, consistency, understanding, and attitude toward representing competences and related resources. There were 25 questions, which were mapped to these four categories as listed in Table 6-3. The rating was done individually by each group member. Then the average of four metrics of subjective criteria was taken for each group in order to compare the SMC application with the plain-text documentation. Table 7-18 shows the purpose of the experiment, the experiment's independent and dependent variables, the number of participants, and related research question to this section of experiment.

Table 7-18: Purpose, number of participants, independent and dependent variables, and related research question of normalisation competences evaluation section of experiment

Purpose	To determine groups' overall reaction toward competences of normalisation in terms of navigation, consistency, understanding, and attitude toward representing competences and related resources.
Number of participants	50 students in School of Computing - 25 students used the SMC application (5 groups of five students each) - 25 students used paper-based documentation (5 groups of five students each) Group averages have been taken.
Independent variable	• Ontologically structured competences through the SMC app (app users) • List of traditional competences through paper-based documentation as plain text (non-app users)
Dependent variables	1. Navigation (6 questions) 2. Consistency (5 questions) 3. Understanding (5 questions) 4. Attitude towards representing competences and related resources (9 questions)
Research question being addressed	Do ontologically structured competences of subject matter through SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding, and attitude toward representing competences?

7.3.1 Experiment Analysis Results for Normalisation Competences as Groups

The multivariate test of significance (MANOVA) between the mean ratings of satisfaction was used to analyse the data obtained from 10 groups of students. Table 7-19 shows the results of mean and standard deviation of all dependent variables. Table 7-20 shows the results of multivariate test of significance between the mean ratings for all dependent variables. The analysis of all individual variables obtained from 25 participants under each condition can be found in Appendix G.4.

Table 7-19: Mean and standard deviation of all dependent variables as groups for evaluation of normalisation competences

Condition		Mean	Std. Deviation	N
Navigation	App users	4.5	.2	5
	Non-app users	1.9	.3	5
Consistency	App users	4.6	.1	5
	Non-app users	1.7	.3	5
Understanding	App users	4.0	.3	5
	Non-app users	2.2	.4	5
Attitude	App users	4.6	.1	5
	Non-app users	1.8	.4	5

Table 7-20: Multivariate test (MANOVA) for all dependent variables as groups for evaluation of Normalisation competences

Effect		Value	F	Hypothesis df	Error df	p
Condition	Pillai's Trace	.97	49.92	4.00	5.00	<.001

The results indicate that the mean rating of all dependent variables for SMC application (app users) was higher than for paper-based documentation (non-app users). Table 7-20 shows the results of multivariate tests of significant differences between the mean ratings for all dependent variables. The results indicate that the p value of Pillai’s Trace is <0.001. This means that the P value is less than 0.05, so the difference is a statistically significant difference between app users and non-app users, based on four categories. Figures 7-12 to 7-15 show the profile graphs of those four categories with standard error.

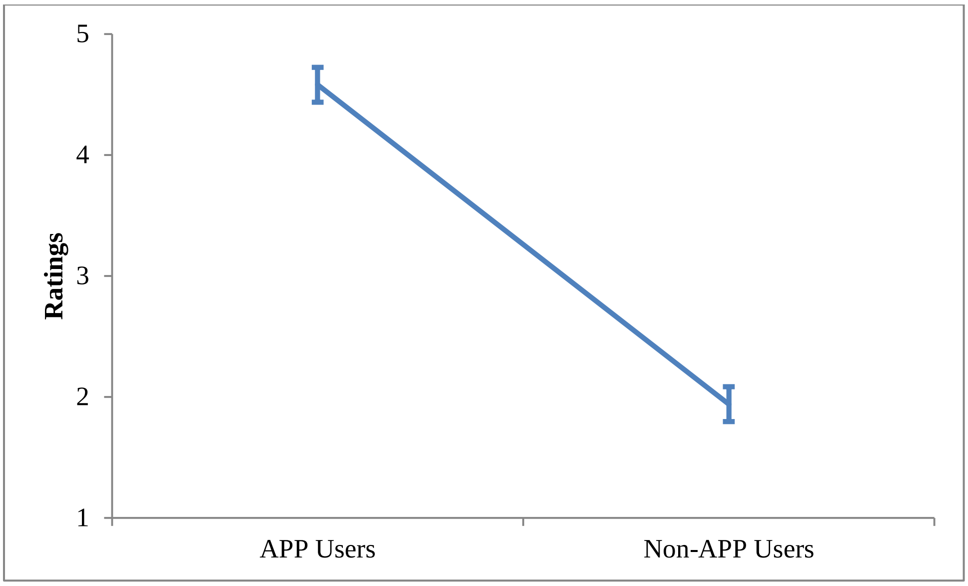


Figure 7-12: Profile graph of mean ratings of navigation with standard error

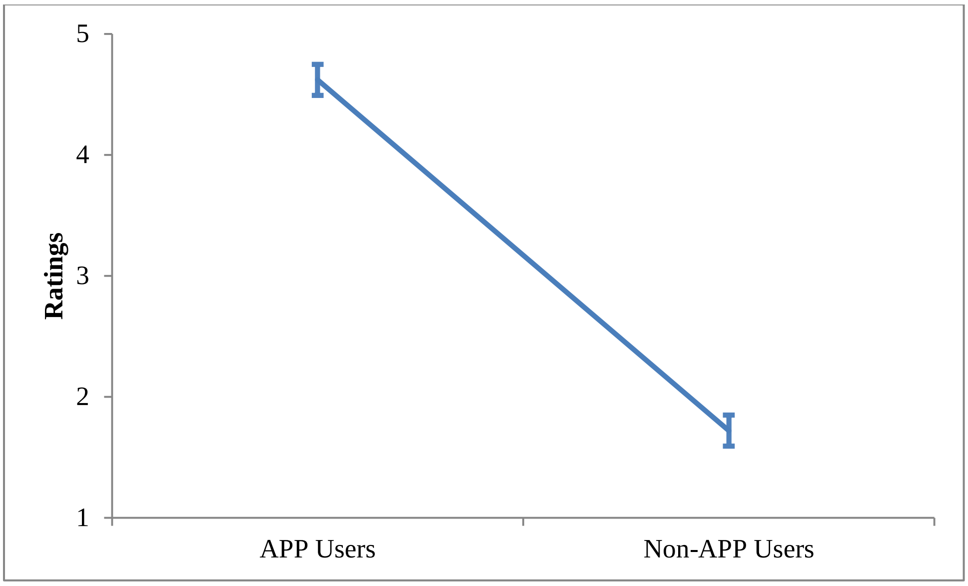


Figure 7-13: Profile graph of mean ratings of consistency with standard error

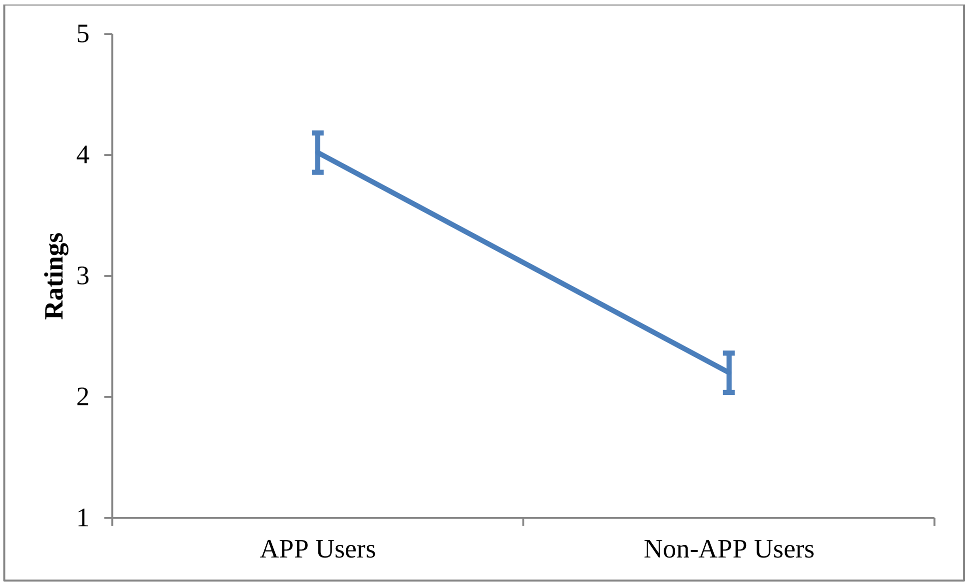


Figure 7-14: Profile of mean ratings of understanding with standard error

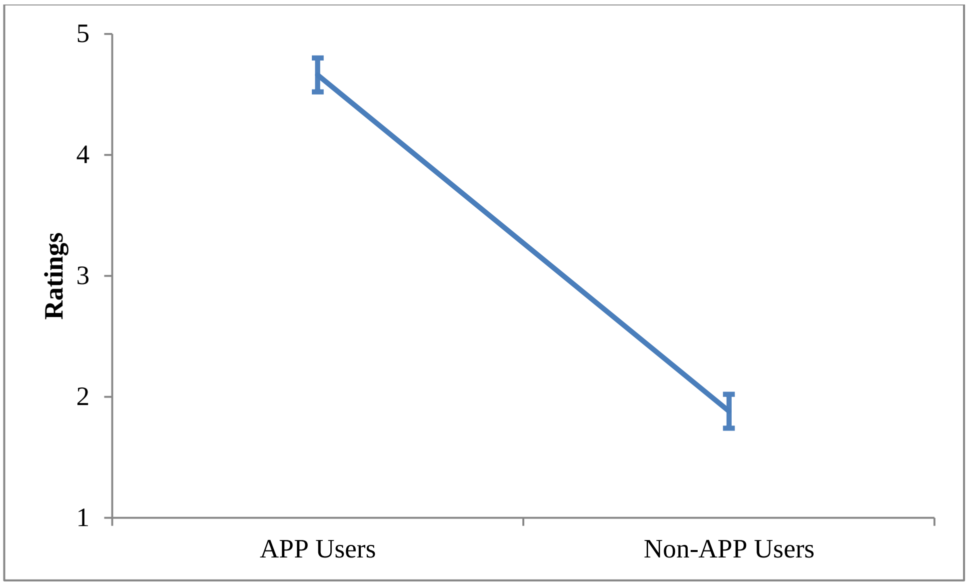


Figure 7-15: Profile of mean ratings of attitude toward representing competences and related resources with standard error

7.4 Results of Evaluation of Group Work Competences

As discussed in section 6.1.7, this section of the experiment aims to evaluate the given group work competences under both conditions and related roles. The groups of students' satisfactions were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') under four categories of criteria: navigation, consistency, understanding, and attitude toward representing competences and related resources. There were 24 questions which were mapped to these four categories as listed in Table 6-4. The rating was done individually by each group member. Then the average was taken for each group for the four metrics of subjective criteria in order to compare the SMC application with the plain-text documentation. Table 7-21 shows the purpose of experiment, the experiment's independent and dependent variables, the number of participants, and related research questions for this section of experiment.

Table 7-21: Purpose, number of participants, independent and dependent variables, and related research question of Group Work competences evaluation section of experiment

Purpose	To determine groups' overall reaction toward competences of collaborative working in terms of navigation, consistency, understanding, and attitude toward representing competences and related resources.
Number of participants	50 students in school of computing - 25 students were using the SMC application (5 groups of 5 students each) - 25 students were using paper-based documentation (5 groups of 5 students each) Group averages have been taken.
Independent variables	• Ontologically structured collaborative working competences through the SMC app (app users) • List of traditional collaborative working competences through paper-based documentation as plain text (non-app users)
Dependent variables	5. Navigation (6 questions) 6. Consistency (5 questions) 7. Understanding (5 questions) 8. Attitude toward representing competences and related resources (8 questions)
Research question being addressed	Do ontologically structured competences of collaborative working through the SMC application meet with satisfaction of groups of students in terms of navigation, consistency, understanding, and attitude toward representing competences of group working?

7.4.1 Experiment Analysis Results for Group Work Competences as Groups

The multivariate test of significance (MANOVA) between the mean ratings of satisfaction was used to analyse the data obtained from 10 groups of students. Table 7-22 shows the results of mean and standard deviation of all dependent variables. Table 7-23 shows the results of multivariate test of significant between the mean ratings for all dependent variables. The analysis of all individual variables which obtained from 25 participants in each condition can be found in Appendix G.5.

Table 7-22: Mean and standard deviation of all dependent variables as groups for evaluation of group work competences

Condition		Mean	Std. Deviation	N
Navigation	App users	4.6	.1	5
	Non-app users	1.7	.5	5
Consistency	App users	4.6	.1	5
	Non-app users	1.6	.4	5
Understanding	App users	4.1	.0	5
	Non-app users	2.2	.2	5
Attitude	App users	4.6	.2	5
	Non-app users	2.0	.2	5

Table 7-23: Multivariate test (MANOVA) for all dependent variables as groups for evaluation of group work competences

Effect		Value	F	Hypothesis df	Error df	p
Condition	Pillai's Trace	.976	50.114	4.000	5.000	<.001

The results indicate that the mean rating of all dependent variables for users of the SMC application was higher than for those of the paper-based documentation. Table 7-23 shows the results of multivariate tests of significant difference between the mean ratings of all dependent variables. The results indicate that the p value of Pillai’s Trace is <0.001. This means the p value is less than 0.05, so the difference between app users and non-app users, based on four categories, was statistically significant. Figures 7-16 to 7-19 show the profile graphs of those four categories with standard error.

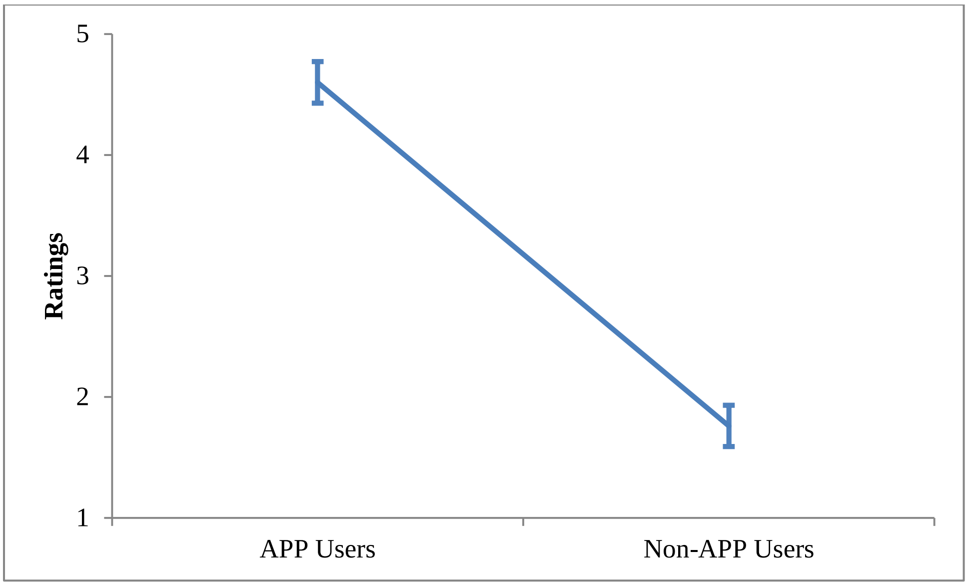


Figure 7-16: Profile of mean ratings of navigation for group work competences with standard error

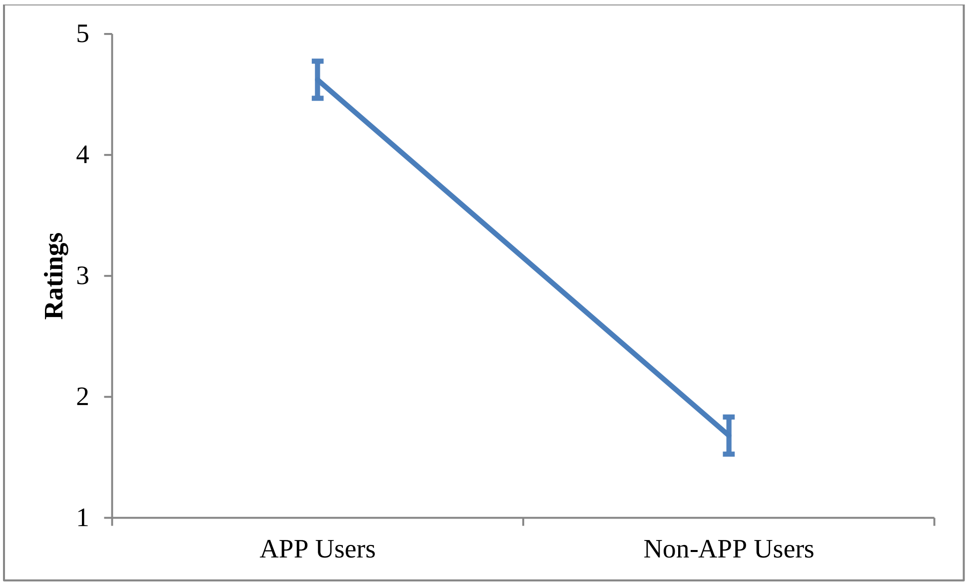


Figure 7-17: Profile of mean rating of consistency of group work competences with standard error

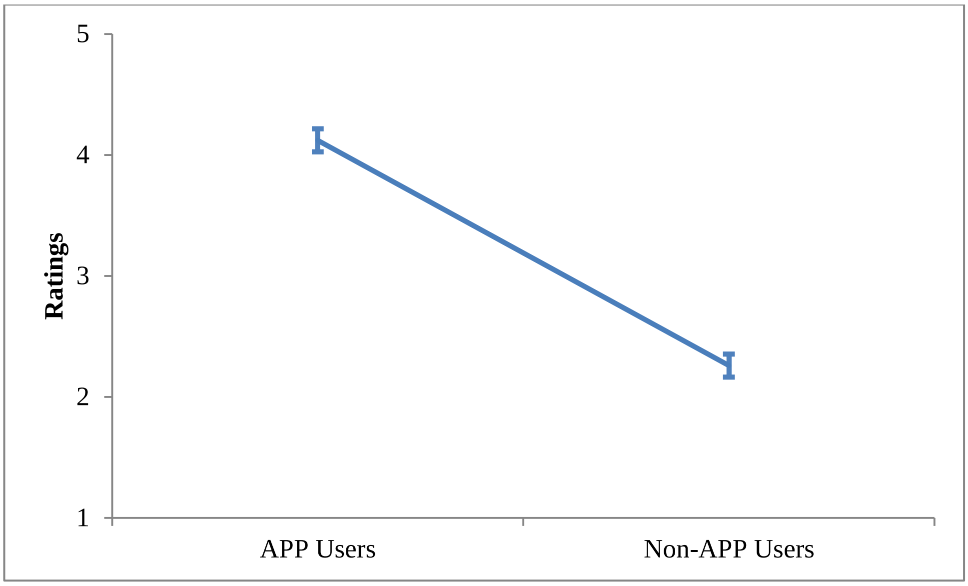


Figure 7-18: Profile of mean rating of understanding of group work competences with standard error

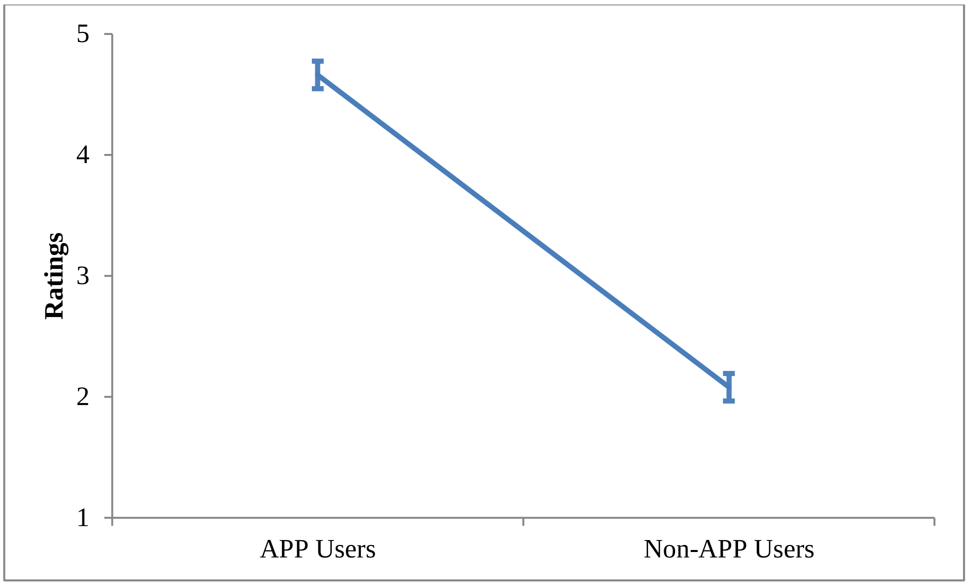


Figure 7-19: Profile of mean rating of attitude toward representing group work competences with related roles and resources with standard error

7.5 Results of Evaluation of Actual Groups Collaborative Working

As discussed in section 6.1.8, this section of experiment aims to evaluate the actual group working or collaborative working among groups under both conditions. The groups of students' evaluations were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') in three categories of criteria: communication, information sharing, and conversation and social skills. There were 36 questions, which were mapped to these three categories as listed in Table 6-5. The rating was done individually by each group member. Then the average was taken for each group of three metrics of subjective criteria in order to compare the SMC application with the plain-text documentation in terms of supporting and leading better collaborative working among groups of students. Table 7-24 shows the purpose of the experiment, the experiment independent and dependent variables, the number of participants, and related research question to this section of experiment.

Table 7-24: Purpose, number of participants, independent and dependent variables, and related research question of actual groups collaborative working evaluation section of experiment

Purpose	To investigate whether both types of competences illustrated through the SMC application or paper-based documentation can lead to better collaborative working while using a social media platform.
Number of participants	50 students in School of Computing - 25 students used the SMC application (5 groups of 5 students each) - 25 students used the paper-based documentation (5 groups of 5 students each) Group averages have been taken.
Independent variable	• Ontologically structured competences through the SMC app (app users) • List of traditional competences through paper-based documentation as plain text (non-app users)
Dependent variables	1. Communication (17 questions) 2. Information sharing (8 questions) 3. Conversation and social skills (11 questions)
Research questions being addressed	Does the SMC application support better collaborative working for groups of students using social media? • Is there a relationship between communication, information sharing, and conversation and social skills when groups work collaboratively?

7.5.1 Experiment Analysis Results for Collaborative Working as Groups

The multivariate test of significance (MANOVA) between the mean ratings of collaborative working was used to analyse the data obtained from 10 groups of students. Table 7-25 shows the results of mean and standard deviation of all dependent variables. Table 7-26 shows the results of multivariate test of significant between the mean ratings for all dependent variables. The analysis of all individual variables which were obtained from 25 participants under each condition can be found in Appendix G.6.

Table 7-25: Mean and standard deviation of all dependent variables as groups for evaluation of actual collaborative working between groups under both conditions

Condition		Mean	Std. Deviation	N
Communication	App users	3.8	1.1	5
	Non-app users	2.1	.5	5
Information Sharing	App users	3.9	1.2	5
	Non-app users	2.1	.4	5
Conversation and Social Skills	App users	3.6	1.1	5
	Non-app users	2.0	.5	5

Table 7-26: Multivariate test (MANOVA) for all dependent variables as groups for evaluation of actual collaborative working among groups

Effect		Value	F	Hypothesis df	Error df	p
Condition	Pillai's Trace	.71	4.93	3.00	6.00	.04

The results indicate that the mean rating of all dependent variables for the SMC application was higher than that for the paper-based documentation. Table 7-26 shows the results of multivariate tests of significant difference between the mean ratings for all dependent variables. The results indicate that the p value of Pillai's Trace is 0.04. This means the p value is less than 0.05, so the difference between app users and non-app users based on three categories was statistically significant. Figures 7-20 to 7-22 show the profile graphs of those three categories with standard error.

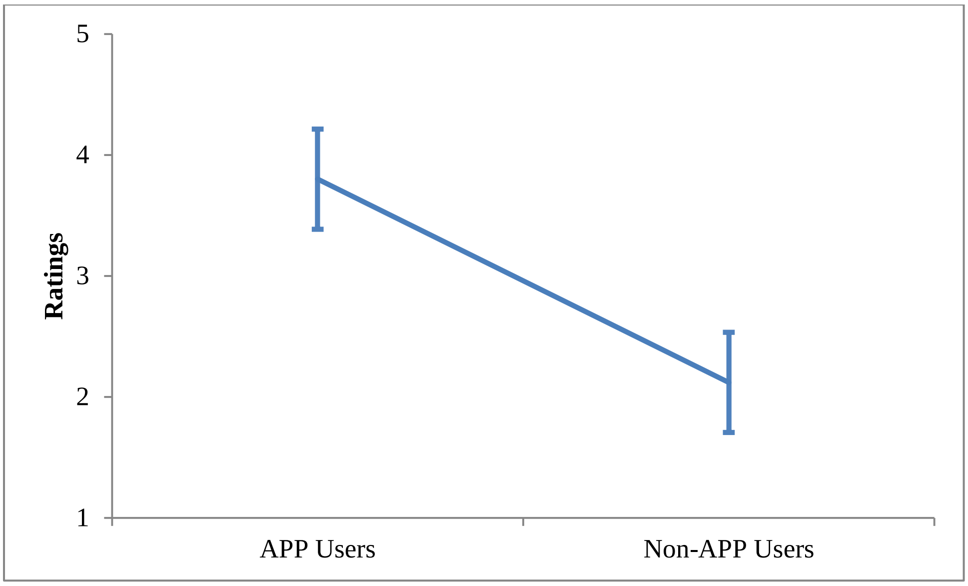


Figure 7-20: Profile of mean rating of communication with standard error for actual collaborative working

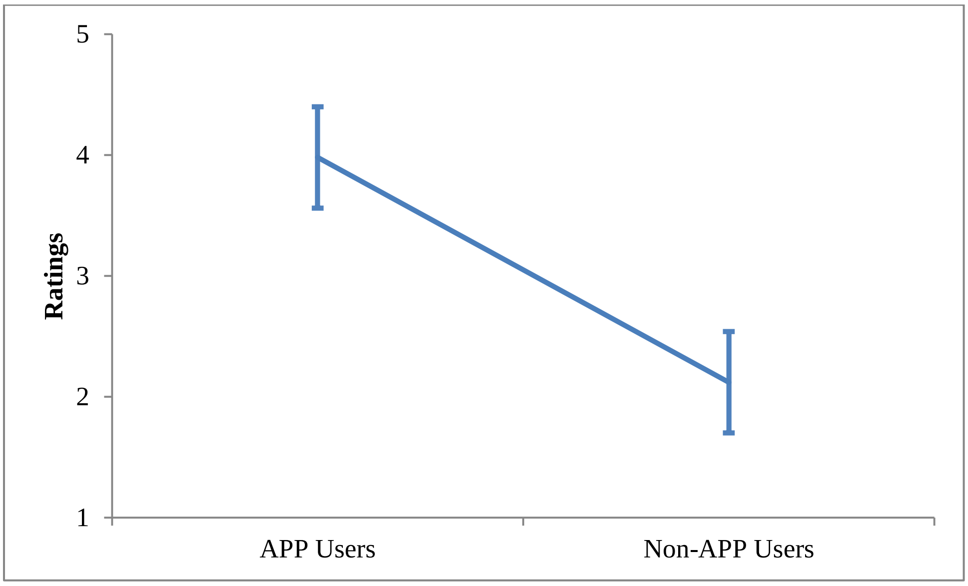


Figure 7-21: Profile of mean rating of information sharing with standard error for actual collaborative working

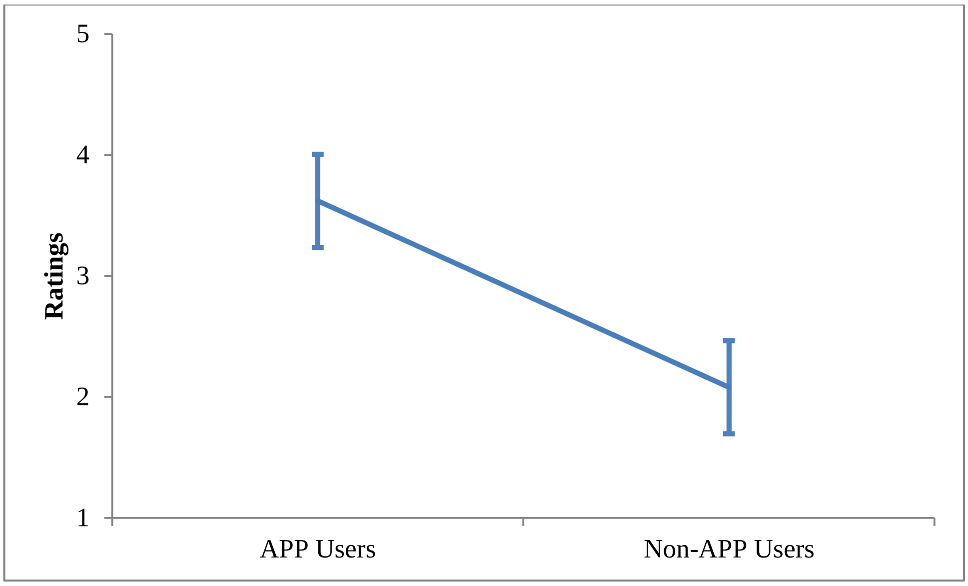


Figure 7-22: Profile of mean rating of conversation and social skills with standard error for actual collaborative working

7.5.2 Correlation between Collaborative Working Variables

There were five groups under each condition who undertook the evaluation. One group of application users has been removed from the correlation results because of their low evaluation, compared with others. This group also scored the lowest marks in both assignments. The non-application users' groups remain the same for correlation analysis.

Table 7-27 shows a very strong statistically significant relationship between communication and information sharing for application users. The Pearson correlation was .804, which is positive. The p value was <0.001, which is less than the level of significance. So, when communication increases, the information sharing increases as well. In addition, there was a statistically significant strong relationship between communication, and conversation and social skills. The Pearson correlation test was .730 with p value <0.001. When communication goes up between students, conversation and social skills go up as well. The relationship between information sharing and conversation skills is considered to be strong because the p value was very close to level of significant. Figures 7-23, 7-24, and 7-25 show the correlation between all variables as dithered data in order to show whole plots for every group participant.

Table 7-28 shows the analysis results for the non-application user groups. There were very strong relationship between all communication, information sharing, and conversation and social skills. The correlation coefficient was positive and p value was <0.001, which is less than the level of significance. So, all variables are significantly related. Figures 7-26, 7-27, and 7-28 show the correlations between all variables as dithered data in order to show whole plots for every group participant.

Table 7-27: Correlation coefficient between three dependent variables for the application users only

		Communication	Information Sharing	Conversation and Social Skills
Communication	Pearson Correlation	1	.804	.730
	p		<.001	<.001
	N	20	20	20
Information Sharing	Pearson Correlation	.804	1	.587
	p	<.001		.006
	N	20	20	20
Conversation and Social Skills	Pearson Correlation	.730	.587	1
	p	<.001	.006	
	N	20	20	20

Table 7-28: Correlation coefficient between three dependent variables for non-application users

		Communication	Information Sharing	Conversation and Social Skills
Communication	Pearson Correlation	1	.940	.946
	p		<.001	<.001
	N	25	25	25
Information Sharing	Pearson Correlation	.940	1	.877
	p	<.001		<.001
	N	25	25	25
Conversation and Social Skills	Pearson Correlation	.946	.877	1
	p	<.001	<.001	
	N	25	25	25

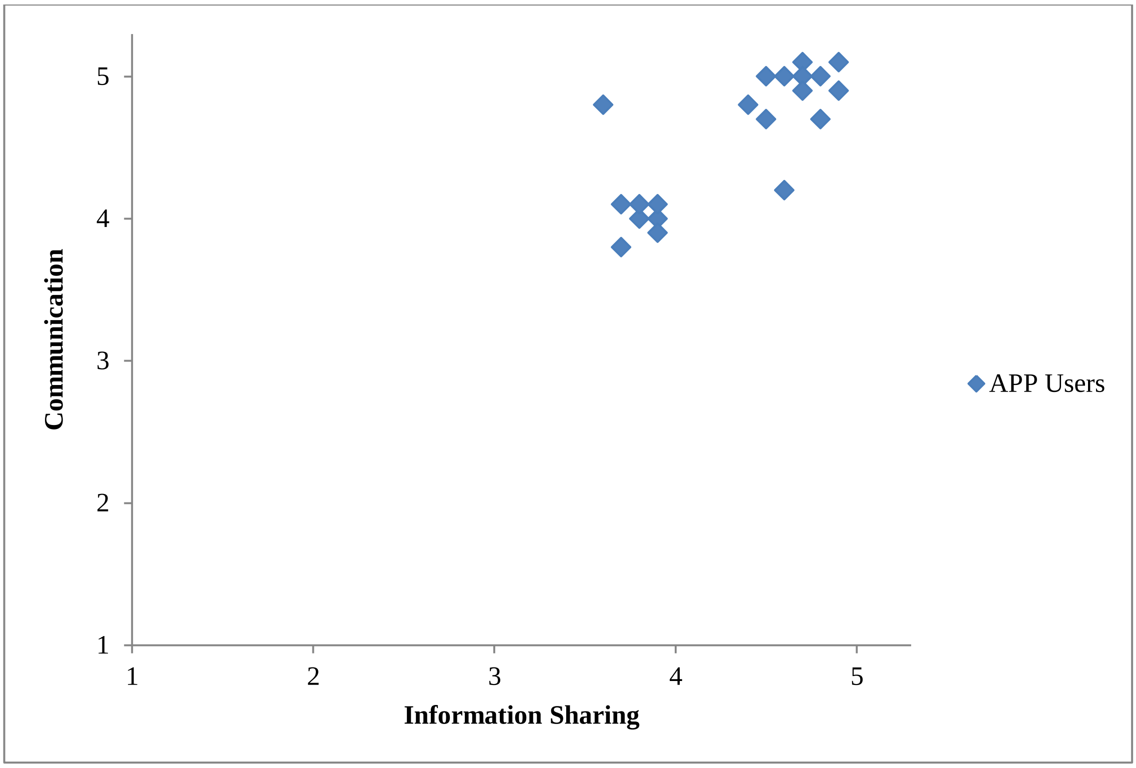


Figure 7-23: Scatter chart illustrating correlation between communication and information sharing for app users for 20 participants. The original data results have been dithered in order to show data points for each participant. The dithering starts at one decimal place.

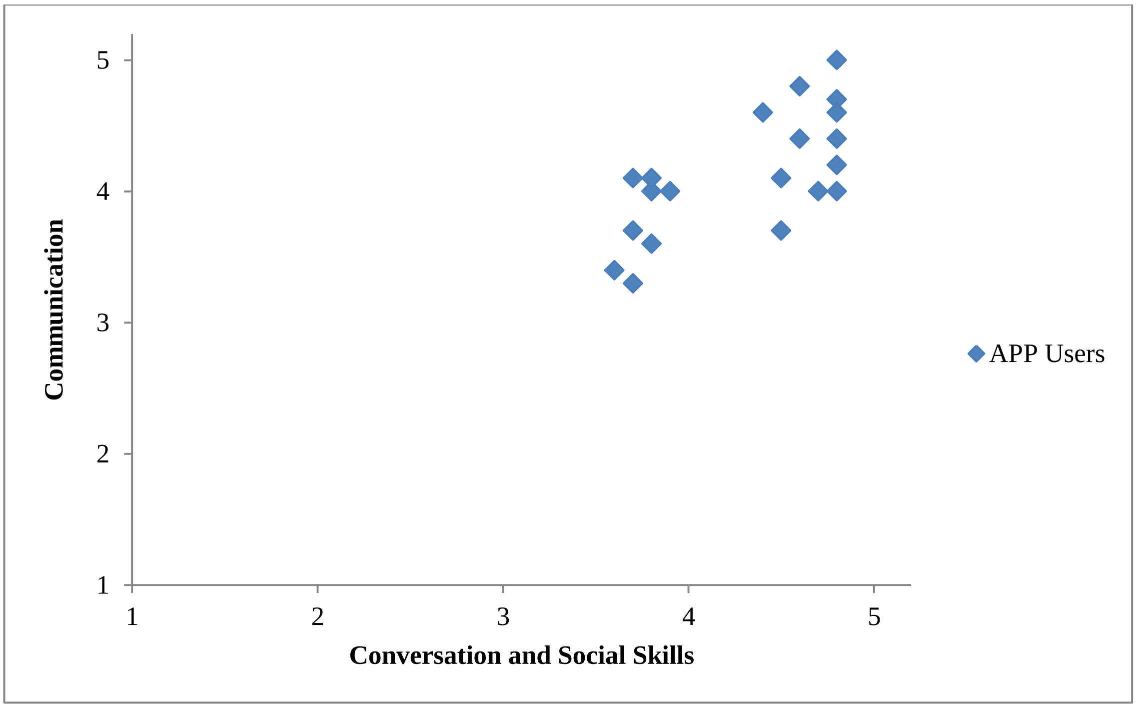


Figure 7-24: Scatter chart illustrating correlation between communication and conversation and social skills for app users for 20 participants. The original data results have been dithered in order to show data points for each participant. The dithering starts at one decimal place.

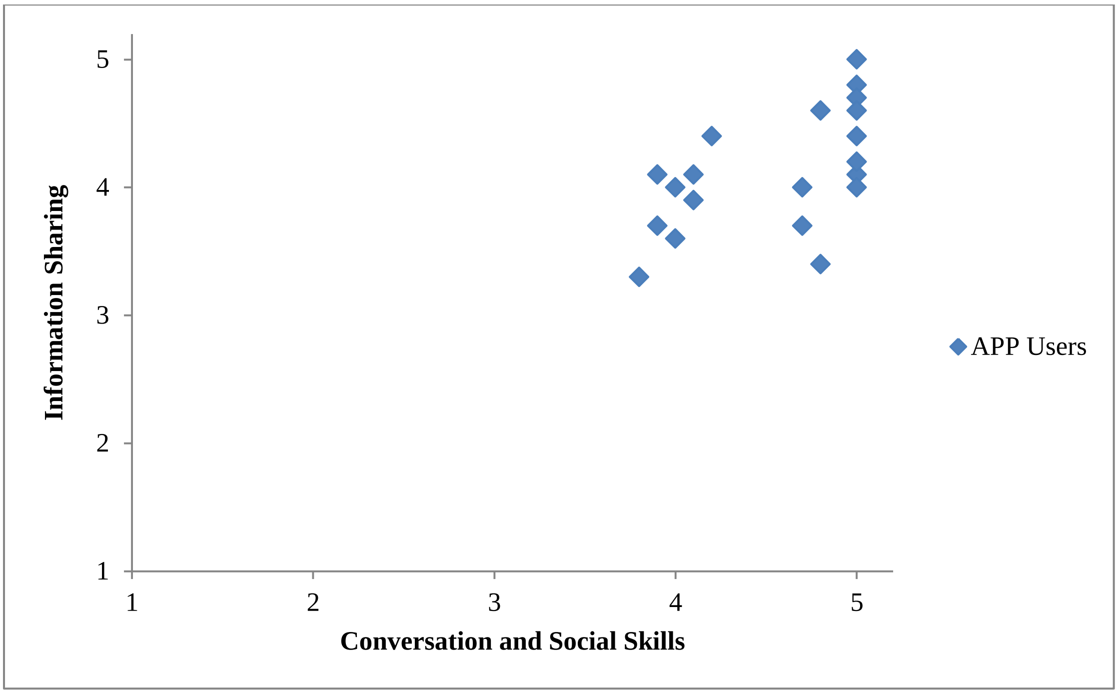


Figure 7-25: Scatter chart illustrating correlation between information sharing and conversation and social skills for app users for 20 participants. The original data results have been dithered in order to show data points for each participant. The dithering starts at one decimal place.

Figure 7-26: Scatter chart illustrating correlation between communication and information sharing for non-app users for 25 participants. The original data results have been dithered in order to show data points for each participant. The dithering starts at one decimal place.

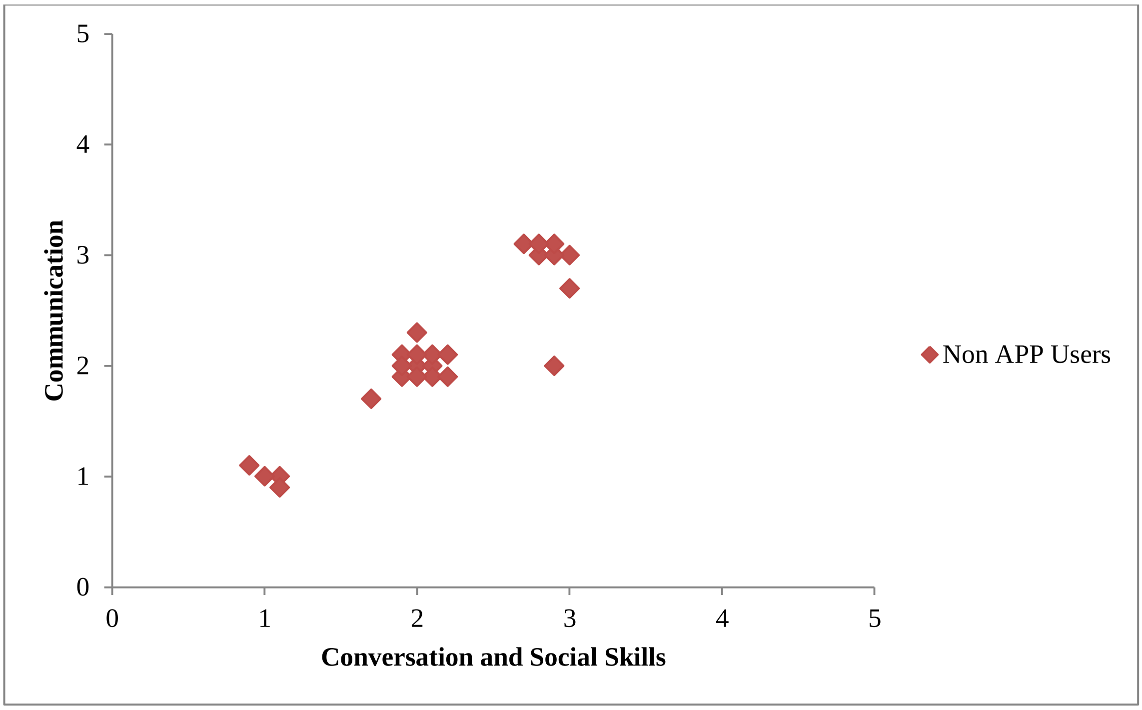


Figure 7-27: Scatter chart illustrating correlation between communication and conversation and social skills for app users for 25 participants. The original data results have been dithered in order to show data points for each participant. The dithering starts at one decimal place.

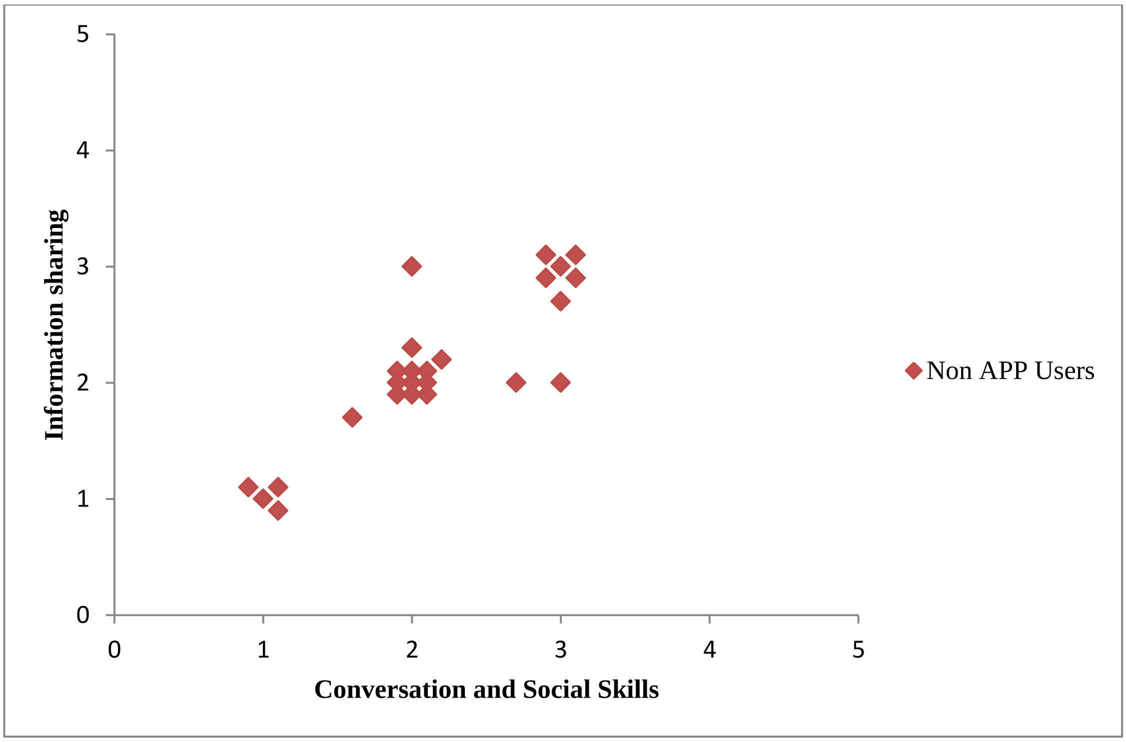


Figure 7-28: Scatter chart illustrating correlation between information sharing and conversation and social skills for app users for 25 participants. The original data results have been dithered in order to show data points for each participant. The dithering starts at one decimal place.

As can be seen from these figures of correlation under both conditions, it is stronger for non-application users than for application users. This is normal as, when correlation goes up, the degree of relationship become weaker. However, the Fisher test R to Z was used as described in Table 7-92. There is a statistically significant relationship between communication and information sharing, and between information sharing and conversation and social skills. The original figures, without data dithering, are listed in Appendix G.7.

Table 7-29: Fisher test R to Z for both conditions

Variables	**Results**	
Communication and information sharing	Z-Score:	-1.945
	P.Value (1-tail)	0.02
	P.Value (2-tail)	0.05
Communication and conversation and social skills	Z-Score:	-2.674
	P.Value (1-tail)	0.003
	P.Value (2-tail)	0.007
Information sharing and conversation and social skills	Z-Score:	-2.135
	P.Value (1-tail)	0.01
	P.Value (2-tail)	0.03

7.6 Results of Evaluation of Retrieved Social Information

As discussed in section 6.1.9, this section of the experiment aims to evaluate the professional skills of students from information on their Facebook profiles. The groups of students' evaluations were measured by using a five-point Likert-type scale ('strongly agree' to 'strongly disagree') in three categories of criteria: usefulness of prior knowledge, ease of use social information, and attitude toward representing social information about students from social media. There were 23 questions, which were mapped to these three categories as listed in Table 6-6. The rating was done individually by each group member. Then the average was taken for each group of the three metrics of subjective criteria in order to compare the SMC application with the plain-text documentation. Table 7-30 shows the purpose of experiment, the experiment's independent and dependent variables, the number of participants, and related research questions for this section of the experiment.

Table 7-30: Purpose, number of participants, independent and dependent variables, and related research question of retrieved social information evaluation section of experiment

Purpose	To investigate whether the SMC application and its contents can facilitate group formation more than paper-based documentation while using a social media platform. Also, this study makes judgments about whether learning results are affected by the group of students' prior knowledge.
Number of participants	50 students in school of computing - 25 students in ILOs application (5 groups of 5 students each) - 25 students in paper-based documentation (5 groups of 5 students each) Group averages have been taken.
Independent variable	• Ontologically structured competences through the SMC app and retrieved Facebook profile information within the SMC application (app users) • List of traditional competences through paper-based documentation as plain text and access to Facebook profiles (non-app users)
Dependent variables	1.Usefulness of prior knowledge (11 questions) 2.Ease of use social information about students (4 questions) 3.Attitude toward representing social skills (8 questions)
Research questions being addressed	Does the SMC application facilitate group formation using social media? • Does groups of students' prior knowledge influence learning results? • Does retrieved related social information meet with the satisfactionof groups of students?

7.6.1 Experiment Analysis Results for Retrieved Social Information

The multivariate test of significance (MANOVA) between the mean ratings of professional skills was used to analyse the data obtained from 10 groups of students. Table 7-31 shows the results of mean and standard deviation of all dependent variables. Table 7-32 shows the results of multivariate test of significance between the mean ratings for all dependent variables. Refer to Appendix G.8 for all seprate variables.

The results indicate that the mean rating of all dependent variables for the SMC application group was higher than for paper-based documentation group. However, the usefulness or prior knowledge mean was slightly different between the app users and the non-app users. The mean was 2.9 for application users and 2.2 for non-application users. Table 7-32 shows the p value of Pillai's Trace is 0.001. This means the p value is less than 0.05, so the difference between app users and non app users was statistically significant, based on three categories. Figures 7-29, 7-30, and 7-31 show the profile graphs of those variables with standard error.

Table 7-31: Mean and standard deviation of all dependent variables as groups for evaluation of retrieved related social information

Condition		Mean	Std. Deviation	N
Usefulness of prior knowledge	App users	2.9	.2	5
	Non-app users	2.2	.2	5
Ease Of Use	App users	5.0	.0	5
	Non-app users	2.0	.7	5
Attitude	App users	5.0	.0	5
	Non-app users	2.6	.5	5

Table 7-32: Multivariate test (MANOVA) for all dependent variables of retrieved related social information

Effect		Value	F	Hypothesis df	Error df	p
Condition	Pillai's Trace	.93	28.35	3.00	6.00	.001

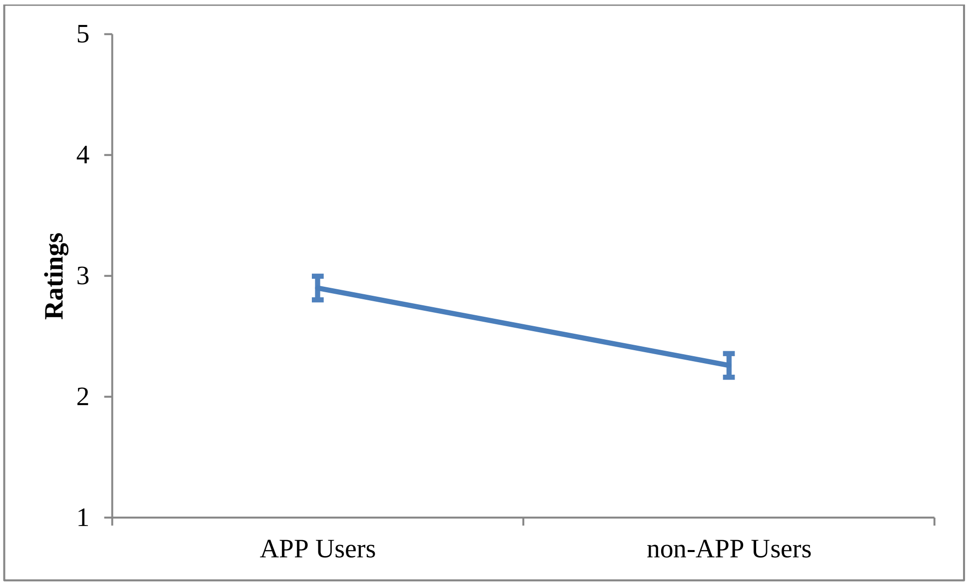


Figure 7-29: Profile of mean rating of usefulness of prior knowledge with standard error for participants' social information

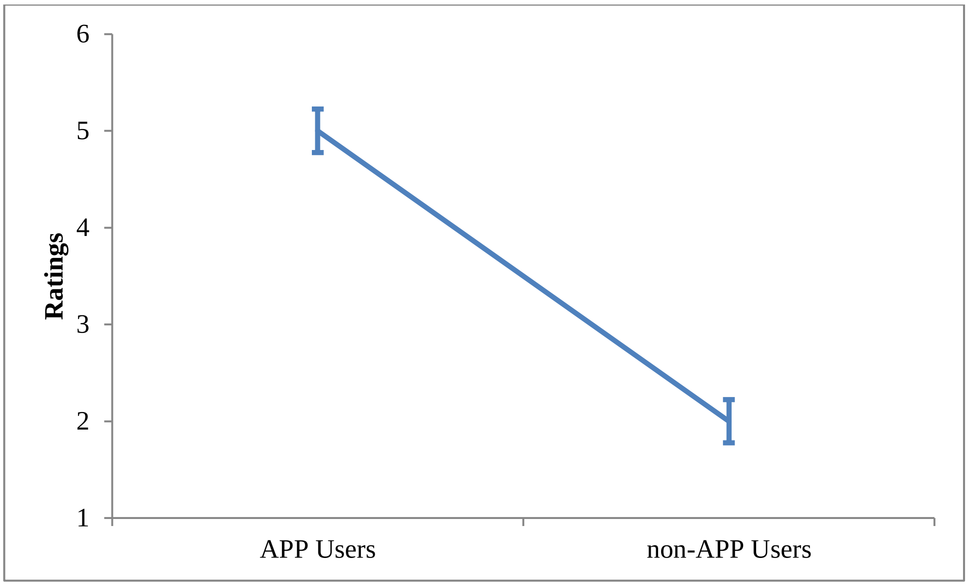


Figure 7-30: Profile of mean rating of ease of use social information about students with standard error for participants' social information

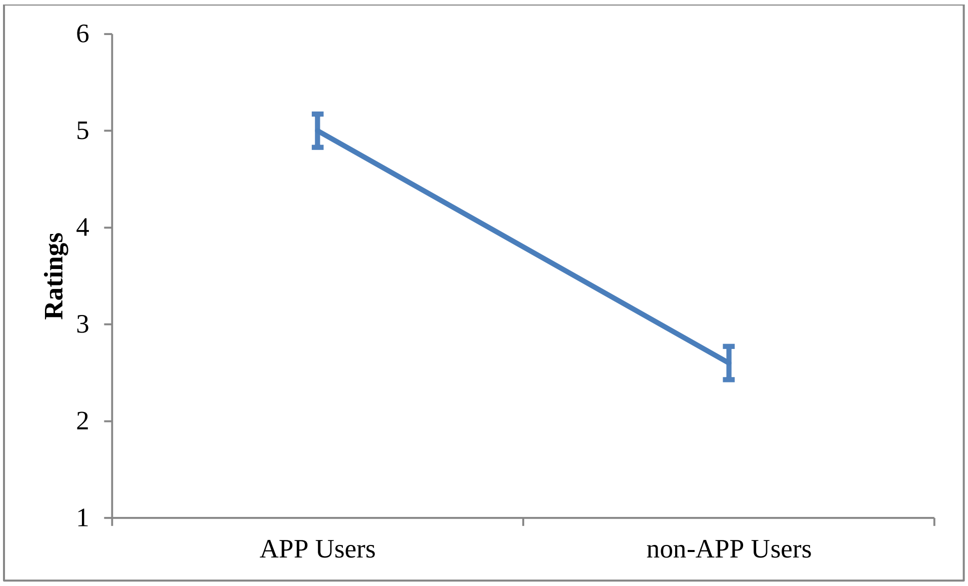


Figure 7-31: Profile of mean rating for attitude toward representing social skills with standard error for participants' social information

7.7 Post-Test Results

There were 58 participants who took the pre-test, so the researcher could ensure that they have no knowledge of normalisation. The pre-test consists of two questions with a number of sub-questions. The total mark allocated for the pre-test was seven, and time allowed was five minutes only. The researcher made a quick tour of participants to check their answers. Participants who scored four and above in the pre-test were excluded from the experiment, which in total was eight individuals. Then the participants were divided randomly by researcher to perform given assignments by using either the SMC application or the paper-based documentation. The results were analysed based on accepted 50 participants for pre-test. At the end of evaluation questionnaires, the same participants were asked to take a post-test. This was the same as the pre-test in terms of content, marks, and time to answer. The participants under the two conditions undertook the post-test individually. The questions can be found in Appendix E.1

Two-way repeated measures ANOVA was used to analyse the obtained test scores, in order to determine the better learning results of the application users and the paper-based document. Table 7-33 shows the mean and standard deviation of test scores, and Table 7-34 shows the test between subject and effect.

Table 7-33: Mean and standard deviation of pre-test and post-test scores

Test Type	Condition	Mean	Std. Deviation	N
Pre Test	App users	1.4	.8	25
	Non-app users	1.1	.8	25
Post Test	App users	7.0	.0	25
	Non-app users	4.6	2.3	25

Table 7-34: Test between-subjects effects of pre and post-tests

Source	Type III Sum of Squares	df	Mean Square	F	p	Partial Eta Squared
Corrected Model	588.400[a]	3	196.133	114.642	<.001	.782
Intercept	1267.360	1	1267.360	740.785	<.001	.885
Test Type	519.840	1	519.840	303.852	<.001	.760
Status	43.560	1	43.560	25.461	<.001	.210
Test Type * Status	25.000	1	25.000	14.613	<.001	.132
Error	164.240	96	1.711			
Total	2020.000	100				
Corrected Total	752.640	99				

The results from the statistical data obtained (as shown in Tables 7-33 and 7-34) are as follows.

- There was a slight difference between the means of the app users and the non-app users in performing the pre-test. The post-test mean for the app users was statistically significantly higher than for the non-app users.
- There was an interaction effect between test type and status p value <0.001 which is less than 0.05.
- There was a statistically significant test type effect (pre and post-test) as the p value is <0.001 < 0.05.
- There was statistically significant status effect (app user or non-app users) as the p value is <0.001 <0.05

The profile plots illustrate the interaction in Figure 7-32 with standard error.

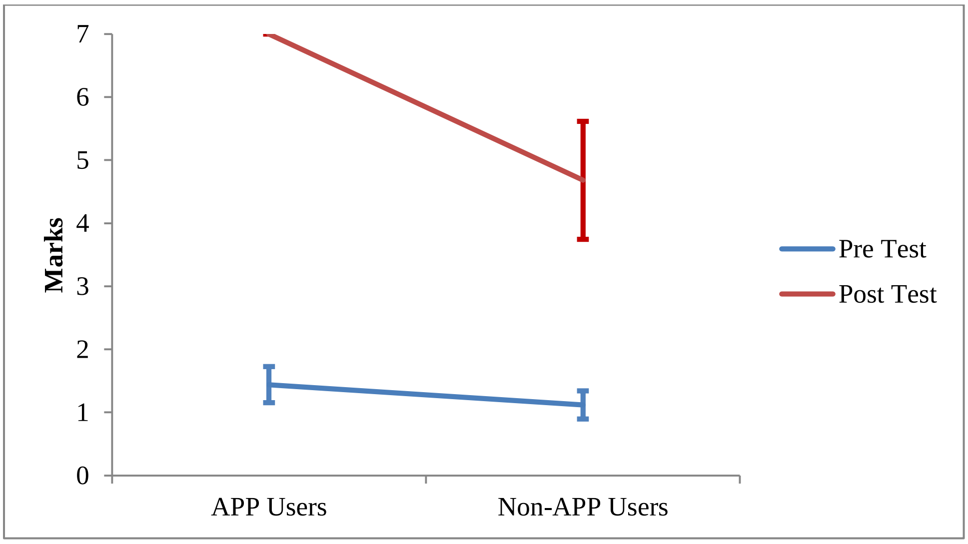


Figure 7-32: Profile of mean test scores of pre- and post-tests with standard error

7.8 Summary

Five main research questions of the first experiment that are related to the learning side have been presented in this chapter. In order to exclude participants who seemed to be familiar with the chosen field of normalisation, a pre-test was conducted. This showed that there was an equivalence between application and non-application users in terms of test scores. The assignment section concerns checking the learning results under the two conditions. It was found that participants who used the SMC application obtained higher marks in the technical task and performed better collaborative work in groups than participants who used the paper-based documentation. The mean for application users was significantly higher than non-application users in both tests. In addition, the results of application users in both assignments were full marks, or close to full marks, apart from one group. On the other hand, there was one group of non-application users that achieved high marks in both tests.

In terms of evaluating the SMC application, groups of participants who used the application found that the competences of the technical task and the group working task were easy to understand, easy to navigate and possessed perfect consistency. They also showed a high level of satisfaction in terms of presenting competences and helping them to perform their future tasks. The other groups, which used paper-based documentation, found difficulties in understanding and following the competences' structure. In addition, groups of participants who used the application rated collaborative working higher than others. Moreover, retrieving social information about students seems helpful in forming suitable groups, rather than accessing each individual's Facebook profile to obtain information about each member.

The first experiment concluded with a post-test, which was identical to the pre-test. Participants who used the SMC application achieved full marks; whereas those who used the paper-based documentation made mistakes on several questions again.

The next chapter will present the analysis results of the second experiment and another study survey. The experiment deals with the teaching side by using OSC to improve teaching performance. The study survey deals with enhancing the teaching and learning environment by using Facebook Groups.

Chapter 8: Experimental Results of Using OSC to Improve Teaching Performance and Using Facebook Groups to Enhance the Teaching and Learning Environment

The previous chapter described the results of learning side of the first experiment. This chapter continues to present an analysis of the second experiment and additional a study survey with further details. The experiment deals with the teaching side by applying the Ontologically Structured Competences (OSC) to teaching and investigating whether it can improve the teaching performance of instructors. The study survey investigates the enhancement of the teaching and learning environment by using Facebook Groups for module activities. The statistical tests and results are presented in this chapter for these experiment and study survey. Each is presented separately, with related research questions and analysis.

8.1 Experiment of Applying Ontologically Structured Competences to Improve Teaching Performance

As discussed in section 6.2, the OSC have been used on the learning side when investigating students' results for given assignments, comparing them with those achieved with a traditional list of competences. The students' learning results under both conditions have been shown in the previous chapter. However, if instructors apply OSC to their teaching, will the teaching performance improve? The instructors thinking and opinion are important to this experiment. The academic lecturers' opinion were measured by using a 5-point Likert-type scale ('strongly agree' to 'strongly disagree') for nine statements relating to OSC instead of list of competences as listed in table 6-7 with corresponding variables, and improving the teaching performance. Table 8-1 shows the purpose of this experiment, the number of participants, the study method, the dependent variables, the conjecture and research question related to this experiment.

Table 8-1: Purpose, number of participants, study method, dependent variables, conjecture and research questions related to the experiment of applying OSC to teaching

Purpose	To investigate whether ontologically structured competences can lead to better teaching performance
Number of participants	84 academic lecturers in a School of Computing with different positions at the university
Study Method	A presentation that features two styles of competences (OSC and traditional lists) Participants were asked to indicate their opinion on applying OSC in their teaching
Dependent variables	Nine questions were asked about: • Clearer goals of teaching • Clear sequence of teaching • Determining the level of knowledge and starting point of teaching • Reviewing acquired knowledge regularly • Delivering better matched subject matter • Delivering greater depth of subject matter • Setting more direct assignments • Timely feedback for students • Make the teaching innovative
Conjecture	*If competences are ontologically structured, then the instructors think they would to perform better teaching.*
Research question Being addressed	Do instructors think that using ontologically structured competences leads to better teaching?

8.1.1 Experiment Analysis Results of Applying OSC to Teaching

The one-sample t-test was used to compare the mean score of a sample to a known value. In this experiment, a one sample t-test was used to determine whether the mean rating for each dependent variable against the approach was significantly higher or lower than 3 (three). This gives the answer to this experiment. A value of 3 indicates ‘Neither agree nor disagree’ on the Likert scale that was used. As a t-test is used to analyse data for each dependent variable separately, The Bonferroni correction (Toothaker, 1993) is then used to obtain a new significant level for the t-test. Table 8-2 shows the mean, standard deviation and standard error mean of all dependent variables in this experiment. Table 8-3 shows the one-sample t-test with p-value as a level of significance.

A Bonferroni correction was used to ensure that no false positives were induced in the data. In order to do so, a variable was only deemed important if its p-value was $< \alpha/_{n} = {}^{0.05}/_{9} = 0.0055 (where\ n\ is\ number\ of\ tests)$. This value indicates that the null value hypothesis was only rejected if the respective p-value was <0.0055. So, the new level of significance for this study, based on the Bonferroni correction, is 0.0055. That means that the p-value has to be less than 0.0055 in order to say that there is a statistically significant result. Without using the Bonferroni correction, the chance of finding one or more statistically significant difference in nine tests is 0.3698 (36.98%). However, by using the Bonferroni correction, the chance of finding one or more statistically significant differences in nine tests is 0.0484 (4.84%).

Table 8-2: Mean, Standard Deviation, and Standard Error Mean of all dependent variables of applying OSC to teaching

Variables	N	Mean	Std. Deviation	Std. Error Mean
T1	84	4.1	.8	.09
T2	84	4.3	.9	.09
T3	84	4.2	.8	.09
T4	84	4.1	.8	.09
T5	84	4.0	.8	.09
T6	84	4.0	.9	.10
T7	84	3.9	.9	.10
T8	84	3.9	.8	.09
T9	84	3.9	.9	.09

Table 8-3: One-sample t-test of applying OSC to teaching

Variables	Test Value = 3					
	t	df	p	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
T1	11.98	83	<.001	1.1	.9	1.3
T2	13.26	83	<.001	1.3	1.1	1.5
T3	13.59	83	<.001	1.2	1.1	1.4
T4	11.66	83	<.001	1.1	.9	1.3
T5	10.52	83	<.001	1.0	.8	1.2
T6	10.02	83	<.001	1.0	.8	1.2
T7	9.56	83	<.001	.9	.7	1.1
T8	10.39	83	<.001	.9	.7	1.1
T9	9.70	83	<.001	.9	.7	1.1

The results from Table 8-2 and Table 8-3 were as follows:

1. Dependent variable: 'Will give me clearer goals in my teaching' as $p < 0.0055$, the mean rating of ' Will give me clearer goals in my teaching' for OSC was statistically significantly higher than 3.
2. Dependent variable: 'Will give me a clear sequence in my teaching' as $p < 0.0055$, the mean rating of 'Will give me a clear sequence in my teaching' for OSC was statistically significantly higher than 3.
3. Dependent variable: 'Will enable me to determine at which level of knowledge I should start teaching' as $p < 0.0055$, the mean rating of 'Will enable me to determine at which level of knowledge I should start teaching' for OSC was statistically significantly higher than 3.
4. Dependent variable: 'Will enable me to review regularly my students' acquire knowledge before moving to new points' as $p < 0.0055$, the mean rating of 'Will enable me to review regularly my students' acquire knowledge before moving to new points' for OSC was statistically significantly higher than 3.
5. Dependent variable: 'Will enable me to deliver to my students subject matter that is better matched to competences' as $p < 0.0055$, the mean rating of 'Will enable me to deliver to my students subject matter that is better matched to competences' for OSC was statistically significantly higher than 3.
6. Dependent variable: 'Will enable me to deliver to my students subject matter in great depth' as $p < 0.0055$, the mean rating of 'Will enable me to deliver to my students subject matter in great depth' for OSC was statistically significantly higher than 3.
7. Dependent variable: 'Will allow me to set assignments that link more directly to taught competences' as $p < 0.0055$, the mean rating of 'Allows me to set assignments that link more directly to taught competences' for OSCs was statistically significantly higher than 3.
8. Dependent variable: 'Will allow my students to obtain timely feedback on their performance' as $p < 0.0055$, the mean rating of 'Allows my students to obtain timely feedback on their performance' for OSC was statistically significantly higher than 3.
9. Dependent variable: 'Will make my teaching innovative' as $p < 0.0055$, the mean rating of 'Makes my teaching innovative' for OSC was statistically significantly higher than 3.

The profile of mean of all dependent variables with standard error mean is shown in Figure 8-1.

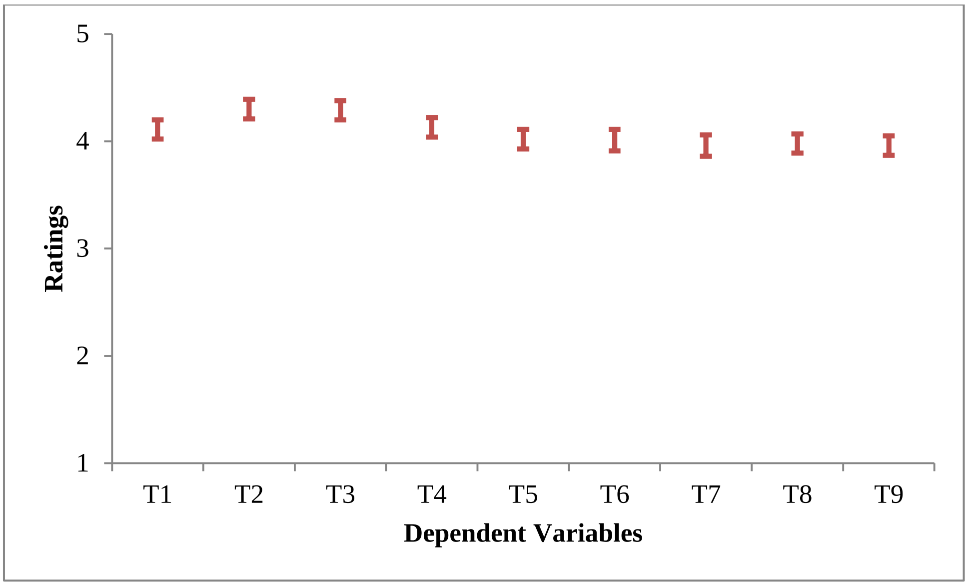


Figure 8-1: Profile of mean ratings of all dependent variables for applying ontologically structured competences to teaching situation with standard error

8.2 Study of Enhancing Teaching and Learning Environment by Using Facebook Group for Module Activities

As discussed in section 6.3, a Facebook group could be use in academia in order to enhance the teaching and learning environment through modules activities. The opinions of instructors who are familiar with Facebook are highly important in this study. The academic lecturers' opinions were measured by using a 5-point Likert-type scale ('strongly agree' to 'strongly disagree') for six statements relating to Facebook group as listed in Table 6-8 with corresponding variables in order to enhance teaching and learning environment. Table 8-4 shows the purpose of this study, the number of participants, the study method, the dependent variables, the conjecture, and research questions related to this study.

Table 8-4: Purpose, number of participants, study method, dependent variables, conjecture, and research question to the study of using Facebook Group to enhance teaching and learning environment

Purpose	To investigate that Facebook enhances the teaching and learning environment by creating a Facebook group for module activities
Number of participants	80 academic lecturers in School of Computing with different range of positions at the university
Study Method	Assuming that there was a Facebook group for own module activities. A questionnaire regarding Facebook and Facebook Groups was answered by instructors who were familiar with Facebook
Dependent variables	Six questions about: • Increasing interaction with students in less formal environment • Increasing the engagement with course • Giving an indication to students of difficulties with taught topics • Encouraging students to conduct effective discussions • Increasing students' motivation to learn • Allowing students to pay more attention to the teaching topics
Conjecture	*If a module has a Facebook group, then the instructors would think the teaching and learning environment will be enhanced.*
Research question	Do instructors think that Facebook Group enhances the students' teaching and learning environment?

8.2.1 Analysis Results of Using Facebook Group to Enhance Teaching and Learning Environment

The one-sample t-test was used to compare the mean score of a sample to a known value. In this study, a one sample t-test was used to determine whether the mean rating for each dependent variable against the approach was significantly higher or lower than 3 (three). This answers this research study. A value of 3 indicates 'Neither agree nor disagree' on the Likert scale that was used. As a t-test is used to analyse data for each dependent variable separately, the Bonferroni correction (Toothaker, 1993) was then used to obtain a new significance level for the t-test. Table 8-5 shows the mean, standard deviation and standard error mean of all dependent variables to this study. Table 8-6 shows the one-sample t-test with p-value as a level of significance.

A Bonferroni correction was used to ensure no false positives were induced in the data. In order to do so, a variable was only deemed important if its p-value was $< {}^{\alpha}/_{n} = {}^{0.05}/_{6} = 0.0083 (where\ n\ is\ number\ of\ tests)$. This value indicates that the null value hypothesis was only rejected if the respective p-value was <0.0083. So, the new level of significance for this study, according to the Bonferroni correction is 0.0083. That means that the p-value has to be less than 0.0083 in order to say that there is statistically significant result. Without using the Bonferroni correction, the chance of finding one or more statistically significant differences in six tests is 0.2649 (26.49%). However, by using the Bonferroni correction the chance of finding one or more statistically significant difference in six tests is 0.0488 (4.88%).

Table 8-5: Mean, standard deviation, and standard error of mean of all dependent variables of using Facebook to enhance the teaching and learning environment

Variables	N	Mean	Std. Deviation	Std. Error Mean
F1	80	4.2	.8	.09
F2	80	4.0	.8	.09
F3	80	4.0	.8	.09
F4	80	3.9	.8	.09
F5	80	4.0	.8	.09
F6	80	3.9	.8	.09

Table 8-6: One-sample test of using Facebook in teaching and learning environment

	Test Value = 3					
					95% Confidence Interval of the Difference	
Variables	t	df	p	Mean Difference	Lower	Upper
F1	12.80	79	<.001	1.2	1.0	1.4
F2	11.38	79	<.001	1.0	.8	1.2
F3	10.40	79	<.001	1.0	.8	1.2
F4	10.14	79	<.001	.9	.7	1.1
F5	10.57	79	<.001	1.0	.8	1.2
F6	10.01	79	<.001	.9	.7	1.1

The results from Table 8-5 and Table 8-6 are as follows:

1. Dependent variable: 'A Facebook group for my module allows me to increase interaction with my students about the topic in less formal environment' as $p < 0.0083$, the mean rating of 'A Facebook group for my module allows me to increase interaction with my students about the topic in less formal environment' for using Facebook to enhance teaching and learning environment was statistically significantly higher than 3.
2. Dependent variable: 'A Facebook group increases the engagement with my course for my students' as $p < 0.0083$, the mean rating of ' A Facebook Group increases the engagement with my course for my students' for using Facebook to enhance teaching and learning environment was statistically significantly higher than 3.
3. Dependent variable: 'A Facebook group gives me an indication of students' difficulties with taught topics, especially when raising questions on specific points' as $p < 0.0083$, the mean rating of 'A Facebook group gives me an indication of students' difficulties with taught topics, especially when raising questions on specific points' for using Facebook to enhance teaching and learning environment was statistically significantly higher than 3.
4. Dependent variable: 'A Facebook group encourages my students to conduct effective discussions' as $p < 0.0083$, the mean rating of ' A Facebook Group encourages my students to conduct effective discussions' for using Facebook to enhance teaching and learning environment was statistically significantly higher than 3.
5. Dependent variable: 'A Facebook group increases my students' motivation to learn' as $p < 0.0083$, the mean rating of ' A Facebook Group increases my students' motivation to learn' for using Facebook to enhance teaching and learning environment was statistically significantly higher than 3.
6. Dependent variable: 'A Facebook group allows my students to pay more attention to the teaching topics' as $p < 0.0083$, the mean rating of ' A Facebook group allows my students to pay more attention to the teaching topics' for using Facebook to enhance teaching and learning environment was statistically significantly higher than 3.

The profile graph of mean of all dependent variables with standard error mean is showed in Figure 8-2.

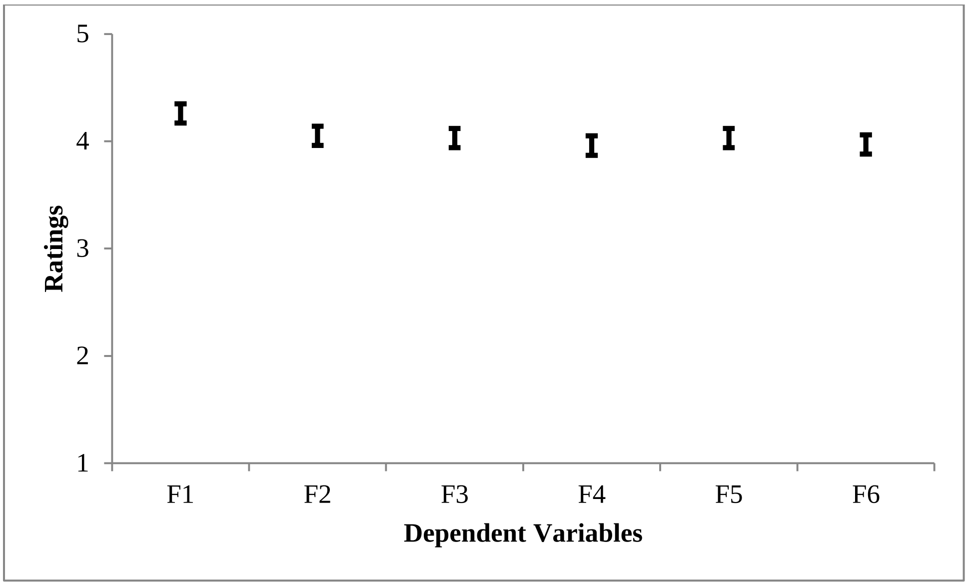


Figure 8-2: Profile of mean ratings of all dependent variables for using Facebook to enhance teaching and learning environment with standard error

8.3 Demographic Questions Regarding Teaching Experience and Using Social Media

The following sub sections concern academic teachers' teaching experience and use of social media both in general and specifically for academic purposes.

8.3.1 Academics' Teaching Experience

Academic teachers were asked to indicate their length of teaching experience at a university. There were 30 academics who had taught between one and five years at university. For a period of between six to 10 years there were 27 academics, and there were 15 who had been teaching at university for between 11 and 15 years. For the greater period of 16 to 20 years, there were 10 academics. One further academic had spent between 21 and 25 years teaching at university, and another who had spent between 31 and 35 years.

These academic teachers have various positions at the university. There were 10 academics who undertook teaching assistance, 28 academics who were lecturers, 23 academics who were assistance professors, 20 associate professors, and three full professors. The majority currently teach computer science. The other subjects include information system (20%) and information technology (14%). Figure 8-3 shows the various lengths of time teaching at university against the number of academics teachers, and Figure 8-4 shows their academics positions, while Figure 8-5 shows their current teaching area.

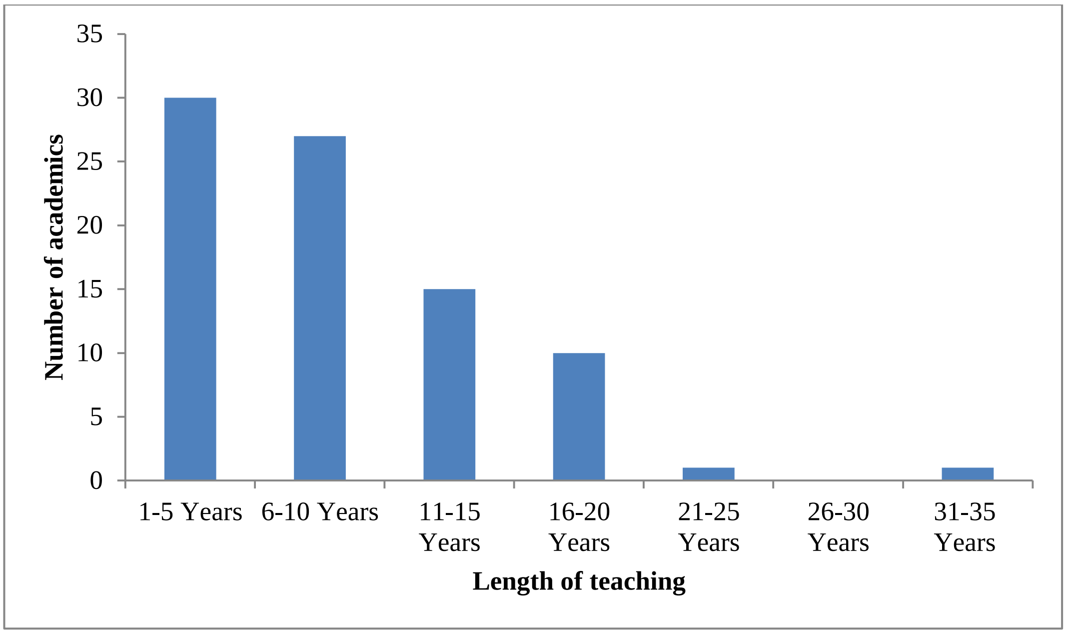


Figure 8-3: Length of experience of teaching by academics at the university.

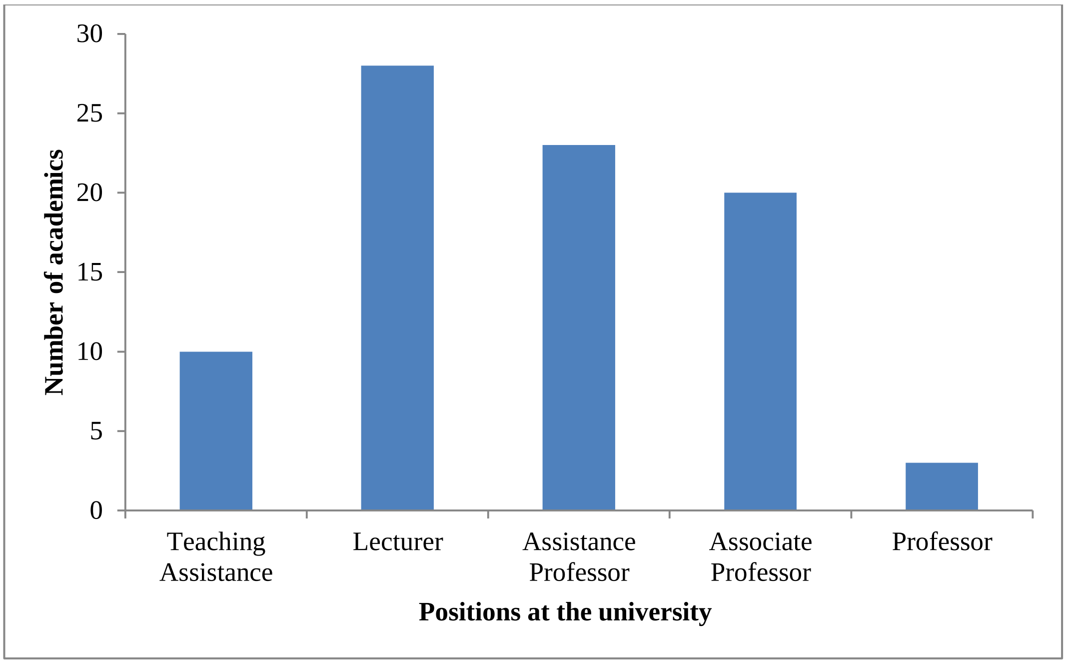


Figure 8-4: Academic positions held at the university

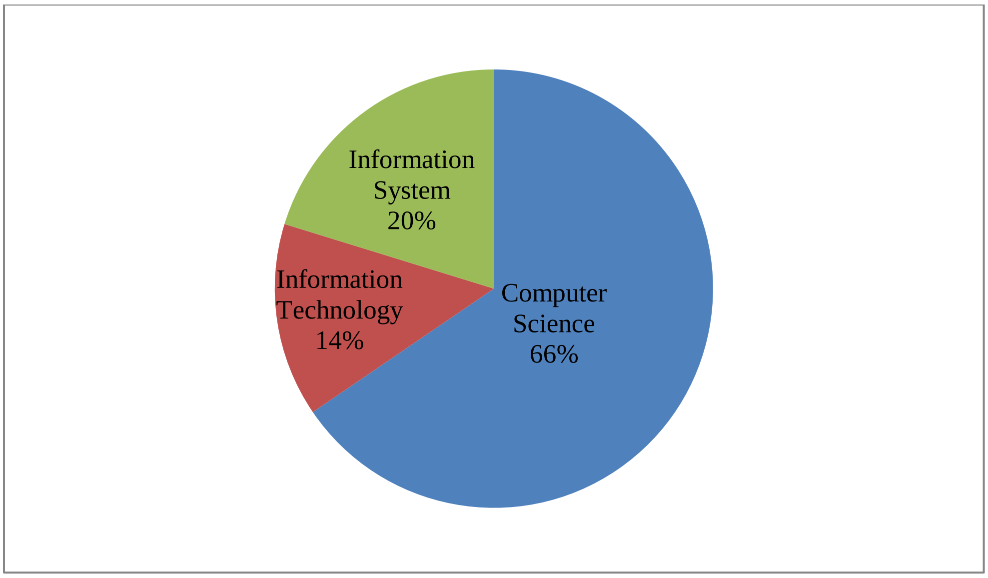


Figure 8-5: Academics' main subject area of teaching

8.3.2 Academic Experience of Using Social Media in General and in Academia

Academics were asked about using social media to support their teaching. There was 1% (1 academic) who always uses social media. In addition, there were 6% (5 academics) who often did. The greatest percentage was 42% (35 academics), who sometimes use social media for teaching purposes. By contrast, 32% (27 academics) of participants rarely depend on social media to support their teaching. Moreover, 19% (16 academics) never use it. Figure 8-6 illustrates numbers of academics against the usual level of their use of social media to support teaching.

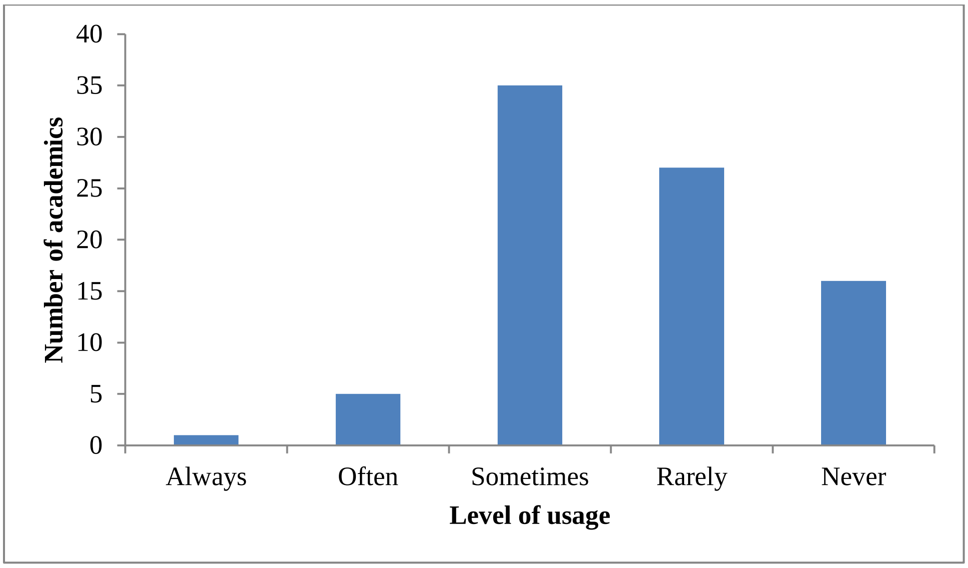


Figure 8-6: Number of academics showing their usual level of use of social media to support teaching

The academic teachers were asked to indicate which social media tool they generally used. The most used were Facebook, Twitter and WhatsApp (13% each). The second most used is YouTube at 12%. After that comes Instagram at 9%, Snapchat at 8%, LinkedIn at 7%, and Google Plus with Telegram at 6% of the usage by academic teachers in general. In addition, there were some tools that were used by academics in general, such as Periscope and Ask at 3% each. Keek and Kik have 2% of usage in general. , and a number of tools scored 1% of usage, such as Tumblr, Pinterest, Flicker and Vine. Figure 8-7 shows the percentage of usage for social media tools in general use by academics.

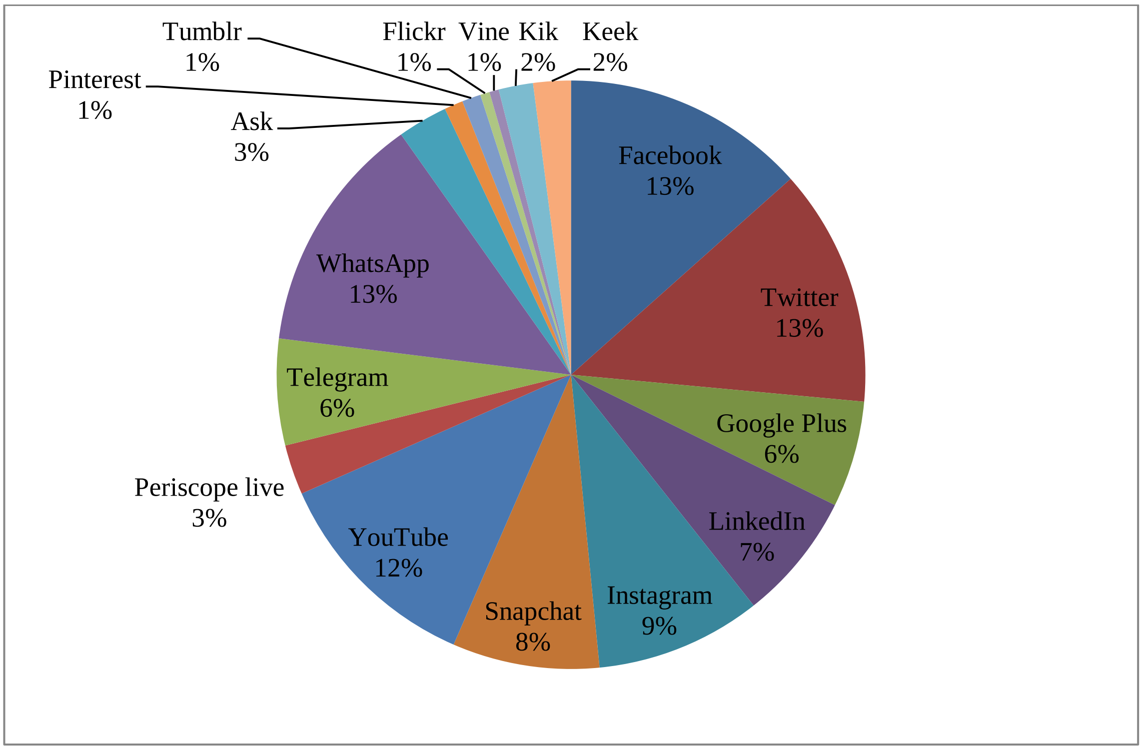


Figure 8-7: Academic usage of social media tools in general, the rest of the social media tools were zero

The academics specified their usage of Facebook in general. Most in this study used Facebook once a day, at 34% (29 academics). Some 18% (15 academics) used Facebook frequently, and 17% (14 academics) used it approximately five times a day. There were 14% (12 academics) who used Facebook once a month, and 11% (9 academics) who did so once a week. Furthermore, there were 6% (5 academics) who did not use Facebook. Figure 8-8 illustrates the academic usage of Facebook in general.

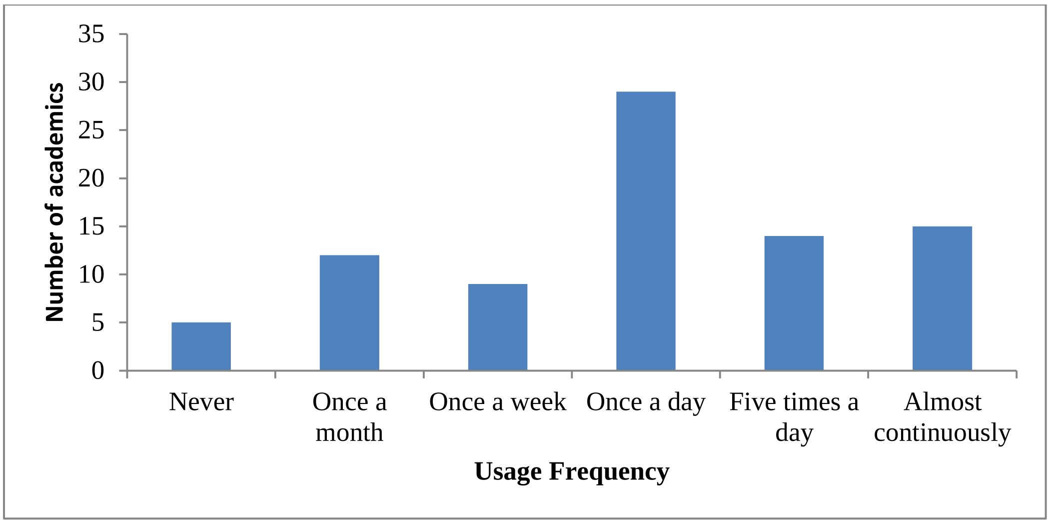


Figure 8-8: Academic teachers' usage Facebook in general

The lectures were asked to specify how many Facebook groups they had joined, for any purposes. The majority had joined between one and five. Some 14 % had joined between six and 10, where just 8% of participants had joined 11 to 15 Facebook groups. Figure 8-9 shows the number of Facebook groups that academic teachers had joined for any purpose.

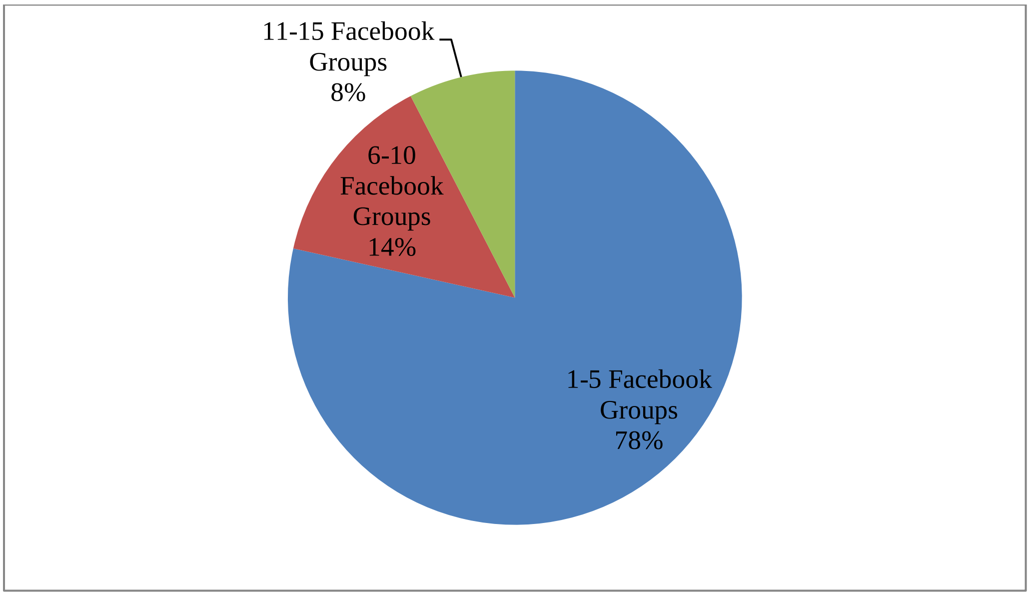


Figure 8-9: Numbers of Facebook groups that academics have joined for any purpose

In terms of interaction with the Facebook groups they had joined, the majority of participants in this study indicated they interacted once a day, at 32% (27 academics). In addition, 20% (17 academics) interacted with the Facebook groups they had joined once a month, and 16% (13 academics) did so once a week. In terms interacting five times a day or frequently with the Facebook groups they had joined were 11% (9 academics), whereas 7 % (6 academics) never interacting with them. Figure 8-10 illustrates the academics' interaction with Facebook groups that they had joined.

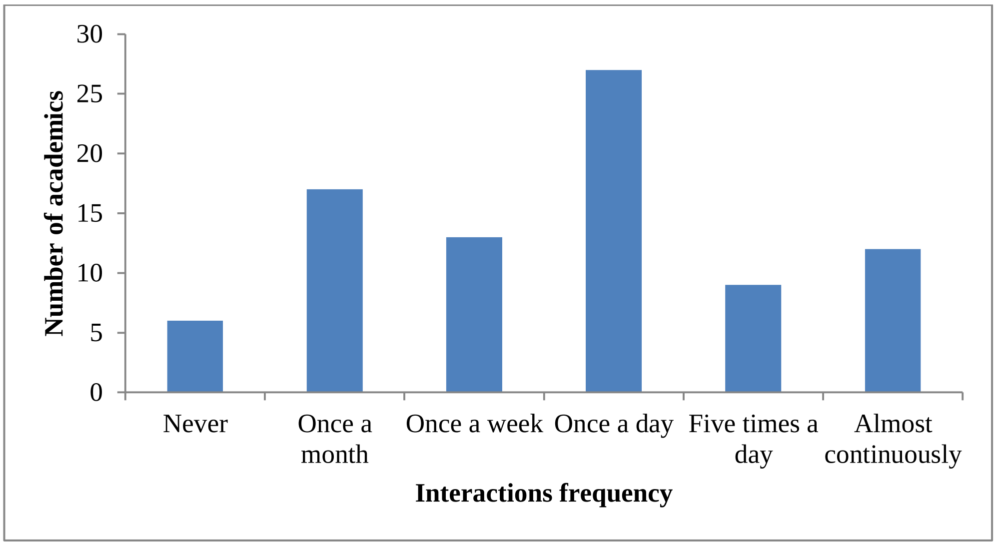


Figure 8-10: Frequency of academics' interactions with Facebook groups that they had joined

In terms of using Facebook Groups in teaching, there were 38% (32 academics) who use Facebook once a month for teaching purposes. There were 18% (15 academics) who used it in teaching on a weekly basis. Moreover, there were 8% (7 academics) who did so once a day and 3% (2 academics) more frequently. There was one academic who uses Facebook for teaching purpose almost continuously. However, 32% (27 academics) do not use Facebook Groups in their teaching purposes. Figure 8-11 shows the level of academic usage of Facebook Groups in teaching.

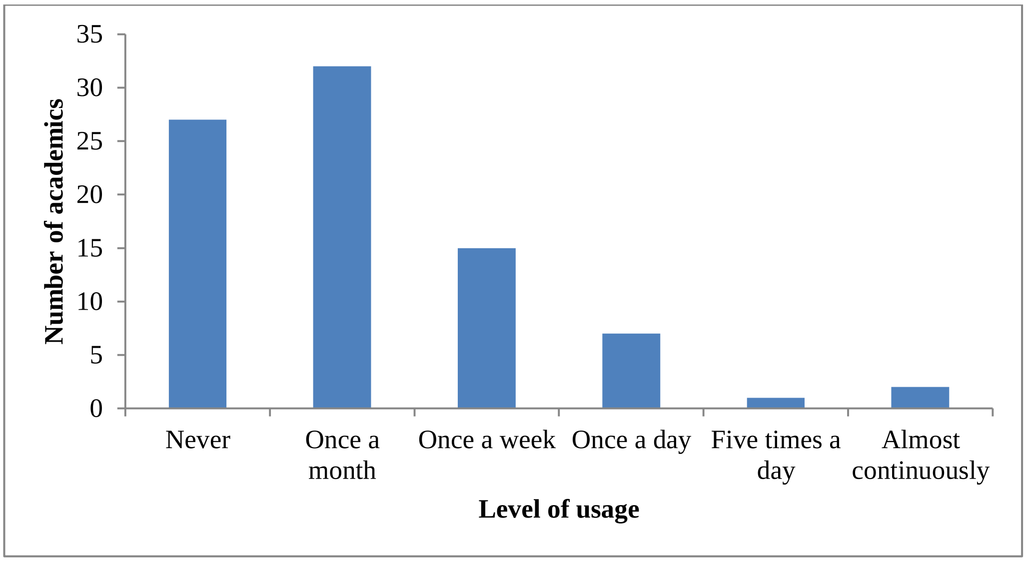


Figure 8-11: Level of academics' usage Facebook Groups for teaching purposes

In terms of academics' interaction with students through Facebook and other tools of social media for teaching purposes, it was found that Facebook is the most popular tool at 45%, followed by WhatsApp as the second popular tool at 22%. After that come Twitter and YouTube, which are considered as o tools for interaction purposes by 19% and 11% of academics respectively. Telegram also scored, at 3% of academics using it in academia. Other social media tools have zero usage for teaching purposes. Figure 8-12 illustrates the usage of Facebook and other tools of social media for interacting with students.

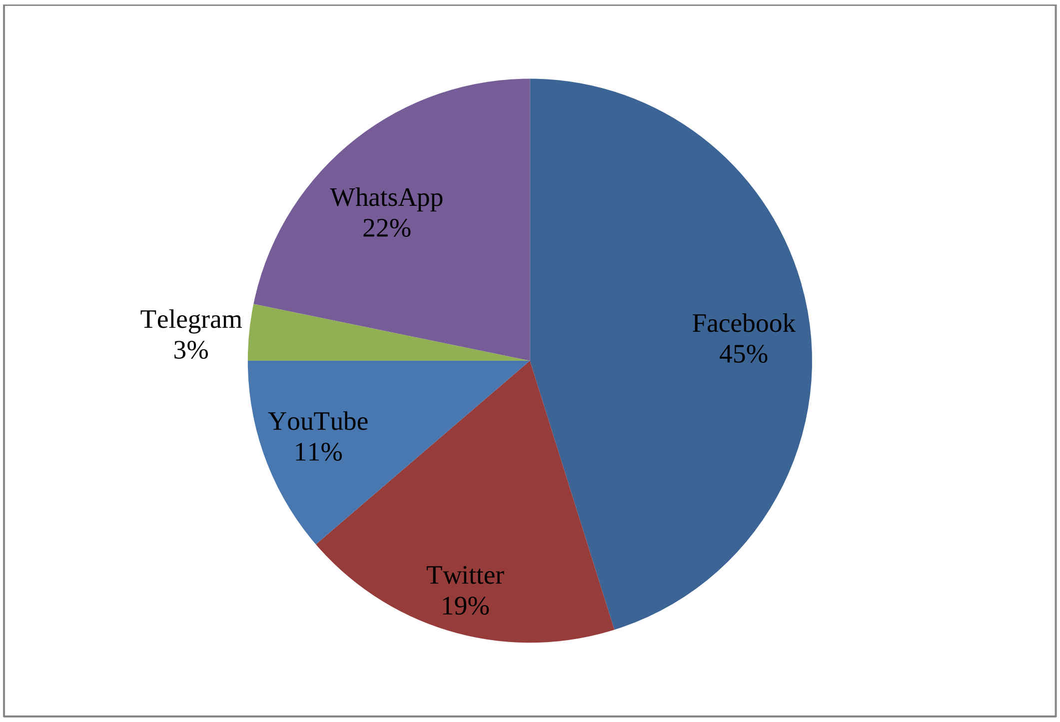


Figure 8-12: Social media tools that used by academics for interaction with students, the rest of social media tools in the questionnaire were zero

Academics indicated that the most common type of interaction taking place between students and teachers through social media tools is event announcement. The second most common interaction is to provide teaching materials, and setting assignments is the least used interaction through social media tools. Figure 8-13 shows the types of interaction that take place using particular social media tools.

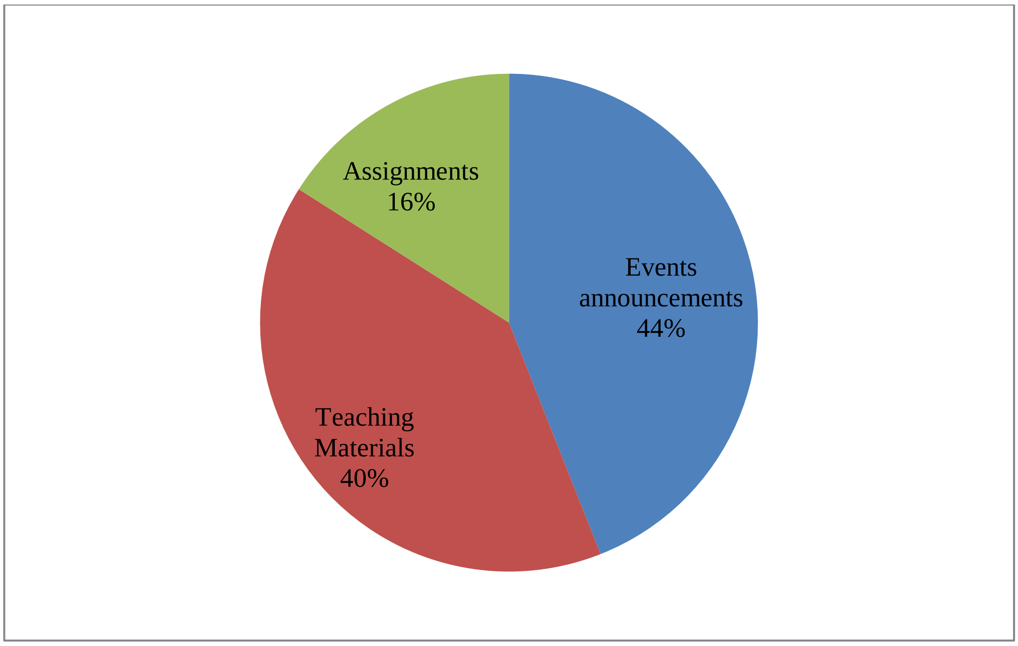


Figure 8-13: Types of interaction between students and teachers using social media tools

8.4 Summary

This chapter described the second experiment and an additional research study that are related to the teaching, and to the enhancement of the teaching and learning environment, with details such as the purpose of study, dependent variables, conjectures and research questions. The experiment was about improving teaching performance by using ontologically structured competences. The participants were academic lecturers at university. They indicated their opinion on a number of questions related to teaching performance. Academics' opinions were analysed in this chapter by using the one-sample t-test. The chapter describes the analysis results, such as the mean and standard error, between all dependent variables with related figures.

In addition, this chapter presented a research study on enhancing the teaching and learning environment by using Facebook Groups for module activities. The opinions of academic lecturers were analysed by using the one-sample t-test. The chapter described the analysis results such as the mean and standard deviation, with the level of significance among the dependent variables. Moreover, it presented some demographic and background questions on academics' teaching experience and use of social media in general and in academia. These background questions are also presented graphically, such as in bar and pie charts, with explanations.

The next chapter is a discussion of the analysis results of both Chapters 7 and 8.

Chapter 9: Discussion

The two previous chapters outlined the experiments results, together with related analyses and an additional study survey. The first experiment was conducted to investigate the learning side of the learning undertaken using SMC application to improve the results of this learning. The second experiment and an additional study survey were conducted to investigate the teaching side, through applying the concept of OSC to improve teaching performance and to study the possibility of enhancing the teaching and learning environment by using Facebook Groups for activities within modules. This chapter discusses the statistical results of the experiments and related research questions. A general discussion and summary are provided at the end of the chapter.

9.1 Do ontologically structured competences enable students to achieve better learning results using the social media SMC application collaboratively?

There were two different assignments to be completed by groups of students as discussed in section 7.2. The first was normalisation, as a technical task. The second was group work, as a facilitator of collaborative working, such as forming and managing more effective groups among students; moreover, group work may introduce an additional component to the teaching and learning situation. Each assignment consisted of five questions, and each corresponds to a specific level in Bloom's taxonomy as seen in tables 6-1 and 6-2. There were two conditions. The first was to use the SMC application ('app users') to answer both assignments. The second was to use paper-based documentation, as a plain text ('non-app users') to answer both assignments. Both the application and the paper-based documentation contained the same information to accomplish the two assignments.

It was known that the students were unfamiliar with the chosen topic of normalisation, as a pre-test had been conducted that showed that all were at the same level of knowledge of this topic as shown in section 7.1. The students' learning results, as groups, were tested under both conditions. There were ten groups in total for this experiment, each of which consisted of five students. Five groups used the SMC application to answer the assignments, and five used the paper-based documentation.

The results in section 7.2.1 showed that the SMC application enables groups of students to gain higher learning results in both assignments than groups that used the paper-based documentation. So, the research questions is positively answered and confirmed.

In terms of the normalisation assignment overall, the mean of the normalisation tasks' marks for the SMC application group users was statistically significantly higher than that for the paper-based documentation group users as discussed in section 7.2.2. Indeed, two groups of users with the SMC application scored full marks, and another two groups were close to full marks. The last group scored a mark that is considered to be half of the assignment's total marks. By contrast, four groups of those who used the paper-based documentation scored below half marks, which is a different range. There was only one group that scored a mark that came close to full marks. Table 7-3 illustrated groups' marks.

In terms of the group-work assignment's overall marks, the mean of the SMC application group users' marks was statistically significantly higher than that of the paper-based documentation group users as discussed in section 7.2.2. Three groups that used the SMC application scored full marks, and the other two were close to full marks. The group that scored the lowest mark in the normalisation assignment also scored the lowest mark in the group-work assignment. In contrast, there was only one group that used the paper-based documentation that scored full marks. This group had also scored the highest marks in the normalisation assignment, which was close to full marks. There were two groups who scored just above half the assignment's total marks, and the rest scored below half marks. Table 7-3 illustrated groups' marks.

The findings show that the ontologically structured competences for normalisation (Figure 4-9) and group work (Figure 4-11) through the SMC application among social media served to enable groups of students to achieve better learning results than groups that used traditional competences, explained and listed in plain-text format on social media. This suggests that learners benefit from ontologies in preforming their assignments. The findings confirm that the ontologies have ability to structure and classify the knowledge domain for learners (Zhou, 2007; Noy & McGuinness, 1993). In addition, when the overall results from the group work increased, so did the normalisation results. This means that there is a compatibility between the collaborative working and the technical assignment; any effect on the group-work assignment will affect the results of the technical assignment.

9.1.1 Is there a relationship between the level of Bloom's taxonomy and students' learning results?

As explained in section 6.1.4.3, each assignment question corresponds to a specific level in Bloom's taxonomy. The first question in both assignments is on the knowledge/remember level of Bloom's taxonomy. The second question in both assignments is on the comprehension/understanding level of Bloom's taxonomy. The application/apply level of

Bloom's taxonomy is seen in question three in both assignments. The fourth and fifth questions in both assignments are on the analysis and evaluate levels, respectively.

In terms of marking each normalisation question as discussed in section 7.2.4, the results showed that the mean of the SMC application group users for questions two, three, four, and five – knowledge/remember, comprehension/understanding, application/apply, analysis, and evaluate levels of Bloom' taxonomy – are statistically significantly higher than the mean of the paper-based documentation groups users' marks. There was no statistics significant difference in first question, corresponding to the knowledge/remember level of Bloom's taxonomy. This means that the SMC application, through its ontological content of the learning task, supports a higher level on Bloom's taxonomy when answering an assignment in groups.

Again, upon marking the group-work question as shown in section 7.2.4, the results showed that the mean of the SMC application group users for questions two, three, four, and five – corresponding to the knowledge/remember, comprehension/understanding, application/apply, analysis, and evaluate levels of Bloom' taxonomy – are statistically significantly higher than the mean of paper-based documentation groups users. There was no statistically significant difference in first question, corresponding to the knowledge/remember level of Bloom's taxonomy. This means that the SMC application, through its ontological content for collaborative working, supports a higher level on Bloom's taxonomy when answering an assignment in groups.

In terms of statistical significance, there was no statistically significant association between either the normalisation questions or the group-work questions, based on Multivariate test (MANOVA) for any questions under either condition (app users and non-app users). The questions' marks have been converted to percentages in order to give possible equality between questions. In addition, the first questions in both assignments were deleted, because there was no difference between app users and non-app users, with zero standard deviation. The multivariate questions did not show any statistically significant association between both assignment questions. However, a correlation test was used for both normalisation and group work as shown in section 7.2.5. The results revealed that there is strong relationship between most of the normalisation and group-work questions. In addition, the rest of questions in both assignments approached the level of statistics significance.

The findings show that the SMC application supports a higher level on Bloom's taxonomy when performing assignment questions relating to that level. Thus, there are very strong relationships between normalisation and group-work assignment questions that correspond to specific levels on Blooms taxonomy. When the Bloom's taxonomy level increases, so do the students’ results. Thus, students obtained higher marks for higher-level questions, for instance those that correspond to apply, analyse and evaluate.

There are a number of reasons why groups who used the SMC application obtained better learning results. The first is the ontologically structured competences. These kinds of competences enable students to perform the assignments in a certain order and in logical steps, such as knowing the main competences, and the sub-competences that are required to perform them. This is consistent with a previous study relating to ontology and modelling of competences in acquiring and preforming structured competences which consider as central goal of education or knowledge management process (Paquette, 2007). The second reason is the specific subject matter content of each competence. The design of subject matter in ontology was according to Merril (1994) categories of subject matter, and task analysis representation for Gilbert and Gale (2007); Sitthisak and Gilbert (2014). The categories of subject matter were presented in section 2.1.5.1The third reason is providing students with specific competences for group working, with related roles. The ontological competence of normalisation and group work may help to achieve more effective group work by simulating the actual group-work competences. The following sections discuss those reasons in more detail.

9.2 Do ontologically structured competences of subject matter through the SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing competences?

The areas of satisfaction for the groups of students fall into four categories: navigation of competences; consistency of competences; understanding of competences; and attitude toward representing competences with related resources as discussed in section 7.3. These were tested with those groups using the SMC application and those using the paper-based documentation. The results showed that, in general, the SMC application met groups of students’ satisfaction with higher ratings for navigation of competences, consistency of competences and understanding of competences. There was a better reaction to representing these competences ontologically with related resources than among the groups of students who used the paper-based documentation.

In particular, the multivariate test (MANOVA) of navigation of competences between groups in both conditions (app users and non-app users) showed that the mean ratings for navigation were statistics significantly different from each other. Groups of students who used the SMC application have found that ontologically competences allowed them to plan their learning activities easily, and to know the order in which to perform the competences, such as main competences, sub-competences, then sub-sub-competence. In addition, ontologically competences are easy to explore quickly, especially in a tree format, by clicking and expanding the content. It is easy to close the content yet return to that point quickly later. Moreover, they helped students to perform the assignment in a logical sequence. These reasons have encouraged the SMC application users to think that, through the SMC application, ontologically structured competences are more navigable and structured than the users of the paper-based documentation. The findings confirm that the results are consistent with studies relating to the ontology in enabling rich content to be well-structured and navigable (Fayzrahmanov et al., 2010; Cranefield & Purvis, 2001)

In terms of consistency of competences between app users and non-app users, the multivariate test (MANOVA) showed that there is a statistically significant difference between those groups of students who used the SMC application and those who used the paper-based documentation. The mean ratings for consistency competences were higher for the SMC application group users. The SMC application group users think that ontologically structured competences provide them with clear steps on how to accomplish the assignment more than do the paper-based documentation groups users. In addition, ontologically structured competences enable students to assess the requirements of each competence in order to achieve it, through knowing the sub- and sub-sub-competences of the main competence. Moreover, they allow students to know what specific subject matter content relates to a competence. This is clear when exploring competences, and locating additional content under a particular competence for a more detailed explanation. Furthermore, the resources within the SMC application are specified only under related competences. Students can add and find more resources for specific competences, rather than the entire set of competences of a topic. These reasons have encouraged the SMC application group users to award a higher rating in terms of consistency of ontologically structured competences than those in the groups using the paper-based documentation. The findings confirm that the results are consistence with a study relating to ontology for enabling a content to be more consistence (Gómez-Pérez, 2004).

The ontologically structured competences through the SMC application are more understandable to the groups of students that used the application than those that used the paper-based documentation. The MANOVA test showed a statistically significant difference in mean ratings between groups of students who used the SMC application and groups who used the paper-based documentation. The mean rating of app users was higher than non-app users. That is, mean ontologically structured competences were more understandable to groups of students who used SMC application than the same competences listed in plain text for groups of students who experienced the paper-based documentation. The ontologically structured competences were found by the SMC application group users to be clear, more so than groups of students who used the paper-based documentation. The subject matter content was also found to be clear and easy to follow by the SMC application users more than the paper-based documentation users. This refers to the ontological design of the categories of subject matter, taking into account the task analysis of each category, then linking each category to the related competence in order to provide further explanation of that competence. A better understanding of subject matter content by the SMC application users means that there is a better design of ontology for those categories of subject matter. The findings confirm that the results are consistent with principles of ontology for providing understandable content through properties (Gruper, 1993)

The groups of students' opinions were measured regarding representing competences for assignments with related resources. The MANOVA test showed that there is a statistically significant difference between groups who used the SMC application and groups who used the paper-based documentation. The groups who used the SMC application gave a higher rating on the representational styles of competences that are ontological contrast listed with related resources. These groups found that representing the competences ontologically is valuable and makes working on assignments interesting, more than those groups of students who used listed competences in the paper-based documentation. The reasons could be that the SMC application allows students to add and tag resources ontologically with related competences. This gives students the chance to search and retrieve structured resources for specific competences easily. In addition, those groups of students who experienced the application have found it useful that added resources are marked with who added them and when, specifying dates and times. They also have found it useful when adding resources that it shows who else added some, with the date and time, to facilitate tracking who is working on the assignment.

The groups of students who gave a lower rating for representing competences as lists in plain text documentation with related resources in Facebook Groups have found that adding resources this way is less structured. There will be difficulties in retrieving those resources after a while, due to the large volume of content. In addition, there is no way to know which resources relate to which competences; adding resources in Facebook Groups is just random. Moreover, group work in tracking through Facebook Groups and paper-based documentation as lists of competences causes difficulties.

The findings show that the ontology of task competences of normalisation as knowledge domain was found by the SMC application group users to be appropriate. They gave a higher rating to navigation, consistency and understanding of competence. The ontological design hinges on enabling the learning objectives for the intended learning outcomes by specifying a main objective and any remaining enabling objectives as discussed in section 2.1.7. Thus, there is a class for a main competence, which may contain sub- and sub sub-competences. Next come the classes of each category of subject matter after each competence, whether main, sub-competence, or sub-sub-competence. There is no correct way to design ontology, but the most effective scheme will give more appropriate results. According to Gruber (1993), ontology is considered to be a modelling domain. Once the ontology generates the required and desired content, it is effective. However, this does not mean that we can ignore the principles of designing an ontology. The design must be aligned with the structuring classes and defining properties in order to generate explicit statements in order to answer specific questions. This has been proven by students who use the SMC application in terms of its ease of navigation, consistency of competence, ease of understanding the content, and attitude to ontologically structured competences through making a contribution to the knowledge base by adding resources in a structured way that mentions who added the resource, along with date and time. This suggests that design the ontology benefits from the methods and theory behind building such ontology which have been described by Noy and McGuinnes (1993) and discussed in section 4.4.

The ontologically structured competences could contribute to enhancing learning among application users by providing this structured content. The tree structure for representing competences ontologically gives an indication to students of how to accomplish the assignment in clear steps. Moreover, the content of the subject matter could help application users to understand the explanation of specific competences, based on the task analysis of subject matter categories. Groups of students know how each item of content relates to which competence. Furthermore, the idea of representing competences ontologically could facilitate students' joint activities by sharing those competences as separate parts between each other and then answering them.

9.3 Do ontologically structured competences of collaborative working through the SMC application meet with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing competences of group working?

Just as satisfaction among the groups of students was measured for the normalisation competences, so it will for the group-work competences, using the same procedure. By introducing task competences and insisting on collaborative work for a given assignment, this research imposes an additional component on the teaching and learning situation. Thus, the competences for the technical task and the actual group work should be compatible. The group satisfaction areas fall into four categories: navigation of collaborative working competences; consistency of collaborative working competences; understanding of collaborative working competences; and attitude toward representing collaborative working competences with related resources as discussed in section 7.4. These were tested for the groups that used the SMC application and those that used the paper-based documentation. The results showed that, in general, the SMC application groups rated their satisfaction higher than those groups that used the paper-based documentation, regarding the navigation of collaborative working competences, consistency of collaborative working competences, understanding of collaborative working competences, and reacting well to representing these collaborative working competences ontologically with related resources.

In particular, the multivariate test (MANOVA) of navigation of collaborative working competences between groups in both conditions (app users and non-app users) showed that the mean ratings for navigation were statistically significantly different between the groups. Groups of students who used the SMC application may have found that the ontological competences of collaborative working allowed them to plan their learning activities easily, through knowing the main collaborative working competences with related explanation or roles. In addition, they are easy to explore quickly, especially in tree format, by clicking and expanding the content, and it is easy to close the content yet return to the previous point quickly. Moreover, the ontologically structured competences of collaborative working helped students to perform the assignment in a logical sequence. These reasons have encouraged the SMC application users to think that ontologically structured competences of collaborative working, through the SMC application, are more navigable and structured than the paper-based documentation users, who dealt with lists of collaborative working competences as plain text. The findings confirm that the results are consistent with studies relating to the ontology in enabling rich content to be well-structured and navigable (Fayzrahmanov et al., 2010; Cranefield & Purvis, 2001).

In terms of consistency of collaborative working competences between app users and non-app users, the multivariate test (MANOVA) showed that there is a statistically significant difference between the groups of students who used the SMC application and those who used the paper-based documentation. The mean ratings for consistency of collaborative working competences were higher in the SMC application group, which also thinks that ontologically structured competences of collaborative working provide them with clear steps on how to accomplish the assignment and work as groups more effectively, more than do the paper-based documentation group users. In addition, ontologically structured competences of collaborative working enable students to distinguish between the main competences of collaborative working and related activities or roles, and let students know which activities or roles are related to a competence. It is straightforward, when exploring collaborative working competences, to find additional content under the competence for a more detailed explanation. Furthermore, the resources within the SMC application are specified only by their related collaborative working competences. Students can add and find more resources for specific collaborative working competences, rather than the entire set of competences of group working. These reasons may encourage the SMC application group users to give higher rating in terms of the consistency of ontologically structured competences for collaborative working than the group using the paper-based documentation. The findings confirm that the results are consistence with a study relating to ontology for enabling a content to be more consistence (Gómez-Pérez, 2004).

The ontologically structured competences of collaborative working, through the SMC application, are more understandable to the groups of students who used the application than those who used paper-based documentation. The MANOVA test showed a statistically significant difference in mean ratings between those who used the SMC application and those who used the paper-based documentation. The mean rating of app users was higher than non-app users. That is, the mean ontologically structured competences of collaborative working were understandable more to the groups of students who used the SMC application than the competences listed as plain text for those who experienced paper-based documentation. The ontologically structured competences of collaborative working were found to be clear by the SMC application group users more than the groups of students who used the paper-based documentation. The related roles or activities to each collaborative working competence were found to be clear and easy to follow to a greater extent by the SMC application users than the paper-based documentation users. This refers to the design of the collaborative working ontology, through specifying a main competence and related activities or roles on how to perform each competence. In addition, the activities or roles that were gathered into a specific competence of collaborative working met the groups of students' understanding more than in the other groups, which used them as plain text without any structuring. The findings confirm that the results are consistent with principles of ontology for providing more understandable content (Gruper, 1993).

The groups' opinions have been measured on the representation of collaborative working competences for assignments and group work with related resources. The MANOVA test showed that there is a statistically significant difference between the groups that used the SMC application and those that used the paper-based documentation. The groups that used the SMC application gave higher rating for the representation styles of collaborative working competences that are ontological contrast listed with related resources. They found that representing collaborative working competences ontologically is valuable and makes working on assignments and actual group work interesting, more than did the groups of students who used listed competences in paper-based documentation. The reasons could be that the SMC application allows students to add and tag resources ontologically with related collaborative working competences. This gives students the chance easily to search and retrieve further structured resources on specific collaborative working competences. In addition, the groups of students who experienced the application have found it useful that any added resources are marked with who added the resource and when, specifying dates and times. Moreover, groups of students have found it useful when adding resources that others who added resources are shown, with the date and time, facilitating group work tracking in order to know who is working on assignments collaboratively.

By contrast, the groups of students that gave a lower rating for their attitude to representing collaborative working competences as lists in plain text documents, with related resources in Facebook Groups, may have found that adding resources this way is less structured. There will be difficulties in retrieving the resources after a while, due to the sheer volume of content. In addition, there is no way to know what resources relate to which collaborative working competences. The roles or activities are also unstructured, in relation to specific competences of collaborative working; adding resources in Facebook Groups is just random. Moreover, group work by tracking through Facebook Groups is tedious; paper-based documentation, as a list of collaborative working competences, causes difficulties.

The findings show that the ontology of collaborative working competences was found appropriate by the SMC application group users. They gave a higher rating for their ease of navigation, consistency and ease of understanding. The ontology design depended on gathering all collaborative working competences and specifying the main competences against any roles to perform those competences as discussed in section 4.5. There was a class for the main collaborative working competence, followed by any related activities or roles. There is no correct way to design ontology, but the most effective ontology achieves more effective and appropriate results. This has been proven by students who used the SMC application in terms of navigation, consistency of competence and understanding the content. Moreover, there is a better attitude to ontologically structured competences for collaborative working by contributing to the knowledge base by adding resources in such a structured way, with mention of who added the resource along with the date and time. This suggests that design the ontology benefits from the methods and theory behind building such ontology which have been described by Noy and McGuinnes (1993) and discussed in section 4.4.

Ontologically structured competences for collaborative working may contribute to student learning in the group of app users by providing such structured content. The tree structure of representing collaborative working competences ontologically may indicate to students how to accomplish assignments in clear steps. Moreover, the roles relating to specific collaborative working competences contribute to their learning by simulating these steps and showing how to perform each one. Having ontologically competences for both the technical task and the group work may lead to better learning in terms of both assignments and collaborative work among students, leading to yet better results.

9.4 Does the SMC application support better collaborative working for groups of students using social media?

The purpose of this evaluation is to determine whether ontologically structured competences, through the SMC application or the list of competences as plain text through paper-based documentation, both for normalisation and collaborative working, lead to better group working by students while using social media. The groups' ratings have been measured in three categories: communication, information sharing, and conversation and social skills as discussed in section 7.5. The results showed that groups of students who used the SMC application gave higher ratings for all three than the groups who used the paper-based documentation. This means that groups of students who used the SMC application worked more collaboratively.

In terms of communication, the multivariate test (MANOVA) revealed that there was a statistical difference between the SMC application group users and the paper-based documentation group users. The mean was higher for groups that used the SMC application, so they were communicating more with each other by applying to the situation and simulating the collaborative working competences. For example, there was someone who acted as a planner for the group. The planner notified members of any changes or problems about the work, estimated how long it would take to finish tasks, and summarised and tracked progress. In addition, there was someone who acted as the leader of the group. The leader asked for feedback, suggested directions in which to accomplish the task and created an environment conducive to group work. Moreover, groups identified someone to act as a negotiator in order to deal with non-contributing members and provide positive support. The groups shared the task between members and exchanged messages via the Facebook Group message service.

In terms of information sharing, the MANOVA test showed that there was a statistically significant difference in mean between the groups of students who used the SMC application and groups of students who used the paper-based documentation. The SMC application users shared information more. Facebook Groups was a common tool between groups in both conditions (app users and non-app users). The difference might be that the SMC application encourages students to tag ontologically any resources with the desired competence. In addition, having such ontologically structured competences motivates students to ask to teach other, check their understanding with their progress so far and conduct effective discussions. By contrast, the groups using paper-based documentation gave lower ratings in terms of information sharing while using Facebook Groups.

There was one competence in collaborative working that required all group members to share, such as by listening to each other, criticising ideas rather than people, apologising to each other, supporting each other, ignoring distraction and expressing opinions. These competences received higher rating from the SMC application group users than the paper-based group users. The MANOVA showed a statistically significant difference between the groups under each condition. This means that having explicit criteria for group work results in effective working among groups. Each member of group knows the personal tasks to undertake and communicates effectively with others.

9.4.1 Is there a relationship between communication, information sharing, and conversation and social skills when groups work collaboratively?

The relationships between actual collaborative working variables have been tested as discussed in section 7.5.2. The Pearson correlation indicated that there is a strong and positive correlation between communication, information sharing, and conversation and social skills. When communication increases, so does information sharing between students. In addition, when information sharing increases, so do conversation and social skills. Likewise, when communication increases, conversation and social skills are similarly enhanced. There were very strong and positive relationships between the groups of students regarding communication, information sharing, and conversation and social skills.

The findings show that through its ontologically content, the SMC application increases actual group working between students on a social media platform. The students were motivated to communicate and share information with others in their groups. However, the analysis results indicate that a single group under the app user condition did not perform well in the assignments. When checking group members' evaluation of collaborative working, it was found that the group was not working collaboratively enough. By contrast, it was found that one group of paper-based documentation users scored very high marks for both assignments. The actual collaborative working evaluation was again checked and this revealed that they worked more collaboratively. This means that the ontologically structured competences are strongly related to collaborative working competences, and are important to each other in order to obtain better results in assignments. Facebook Groups is also important to collaborative working, with the integrated SMC application to manage actual group working. The findings confirm that the results are consistent with a previous study relates to principles of ontology support collaborative working (Tudorache, Noy, Tu, & Musen, 2008).

9.5 Does the SMC application facilitate group formation using social media?

The purpose of this evaluation was to investigate whether the SMC application and its content can facilitate the formation of groups, comparing this to those groups with paper-based documentation and using social media. Also, it was to confirm whether learning results are affected by groups of students' prior knowledge and to indicate groups of students' satisfaction at the retrieval of their social information from Facebook profiles. The groups of students' satisfaction was measured in three categories: usefulness of prior knowledge; ease of use of information about students; and the attitude to representing social skills as discussed in section 7.6.

The results showed that having ontologically structured competences for normalisation as a technical task, collaborative working competences for group working, and retrieval of student social skills from personal Facebook profiles leads to ease of comparison of the requirements of assignments using the available social skills possessed by students. The result of this comparison leads to better group formation. The MANOVA test showed that there were statistically significant differences between groups of users of the SMC application and groups of users of the paper-based documentation. Groups with the SMC application gave a very high rating for ease of use of social information and its comparison with the requirements of assignments. On the other hand, groups of paper-based documentation may have found it difficult to access each students' profile to read personal social information in order to form their group. This means that the SMC application facilitates quick and organised group formation. The findings confirm that the results are consistent with a number of studies relating to the ontology principles and benefits in supporting group formation among learners (Supnithi, Inaba, Ikeda, Toyoda, & Mizoguchi, 1999) (Isotani, Inaba, Ikeda, & Mizoguchi, 2009) (Wessner & Pfister, 2001).

9.5.1 Does groups of students' prior knowledge influence learning results?

The results showed that under neither condition was the students' learning not affected by their prior knowledge. It was confirmed that the content of ontologically structured competences for both normalisation and collaborative working was enough to accomplish the assignments, unlike in the groups using the paper-based documentation. In addition, groups of students with the SMC application went to simulate the collaborative working competences by sharing and acting out those competences with each other, whereas there was less consideration of these competences in the paper-based groups. Moreover, the results showed that retrieving information on social skills and comparing them to the needs of both ontologies helped students to form more effective groups than random or friendship-based groups. Furthermore, information and social skills details that were retrieved from students' Facebook profiles met the satisfaction of those groups of students who used the SMC application.

In terms of usefulness of prior knowledge, the multivariate test revealed a statistically significant difference in mean ratings between the SMC application groups and the paper-based documentation groups. This difference refers to the SMC application group users indicating that the content of assignments and group work were enough, so they updated their skills according to the information of ontologically competences and simulated them. This means that students' prior knowledge did not affect their learning results. So, ontologically structured competences play a more important role in learning than in groups who used the paper-based documentation.

9.5.2 Does retrieved related social information meet with the satisfaction of groups of students?

The groups of students' opinions have been measured on representing social skills in order to compare them with the assignment's requirements and then to form suitable groups. The MANOVA test showed that there was a statistically significant difference between groups who used the SMC application and groups who used the paper-based documentation. The groups who used the SMC application gave a very much higher rating for their attitude to retrieving social information from users' Facebook profiles. These groups found that retrieving social skills about students is valuable and makes for a more suitable group, more than those who used listed competences in paper-based documentation and had to check each user profile in order to read personal social information. In addition, groups of students who used the SMC application indicated that providing additional information such as bio, education and work information, and gender enhances the decisions on potential group members attributes, apart from their social skills. Moreover, the notes section in the SMC application were found to be a popular way to find comments about students in terms of their work progress before considering the formation of a group. That means that retrieving social information about students from Facebook profiles through the SMC application met the group of students' satisfaction more than that those that used the paper-based documentation.

In summary, besides the ontologically competences, generating social information about the students to undertake a technical task using group working enhances the group's formation. In addition, representing this information through the SMC application met students' satisfaction, more than asking them to access each individual student's profile to read their information before considering them as a potential group member. The analysis results also prove that students' prior knowledge did not influence learning results. The reasons for gaining better learning results are due to both the ontologies of task competences and collaborative working, and comparing available students' skills to form a suitable group.

9.6 Discussion on Pre-Test and Post-Test Results

The purpose of the pre-test in the early stages of the experiment was to ensure that participants were not familiar with normalisation as a knowledge domain. The results showed that participants were equal in their knowledge about normalisation as seen in section 7.1. The mean showed that there was a very slight difference between app users and non-app users. This is why the score of the pre-test showed different marks between students. For instance, a number of students achieved marks in the range of zero to three. Participants who scored four and above were excluded from the experiment. The allocation of participants was random, so it was by only by chance that app users scored more in the range of up to three than non-app users. The pre-test confirmed that students were not familiar with normalisation and that the learning results of the assignment were not affected.

As the assignments were undertaken collaboratively in groups, the same questions from the pre-test could be given to participants individually, as a post-test, under each condition (app users and non-app users), after they finished answering the questionnaires. It was found that participants who used the SMC application scored full marks in the post-test as shown in section 7.7. The mean was seven, as the total mark of post-test, with zero standard deviation. The non-app users had improved, but their marks were still lower than those of the SMC application users. In terms of statistics, the two-way repeated measures ANOVA test was used to analyse the obtained test scores. The results showed that there was a statistically significant difference between pre- and post-test under both conditions. The post-test shows a further enhancement through the SMC application, by virtue of its ontological content leading to better learning results.

9.7 Summary Discussion on Experiment Results of Using SMC Application

An experiment was conducted in order to investigate whether the SMC application can support obtaining better learning results for a given assignment through working collaboratively, compared to traditional lists of competences with related content in paper-based documentation and using Facebook Groups. The content of the application is ontologically structured competences for a chosen knowledge domain, namely either normalisation or group-work competences. Participants were asked to form suitable groups and to complete a given assignment about normalisation using group working. It was found that groups of students who used the SMC application obtained greater learning results in both assignments than the groups using the paper-based documentation. The assignments' questions corresponded to specific levels on Bloom's taxonomy, so the SMC application supported a higher level of questions at a high level on Blooms' taxonomy in terms of obtaining results. In addition, the ontologically structured competences for normalisation and group work met the satisfaction of those groups of students who used the SMC application in terms of navigation, consistency, understating, and attitude toward representing ontologically competences, more than those who used listed competences as plain text through paper-based documentation. Moreover, the SMC application helped groups of students to work more collaboratively in terms of communication, information sharing, and conversation and social skills on given assignments, more than groups of students who experienced the paper-based documentation. Furthermore, it was found that the SMC application facilitated group formation by generating social information about students in order to compare this with the assignment's requirements. The better learning results refer to ontologically structured competences with related content in both normalisation and group work. The results were not affected by students' prior knowledge. The statistics test confirmed that the SMC application leads to better learning results, encourages more collaborative working, and enhances group formation while using Facebook Groups.

9.8 Do instructors think that using ontologically structured competences leads to better teaching?

This experiment was to determine instructors' overall opinion on whether ontologically structured competences can lead to better teaching as discussed in section 8.1. The measurement depends on whether reaction ratings were statistically significantly different from the middle, 'neutral' option for each statement, 'neither agree nor disagree'. The results revealed that the academic teachers or instructors were statistically significantly satisfied with applying ontologically structured competences to their teaching, resulting in better teaching. The mean ratings were higher than the middle, 'neutral' option. The instructors thought that the approach enabled them to have much clearer goals and sequences in their teaching. In addition, instructors thought that the ontologically structured competences enabled them to determine the level of knowledge at which they should start teaching, and to review their students' acquired knowledge regularly before moving onto new points. Moreover, they indicated that they enabled them to deliver subject matter that was better matched to the objective, both succinctly and in great depth. Furthermore, instructors thought that they could help them to set more assignments more directly on the taught competences and to give timely feedback to their students. They also thought that, by applying ontologically structured competences, their teaching would be innovative and interesting.

In terms of setting more assignments more directly on the taught competences, allowing students to obtain timely feedback and making teaching innovative, the mean ratings were just below those of previous variables such as clearer goals, a better sequence of teaching and determining the starting level of knowledge for teaching. This may refer to academic teachers believing that their current teaching is entirely suitable and that they already give feedback to their students at the appropriate time.

The findings show that the ontologically structured competences met instructors' satisfaction. The main ratings were statistically significantly different from neutral. Thus, academic teachers think that by applying ontologically structured competences they could teach better. This study concerns the teaching side, applying the concept of ontology to teaching by using competences.

Now, both learning and teaching sides have been investigated in terms of using and applying ontologically structured competences. The statistical results have shown significant mean ratings in both conditions, with more satisfaction for ontological competences.

9.9 Do instructors think that Facebook Groups enhances the students' teaching and learning environment?

This study was to determine instructors' overall thinking on whether using Facebook Groups for module activities could enhance the teaching and learning environment. The measurement of this study depends on whether reaction ratings were statistically significantly different from the middle, 'neutral' option for each statement, which was 'neither agree nor disagree' as discussed in section 8.2. The results revealed that academic teachers or instructors were statistically significantly satisfied with using Facebook Groups as an enhancement of the teaching and learning environment, by allowing the module activities to take place within this medium. The mean ratings were higher than the middle, 'neutral' option. The instructors thought that using Facebook Groups for the module allows teachers to have increased interaction with students about the taught topic in a less formal environment. In addition, they thought that it increased the engagement of teachers and students with the course. Moreover, the instructors thought that any difficulties with the taught topic would be easily identified, because students would ask questions of each other about specific points using Facebook Groups. Furthermore, academic teachers thought that encouraging students to conduct effective discussions and increasing their motivation to learn and to pay attention to teaching topics would be easier through Facebook Groups.

In terms of encouraging students to conduct effective discussions and pay more attention to teaching topic, mean ratings were just lower than previous variables such as increased interaction, increased engagement and increased motivation. This may refer to academic teachers believing that their students could conduct effective discussions without Facebook Groups, and that their students pay attention to their current teaching topic without using Facebook Groups.

The findings show that using Facebook Groups for module activities met instructors' satisfaction. The main ratings were statistically significantly different from neutral. So, academic teachers think that using Facebook Groups for module activities could enhance the teaching and learning environment by increasing interaction between teachers and students, increasing engagement with the course, conducting effective discussions, increasing the motivation to learn, paying more attention to taught topics, and easily identifying the points of difficulty with students about taught topics. So, it seems that Facebook will play an important role in academia. The findings confirm that the results are consistent with studies relates to protection of Facebook to be popular in academia and could enhance the teaching and learning environment (Kabilan, Ahmad, & Abidin, 2010) (Manca & Ranieri, 2013).

The majority of this study's participants who are academic teachers sometimes use social media to support their teaching. It was found that most use Facebook Groups for teaching purposes once a month. In addition, the most popular a tool of social media in academia was Facebook. WhatsApp was found to be a popular second social media tool for use in academia. It has messaging services and allows for group formation for chatting purposes and event announcements. WhatsApp has a limit on group formation; it currently allows a maximum of 50 members in groups. Twitter and YouTube are the third and fourth most popular tools for use in academia, respectively, according to participants in this study. Twitter has a limit on the number of characters in each tweet, so it can be used at the most for event announcements or quick reminders for academic purposes. YouTube is useful for providing students with links to specific topics for further explanation or learning. These can be shared via WhatsApp, Twitter and Facebook Groups. The most popular kind of interaction between students and academic teachers using social media tools relates to event announcements, then teaching materials and, lastly, assignment purposes.

9.10 General Discussion

In terms of learning, groups of students who used the developed application for the assignments achieved better results than those who did not use the application. The ontologically structured competences support students, through the application, to accomplish the given assignments successfully, to work collaboratively more effectively and to organise the formation of the group. The groups of students who used the application were satisfied with the application content, more than those who used lists of competences in plain text in documentation. Facebook Groups becomes more effective for collaborative working when there is an integrated application that supports students' learning in terms of knowing the assignment's requirements and generating social information to enhance group formation by comparing people's attributes to the requirements of the assignment.

In terms of teaching, the ontologically structured competences met instructors' satisfaction. The instructors thought that they could teach better by using them. The approach allows teachers to have clearer goals and a sequence in their teaching. In addition, with ontologically structured competences teachers could determine the level of starting knowledge for teaching and always to review their students' acquired knowledge before moving onto new topics. On the other hand, the teaching and learning environment could be enhanced by using Facebook Groups for module activities. Instructors thought that Facebook Groups could increase interaction with students and encourage students to learn. Facebook Groups also increase students' engagement with their course and make it easy to identify difficulties regarding taught topics.

Thus, e-learning could be enhanced by integrating knowledge management and social media. Knowledge management can be seen as ontologically structured content of competences, where competences form part of e-learning and applying them helps students to complete assignments. Facebook Groups is a tool on social media for collaborative work on assignments, and enhances group formation.

9.11 Summary

This research contributes an application for social media competences presented as ontologically structured content, while using Facebook Groups as a component of the social media tools. The developed application was investigated by using students to complete two assignments, then measuring the learning results. In addition, parts of the SMC application, the ontologically structured competences, were investigated by means of consulting academic teachers in order to lead to better teaching performance. In terms of learning, the SMC application led to better learning results than the traditional way of representing competences as a list in a plain text format. In addition, it proved that, collaboratively, a group of students works more effectively, as the SMC application enhances group formation. The content of the SMC application, being ontologically structured, meets students' satisfaction in various ways such as ease of understanding, consistency, ease of navigation, and a more favourable attitude toward this representation than lists of competences in plain text. The academic teachers indicated that their teaching performance would improve through using ontologically structured competences. Also, they proved that Facebook Groups lend an enhancement to the teaching and learning environment.

The next chapter will highlight in detail the contribution of this research and conclude of thesis, suggesting future work and the directions for future research.

Chapter 10: Conclusion, Contribution and Future Work

This chapter presents the conclusions of the research and discusses the research contribution, then provides the directions for future work.

10.1 Conclusion

This thesis has identified an area of research that focuses on integrating KM and social media in order to enhance e-learning. The study looks to e-learning as a competence structure in a specific knowledge domain using collaborative working, with KM as an ontology that derives the competences. The social media tool consists of Facebook Groups, supporting collaboration in a teaching and learning situation using the principles of KM through the developed SMC application. Constructing the task competences consists of linking categories of subject matter to related competences. Collaborative working competences are based on available social skills such as planning, encouraging and dealing with underperforming members with related specific roles. These two types of competences have been developed ontologically. By providing students with both, they will be able to appreciate the requirements of an assignment, and to form and manage their own groups.

In order to complete an assignment successfully, students need to gather in Groups. They need to know both what the assignment and what the group work require. Both the ontologies of task competences and collaborative working competences help, and the developed SMC application enables them to generate and explore these competences. The application uses Facebook features that provide a personal profile of each user, such as professional skills, biographical content and gender, and this profile will be compared with the ontology of task competences and collaborative working competences in order to connect students in Groups. Once these are formed, students may share resources such as documents, links, files or photos that relate to the task competences and collaborative working competences. They are able to add any resource in Facebook Groups and link it ontologically to task competences or collaborative working competences through the SMC application. This is considered as KM, because adding content follows a specific structure; it is not random. In addition, the SMC application enables students to make notes about their progress or assigned tasks. Any resources or notes in the SMC application are tracked by providing the name of the person who added the resources or notes, with the date and time of editing.

The first experiment was conducted in order to evaluate the SMC application. The students were unfamiliar with the chosen topic of normalisation, as a pre-test had been conducted. There were ten groups in total for this experiment, each consisting of five students. Five groups used the SMC application to answer the assignments and five used the paper-based documentation. There were two assignments to be completed by these groups of students. The first was normalisation, as a technical task. The second was group work, as a facilitator of collaborative working, such as forming and managing more effective groups among students. Moreover, group work introduces an additional component to the teaching and learning situation. Each assignment consisted of five questions, each one corresponding to a specific level in Bloom's taxonomy. There were two conditions. The first was to use the SMC application ('app users') to answer both assignments. The second was to use paper-based documentation, in plain text ('non-app users') to answer both assignments. The experimental results revealed that the SMC application enables groups of students to gain higher results in both assignments than groups that used paper-based documentation. Both normalisation and group work assignments marks for the SMC application groups' users were statistically significantly higher than those for the paper-based documentation groups' users. This means that the ontologically structured competences for normalisation and group work through the SMC application on social media served to enable students to achieve better learning results than groups that used traditional competences that were explained and listed in plain text format on social media. So, the research question is positively answered and confirmed. The results of the pre-test showed that all students were at the same level of knowledge of normalisation, but the post-test results revealed that students who used the SMC application scored full marks, in comparison with lesser scores among students who used paper-based documentation. Furthermore, the SMC application supports a higher level on Bloom's taxonomy when undertaking assignment questions relating to that level. The findings show that there was statistically significant strong relationship between normalisation and group work assignment questions that corresponded to specific levels on Bloom's taxonomy. When Bloom's taxonomy level increased, so did the students' results. So, the research question is positively answered and confirmed.

The areas of satisfaction with the normalisation competences and collaborative working competences were tested among groups using SMC application and those using paper-based documentation in the following terms: navigation of competences; consistency of competences; understanding of competences; and attitude toward representing competences. The results revealed that the SMC application met groups of students' satisfaction with a higher rating for navigation of competences, consistency of competences, understanding of competences, and toward representing competences for both normalisation and collaborative working. There was a better reaction among these groups to representing competences ontologically with related resources or roles than among those that used paper-based documentation. The results of the investigation of the level of satisfaction with both subject matter competences and collaborative working competences showed that the SMC application users were significantly more satisfied than the paper-based documentation users. This means that the ontologically structured competences for subject matter and collaborative working met with the satisfaction of groups of students in terms of navigation, consistency, understanding and attitude toward representing those competences. So, the research questions regarding subject matter and collaborative working were positively answered and confirmed..In addition, the actual groups' collaborative working was measured in three categories – communication, information sharing, and conversation and social skills. This was done to determine whether ontologically structured competences in the SMC application, or a list of competences as plain text in paper-based documentation, both for normalisation and collaborative working, lead to better group working by students while using social media. The result showed with statistically significant results that groups of students that used the SMC application worked more collaboratively than those that used paper-based documentation. There were statistically significant strong relationships between communication, information sharing, and conversation and social skills: when one increased, the others increased as well. This means that the ontologically structured competences in SMC application led to better collaborative working by groups. So, the research questions regarding actual collaborative working were positively answered and confirmed.

The SMC application was tested in terms of facilitating group formation, comparing the groups that used paper-based documentation and those that used social media. Also, this was to confirm whether learning results were affected by groups of students' prior knowledge and to indicate groups of students' satisfaction with the retrieval of their social information from Facebook profiles. The groups of students' satisfaction was measured in three categories: the usefulness of prior knowledge; the ease of use of information about students; and the attitude to representing social skills. The results revealed that under neither condition was the students' learning unaffected by their prior knowledge. It was confirmed that the content of ontologically structured competences for both normalisation and collaborative working was enough to accomplish the assignments. Moreover, the results showed that SMC application and its ontologically structured content helped to form more effective groups than in groups using the paper-based documentation. Furthermore, the information and social skills details that were retrieved from students' Facebook profiles met with the satisfaction of those groups of students that used the SMC application. There were statistically significant results in terms of facilitating group formation and attitudes toward representing students' social information to use with ontologically structured competences. This means that ontologically structured competences to generate social information from users' profiles facilitate group formation. So, the research questions regarding facilitating group formation through the SMC application were positively answered and confirmed.

There were a second experiment and additional study survey regarding improving teaching performance by using ontologically structured competences in teaching, and enhancing the teaching and learning environment by using Facebook Groups for module activities. In the second experiment, the instructors' overall opinions were taken into account. The results revealed that the ontologically structured competences met the instructors' satisfaction. They believed that by applying ontologically structured competences they could teach better in terms of having a clear sequence for teaching, determining at which knowledge level they should start teaching, reviewing regularly students' acquired knowledge, providing feedback in good time, and delivering better matched subject matter at greater depth. The study survey of using Facebook Groups for module activities, the results of instructors' thinking showed that it could enhance the teaching and learning environment by increasing the interaction between teachers and students, the motivation to learn and the engagement with the course, and conducting effective discussions. There were statistically significant results from both the second experiment and the additional study survey. This means that the ontologically structured competences can lead to better teaching performance and that Facebook has very strong potential to enhance the teaching and learning environment through module activities. So, the research questions regarding better teaching performance and enhancing the teaching and learning environment were positively answered and confirmed.

Overall, this research introduces a Social Media Competence (SMC) application. The application has ontologically structured competences. Both students and instructors can benefit from these competences. Collaboratively, students can answer the given assignments successfully, and can form and manage more effective groups. Applying the ontologically structured competences improves instructors' teaching performance. The evaluation of the SMC application shows its effectiveness in supporting students to obtain better learning results and to work more collaboratively. In addition, taking ontologically structured competences as part of SMC application and applying it to teaching was granted to improve instructors' teaching performance. Moreover, the teaching and learning environment is enhanced by creating a Facebook group for module activities.

Thus, e-learning may be enhanced by integrating knowledge management and social media. Knowledge management can be seen as the ontologically structured content of competences, social information and notes in the SMC application, where competences form part of e-learning and applying them helps student to complete the assignment via developed SMC application. A

Facebook group is a tool of social media for collaborative work on assignments, and enhances group formation.

10.2 Contribution

This research advances state-of-the-art enhancements to e-learning by the integration of KM and social media through developing a social application, termed the Social Media Competence (SMC). The contributions of this research can be summarised as follows.

10.2.1 Designing A Social Media Competence Application

The design process of the SMC application plays an important role in terms of allowing students to interact with the application easily and providing them with assignment requirements. In addition, the competence structure design of the learning task is an essential factor in allowing students to achieve better learning results. The competences of the chosen knowledge domain were considered and then finalised into main, sub-, and sub-sub competences. The subject matter content of each competence was also analysed according to Merrill's categories. Then, the ontology of the subject matter was designed according to the competence structure and the subject matter categories. In order to make the ontology content explicit to users, properties were introduced to link to the content of the subject matter in explicit sentences. In addition, a number of the classes in the ontology were designed to provide further explanation and give examples of specific content.

The formalisation of collaborative learning is an important contribution to this research. The design of collaborative working competences was introduced and then finalised into main competences, with related roles on performing each. The design of the ontology was based on the structure of collaborative working competences. There was a class for collaborative working competences. Next, the roles were linked to the desired competences, with further examples or explanations. The students found the collaborative working competences understandable and helpful. The design of the collaborative working competences allowed students to work more collaboratively on given assignments and to form their group. Group formation was based on generating students' social information and skills from their Facebook profiles and comparing these with the ontologies of both the subject matter and the collaborative work in order to choose suitable students for specific tasks.

Developing a social application which involves ontological content as a facilitator of pedagogical activities is the key contribution of this research. The outstanding feature of the developed social application is the ontological structure of competences in a specific knowledge domain, plus collaborative working. In addition, the social application reads the social information of specific Facebook group members from their profiles in order to improve group formation. Moreover, it allows its users to make notes about defined group members, the relevant task and its progress. Because it is a social application, users can contribute to the knowledge-based ontologies by adding additional resources to specific competences, with the ability to view and delete these. The deletion of a resource can be achieved only by the user who originally added it. The date and time of an added resource or note are shown against who added them.

Through the experiment conducted in this research, the following sections were explored:

1) Students' ability to accomplish assignments successfully when using the SMC application;
2) Students' satisfaction with using normalisation competences as a facilitator of learning;
3) Students' satisfaction with using collaborative working competences as a facilitator of learning;
4) Students' ability to work more collaboratively and conduct more effective group work when using SMC application;
5) Students' satisfaction with the SMC application as facilitator for learning and group formation.

The results of the experiment were that the SMC application enables students to achieve better learning results in both the normalisation and the group work assignments. In addition, the findings show that students were satisfied with ontologically structured competences for both normalisation and group work through the SMC application. They confirm that students worked more collaboratively when using SMC application. Furthermore, students were satisfied with the SMC application and its ontologically structured content, and this, in turn, facilitates group formation among students by comparing the requirements of the assignments and the social attributes available among the students.

10.2.2 Developing ontologies based on competence components

There were two independent ontologies. The first relates to the task competences of the chosen knowledge domain. The second ontology relates to collaborative working competences. In order to construct the task competence ontology for a specific knowledge domain, a competence structure has been taken into account. After choosing the knowledge domain, all the necessary competences to perform the domain were set. The subject matter relating to those competences was analysed in four categories of subject matter: fact; concept; procedure; and principle. Next, the competences of related subject matter were finalised. The ontology of task competences was constructed, according to the competence structure and the related content. The main competences were followed, if necessary with a number of sub-competences, then linked to related categories of subject matter. The ontology of collaborative working was constructed by identifying a number of collaborative working competences and mapping them to four main competences. Again, the main competences had related roles on how to perform those competences. Both ontologies allow users to add resources to specific competences and to delete their own added resources. This facilitates finding additional material for specific competences when the content of the subject matter and its related roles are insufficient.

10.2.3 Display students social information

In order to enhance group formation and allow students to choose suitable group members, some information from students' Facebook profiles are exploited. This information allows students to compare the requirements of the assignment with skills available in their classmates. The application organises and structures this information in a way that allows students to identify them easily, instead of having to access each separate profile on Facebook to find the information. This is the benefit of having a Facebook group to gather together all the module's students.

10.2.4 Making notes about members through the application

The application does not only provide information on how to perform assignments, but enables its users to interact, such as by adding comments on relevant group members in terms of their progress or assigned tasks. In addition, students can contribute to the knowledge base by adding resources and tagging them with the competences desired, with the ability to delete their own added resources.

10.2.5 Ontologically structured competences to improve teaching

Ontologically structured competences (OSC) are a major component of the SMC application. They have been used in learning in order to investigate students' ability to accomplish the given assignments. In terms of applying OSC to teaching, an evaluation was conducted of the instructors' reaction to the approach. The findings are that instructors were significantly satisfied with applying OSC to teaching, for example having far clearer goals and sequences for teaching, determining at which level of knowledge they decide to start teaching, reviewing regular students' acquired knowledge and providing them with regular feedback. Instructors thought that applying OSC to their teaching allows them to set assignments that are more directly aligned with the taught competences and makes their teaching innovative.

10.2.6 Enhancing teaching and learning environment by using Facebook Group

Facebook has been used in this research to support collaborative working via the SMC application. The SMC application can organise Facebook content in a structured manner, such as by retrieving social information in particular way and tagging added resources for a Facebook group that have the desired competences. Aside from that, Facebook Groups was investigated in terms of enhancing the teaching and learning environment by creating a group for the module activities. The opinions of instructors were taken into account. The findings show that instructors were significantly satisfied with using Facebook Groups for module activities to enhance the teaching and learning environment. This was by means of increasing the interaction between students and teachers, the engagement with the course and the motivation to learn, and conducting effective discussions and paying closer attention to the topics taught.

10.3 Future Work

There are a number of research directions in which this work could be extended. We believe that the SMC application introduced in this research can contribute to state-of-the-art enhancements in e-learning by integrating KM and social media in educational communities universally. Thus, future research may be in the following directions.

10.3.1 Learning paths

This research focuses on answering given assignments based on ontologically structured competences. Students need to explore whole competences in order to accomplish the assignments successfully. However, there is another research possibility: that of investigating which path of competences can successfully answer the assignments in the shortest time without affecting the quality of the work. This involves a review of the knowledge base (ontology) and the competence structures for the chosen knowledge domain. In addition, it requires students to choose exciting competences in order to generate a suitable learning path in terms of answering an assignment or task. As a result, further study on existing complex ontologically structured competences might be explored. Further work could involve a better algorithm for structuring competences for learning paths when multiple existing competences structured are chosen. This would also take into account the size of the competence structures to answer the assignments, whether small, medium or large. So, investigating the best learning paths for answering the assignments might reveal a number of sub-works, such as reconstructing ontologies, better algorithms for generating a learning path, and enabling students to perform assignments in less time while preserving a good standard.

10.3.2 Improving the competences structure for collaborative working

This research focuses on the basic skills or competences that must be taken into account when working in the group. There are a number of social skills that have to be mapped into ontologies of collaborative working. Currently, there are four main competences, and the size of group is the optimum, between three to five students. When the group contains more than five members, they must share all the given competences of collaborative working in an equal way. This requires further study of the literature to come up with more competences for large group work with more specific and sufficient roles. The roles must be explained explicitly. In addition, the new collaborative working competences must be aligned to the given competences to answer the assignments. Any effect on either competence must influence the final results in the assignments. This requires an intensive reading of the literature and minor modifications to the ontology of collaborative working.

10.3.3 The Social Media Competence Application

In this research, the SMC application was deployed as a web-based application. The design and implementation did not particularly address usability and accessibility. A future plan is to include a self-search engine in the application to improve its usability and accessibility. At present, it can be accessed via a URL. Future plans are to reprogram it in order to make it an independent application in Apple Stores or Android, ready to be downloaded. This leads to another direction of research, which is mobile learning. Future research could focus on the ontological content of competences via mobile applications to enhance students' learning.

10.3.4 Additional tools for social media for supporting collaboration

This research has investigated Facebook, as it is a hugely popular and well-known tool. The purpose of using social media is to support collaboration, so there is the need to include further social media tools and examine their ability to support collaborative working in various ways, such as generating the content of their profiles to enhance group formation, and being able to add content inside the medium and link them, ontologically, with students' reaction to this particular medium. This requires intensive work in terms of programming and identifying the API of each social media tool considered, such as Twitter, Google Plus, YouTube and LinkedIn. The findings will be compared with the results obtained with Facebook in this study. This will support collaboration, then judge which supports collaboration best.

10.3.5 Additional tools of social media in SMC application

This research has used Facebook to read and generate the content of users' profiles in order to allow participants to form suitable groups. Social information in each profile was considered. The future plan is to incorporate more than one social media tool in order to enhance group formation. Each has special taxonomy of profile and new content. Gathering this information from various sources of particular social media tools will provide students with clear information about their colleagues in order to form suitable groups, for example using some Facebook content, taking into account information from a Twitter profile and considering aspects of someone's LinkedIn. This demands the construction of an ontology of social information about students. The ontology contains information from different sources of social media. Once the ontology is constructed, its implementation will use a more complicated algorithm to enhance group formation through providing social information and skills about students from various sites.

10.3.6 Notes and comments in SMC application

Currently, the notes made using the SMC application are visible to all the students who are enrolled on the module. The plan is to make a more complicated algorithm that enables students in a specific group to see only those comments and notes that were written by their group's members. This involves an intensive algorithm and effective user management administration. It requires the application to enable students to send an invitation, then other students to accept it. After that, the students are on a special list. In addition, resources added to the knowledge base will have restrictions that can be imposed by users. These are that added resources may be visible to everyone in the class or only to group members. The design of the ontology will be modified to handle these features.

10.3.7 Self-assessment and feedback

The current process within the SMC application is to provide information to students on how to answer the assignments collaboratively and to enhance group formation with collaborative working. In an e-learning transaction (Figure 2-2), the 'show' and 'tell' have been implemented as per this research, while the 'ask' has been considered in setting the assignments, then students respond. However, a future plan is to look at 'ask' from a different angle. The 'ask' checks or confirms students' learning with them in order to help or support their understanding. This plan generates an assessment question based on the current competence being visited. Students will be asked a question and, based on the answer, 'feedback' is shown. Based on this feedback, a special learning path will be generated. This requires modifications to the ontology and a special structure of competences, with a number of paths toward accomplishing the assignments.

Appendix A

This appendix shows all programming code related to task competence ontology.

A.1 RDF Code for Building Task Competence Ontology

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:cm="http://www.cmodel.com/elements/">

<rdf:Description rdf:about="http://www.cmodel.com/elements/task/normalise">
  <cm:topic>"Normalization"</cm:topic>

<cm:hasCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/NF11">
<dc:title>"Un-normalised form of database table"</dc:title>
<cm:hasOrder>1</cm:hasOrder>

  <cm:hasSubCompetence>
  <rdf:Description rdf:about="http://www.cmodel.com/comp/DN1">
<dc:title>"Define Normalisation"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/DPK12">

<dc:title>"Definition of Normalisation"</dc:title>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/Fact11">
<dc:title>"Normalisation Subcompetence"</dc:title>

<cm:SubMatterType>Fact</cm:SubMatterType>
  <cm:hasExample></cm:hasExample>
<cm:hasFactPair>
 <rdf:Description rdf:about="http://www.cmodel.com/fact/factpair11">

<cm:factName>Normalisation</cm:factName>
         <cm:hasConnection>is</cm:hasConnection>
     <cm:factValue>" a techniques used when designing a database. Normalisation involves a multi-step
process with aim to reduce data redundancy and to help eliminate data anomalies that can result from
such redundancy. Normalisation works through a series of stages, described as normal forms: the first
three stages are referred to as: first normal form (1NF); second normal form (2NF); and third normal form
(3NF)."</cm:factValue>
</rdf:Description>
</cm:hasFactPair>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
 </cm:hasSubCompetence>

  <cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/DUN2">
<dc:title>"Define Un-normalised form"</dc:title>
<cm:hasOrder>2</cm:hasOrder>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/DPK113">
<dc:title>"Definition of Un-normalised form "</dc:title>
<cm:hasSubjectMatter>
```

```xml
<rdf:Description rdf:about="http://www.cmodel.com/submatter/Fact12">
   <dc:title>"Un-normalised form"</dc:title>
<cm:SubMatterType>Fact</cm:SubMatterType>
<cm:hasExample></cm:hasExample>
<cm:hasFactPair>
<rdf:Description rdf:about="http://www.cmodel.com/fact/factpair12">
<cm:factName>Un-normalised form</cm:factName>
<cm:hasConnection>is</cm:hasConnection>
<cm:factValue>" a table that contains one or more repeating groups of data"</cm:factValue>
</rdf:Description>
</cm:hasFactPair>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
 </cm:hasSubCompetence>

  <cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/LUForm1">
<dc:title>"List un-normalised form of database table characteristics"</dc:title>
<cm:hasOrder>3</cm:hasOrder>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/LUNForm12">
<dc:title>" Characteristics of un-normalised form of database table"</dc:title>

<cm:hasCapability>List</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/concept/Concept112">
<cm:SubMatterType>"Concept"</cm:SubMatterType>
<cm:hasExample></cm:hasExample>
<dc:title>"Un-normalised form"</dc:title>
<cm:hasDomainConn>is Kind of </cm:hasDomainConn>
<cm:hasDomain>Normalisation Process</cm:hasDomain>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar112">
<cm:attributeName>Data</cm:attributeName>
<cm:hasConnection>might be</cm:hasConnection>
<cm:attributeValue>repeated</cm:attributeValue>
 </rdf:Description>
</cm:hasCharactertics>
  <cm:hasCharactertics>
<rdf:Description
rdf:about="http://www.cmodel.com/concept/CChar113"><cm:attributeName>Data</cm:attributeName>
<cm:hasConnection>might be</cm:hasConnection>
<cm:attributeValue>non-atomic</cm:attributeValue>
</rdf:Description>
   </cm:hasCharactertics>
  <cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar114">
<cm:attributeName>Fields</cm:attributeName>
<cm:hasConnection>could be</cm:hasConnection>
<cm:attributeValue>repeated</cm:attributeValue>
</rdf:Description>
 </cm:hasCharactertics>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
```

```
</cm:hasSubCompetence>

  <cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/LNS11">
<dc:title>"List Normalisation Steps"</dc:title>
<cm:hasOrder>4</cm:hasOrder>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/NSteps1">
<dc:title>"Normalisation Steps"</dc:title>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/procedure1">
<cm:SubMatterType>Procedure</cm:SubMatterType>
   <cm:hasExample></cm:hasExample>
   <dc:title>"Normalisation "</dc:title>
   <cm:hasProcNameCon>applies to</cm:hasProcNameCon>
<cm:hasSituation>un-normalised form of database table</cm:hasSituation>
<cm:hasGoalCon>to</cm:hasGoalCon>
<cm:hasGoal>Third Normal Form</cm:hasGoal>
   <cm:hasProcedureStep>
<rdf:Description rdf:about="http://www.cmodel.com/proc/step1">
<cm:stepNum>1</cm:stepNum>
<cm:stepName>Normalise to First Normal Form</cm:stepName>
</rdf:Description>
</cm:hasProcedureStep>
<cm:hasProcedureStep>
<rdf:Description rdf:about="http://www.cmodel.com/proc/step2">
<cm:stepNum>2</cm:stepNum>
<cm:stepName>Normalise to Second Normal Form</cm:stepName>
</rdf:Description>
</cm:hasProcedureStep>
<cm:hasProcedureStep>
<rdf:Description rdf:about="http://www.cmodel.com/proc/step3">
        <cm:stepNum>3</cm:stepNum>
<cm:stepName>Normalise to Third Normal form</cm:stepName>
</rdf:Description>
</cm:hasProcedureStep>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
    </cm:hasSubCompetence>
  </rdf:Description>
  </cm:hasCompetence>

<cm:hasCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/1NF">
  <dc:title>"Normalize to First Normal Form"</dc:title>
<cm:hasOrder>2</cm:hasOrder>
<cm:hasCapability>Normalise</cm:hasCapability>
 <cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/SubjectMatter1"> <dc:title>"First Normal
Form"</dc:title>
</rdf:Description>
</cm:hasSubjectMatter>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/RPGD">
<dc:title>"Remove Repeating Group of Data"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>Remove</cm:hasCapability>
```

<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/SubjectMatter2">
<dc:title>"Repeating Group of Data"</dc:title>
</rdf:Description>
</cm:hasSubjectMatter>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/LRGDC">
<dc:title>"List Repeating Group of Data characteristics"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>List</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/concept/Concept1">
<cm:SubMatterType>"Concept"</cm:SubMatterType>
<cm:hasExample>
For example: Consider the following attributes for Table_Product (Product_ID , Color, Price)
The table is not in First Normal Form because the [color] column may contain multiple values such as "red" and "green" in the same row.

To bring this table to First Normal Form, we split the table into two tables and now we have the following results. Table_Product_Prince which contains (Product_ID, Price), Table_Product_Color which contains (Product_ID, Color).
Now First normal Form is satisfied, as the columns on each table hold just one value.

</cm:hasExample>
<dc:title>"Repeating Group of Data "</dc:title>
<cm:hasDomainConn>is kind of</cm:hasDomainConn>
<cm:hasDomain>Normalisation Processes for First Normal Form</cm:hasDomain>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar1">
<cm:attributeName>Column values</cm:attributeName>
<cm:hasConnection>are</cm:hasConnection>
<cm:attributeValue>Unique</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar2">
<cm:attributeName>Row identifier</cm:attributeName>
<cm:hasConnection>is </cm:hasConnection>
<cm:attributeValue>Unique</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar3">
<cm:attributeName>field name</cm:attributeName>
<cm:hasConnection>is </cm:hasConnection>
<cm:attributeValue>Unique</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar4">
<cm:attributeName>Broken of data items</cm:attributeName>
<cm:hasConnection>is </cm:hasConnection>
<cm:attributeValue>not permitted</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasSubCompetence>

<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/IPKey">
<dc:title>"Identify Primary Key"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>Identify</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/SM4">
<dc:title>"Primary Key"</dc:title>
</rdf:Description>
</cm:hasSubjectMatter>

<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/LPKC">
<dc:title>"List Primary Key Characteristics"</dc:title>
<cm:hasOrder>2</cm:hasOrder>
<cm:hasCapability>List</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/concept/Concept2">
<cm:SubMatterType>"Concept"</cm:SubMatterType>
<cm:hasExample></cm:hasExample>
<dc:title>"Primary Key "</dc:title>
<cm:hasDomainConn>is kind of</cm:hasDomainConn>
<cm:hasDomain>Database keys</cm:hasDomain>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar5">
<cm:attributeName>Existence</cm:attributeName>
<cm:hasConnection>is</cm:hasConnection>
<cm:attributeValue>Always</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar6">
<cm:attributeName>Range of Values</cm:attributeName>
<cm:hasConnection>are</cm:hasConnection>
<cm:attributeValue>Unique</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar7">
<cm:attributeName>Range of Values</cm:attributeName>
<cm:hasConnection>are</cm:hasConnection>
<cm:attributeValue>Excluded Null</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar8">
<cm:attributeName>Variability</cm:attributeName>
<cm:hasConnection>is</cm:hasConnection>
<cm:attributeValue>None</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/DPK">
<dc:title>"Define Primary Key"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>Define</cm:hasCapability>

```
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/Fact1">
<dc:title>"Primary Key"</dc:title>
<cm:SubMatterType>Fact</cm:SubMatterType>
<cm:hasExample></cm:hasExample>
  <cm:hasFactPair>
<rdf:Description rdf:about="http://www.cmodel.com/fact/factpair1">
<cm:factName>Primary Key</cm:factName>
<cm:hasConnection>is</cm:hasConnection>
<cm:factValue>" a key that uniquely identifies each record in a table"</cm:factValue>

</rdf:Description>
</cm:hasFactPair>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasCompetence>

<cm:hasCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/2NF">
<dc:title>"Normalise to Second Normal Form"</dc:title>
<cm:hasOrder>3</cm:hasOrder>
  <cm:hasCapability>Normalise</cm:hasCapability>
   <cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/SM5">
<dc:title>"Second Normal Form"</dc:title>
 </rdf:Description>
</cm:hasSubjectMatter>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/N1NF2">
<dc:title>"Normalise to First Normal Form"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
</rdf:Description>
</cm:hasSubCompetence>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/RPD">
<dc:title>"Remove Partial Dependency"</dc:title>
<cm:hasOrder>2</cm:hasOrder>
 <cm:hasCapability>Remove</cm:hasCapability>
  <cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/SM6">
<dc:title>"Partial Dependency"</dc:title>
</rdf:Description>
</cm:hasSubjectMatter>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/Competence221">
<dc:title>"List Partial Dependency Characterisitcs"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>List</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/concept/Concept3">
<cm:SubMatterType>"Concept"</cm:SubMatterType>
<cm:hasExample>
For example: Consider Table_Purchase_detail with following attributes (Customer_ID, Store_ID,
Purchase_Location).
```

This table has a composite primary key [Customer ID, Store ID]. The non-key attribute is [Purchase Location]. In this case, [Purchase Location] only depends on [Store ID], which is only part of the primary key. Therefore, this table does not satisfy second normal form.
To bring this table to Second Normal Form, we break the table into two tables, and now we have the following results. Table_Purchase which contains (Customer_ID, Store ID), and Table_Store (Store ID, Purchase_Location).
What we have done is to remove the partial functional dependency that we initially had. Now, in the table [TABLE_STORE], the column [Purchase Location] is fully dependent on the primary key of that table, which is [Store ID].
</cm:hasExample>
<dc:title>"Partial Dependency "</dc:title>
<cm:hasDomainConn>is kind of</cm:hasDomainConn>
<cm:hasDomain>Normalisation Processes for Second Normal Form </cm:hasDomain>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar9">
<cm:attributeName>Non- key attributes of each column</cm:attributeName>
<cm:hasConnection>Must Depends on</cm:hasConnection>
<cm:attributeValue>every part of the primary key</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasCompetence>

<cm:hasCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/3NF">
<dc:title>"Normalise to Third Normal Form"</dc:title>
<cm:hasOrder>4</cm:hasOrder>
<cm:hasCapability>Normalise</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/SM71">
<dc:title>"Third Normal Form"</dc:title>
</rdf:Description>
</cm:hasSubjectMatter>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/N2NF2">
<dc:title>"Normalise to Second Normal Form"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>Normalise</cm:hasCapability>
</rdf:Description>
</cm:hasSubCompetence>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/RFD2">
<dc:title>"Remove Functional Dependency"</dc:title>
<cm:hasOrder>1</cm:hasOrder>
<cm:hasCapability>Remove</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/submatter/SM81">
<dc:title>"Functional Dependency"</dc:title>
</rdf:Description>
</cm:hasSubjectMatter>
<cm:hasSubCompetence>
<rdf:Description rdf:about="http://www.cmodel.com/comp/LFDC1">
<dc:title>"List Functional Dependency Characteristics"</dc:title>
<cm:hasOrder>1</cm:hasOrder>

<cm:hasCapability>List</cm:hasCapability>
<cm:hasSubjectMatter>
<rdf:Description rdf:about="http://www.cmodel.com/concept/Concept41">
<cm:SubMatterType>"Concept"</cm:SubMatterType>
<cm:hasExample>
For example: Consider the following attribute for Table_Book_Detail (Book_ID, Genre_ID, Genre_Type, Price).
In the table able, [Book ID] determines [Genre ID], and [Genre ID] determines [Genre Type]. Therefore, [Book ID] determines [Genre Type] via [Genre ID] and we have transitive functional dependency, and this structure does not satisfy third normal form.
To bring this table to third normal form, we split the table into two as follows: Table_Book which contains (Book_ID, Genre_ID, Price), and Table_Genere which contains (Genere_ID, Genre_Type).
Now all non-key attributes are fully functional dependent only on the primary key. In [TABLE_BOOK], both [Genre ID] and [Price] are only dependent on [Book ID]. In [TABLE_GENRE], [Genre Type] is only dependent on [Genre ID].
</cm:hasExample> <dc:title>"Functional Dependency "
</dc:title> <cm:hasDomainConn>is kind of</cm:hasDomainConn>
<cm:hasDomain>Normalisation Processes for Third Normal Form</cm:hasDomain>
<cm:hasCharactertics>
<rdf:Description rdf:about="http://www.cmodel.com/concept/CChar11">
<cm:attributeName>There are no non-key attributes</cm:attributeName>
<cm:hasConnection>that depend</cm:hasConnection>
<cm:attributeValue>on another non-key attribute</cm:attributeValue>
</rdf:Description>
</cm:hasCharactertics>
</rdf:Description>
</cm:hasSubjectMatter>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasSubCompetence>
</rdf:Description>
</cm:hasCompetence>
</rdf:Description>
</rdf:RDF>

A.2 Programming Code for retrieving task competence ontology content

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>

   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
     </script>
</head>
<body>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<%
String AccessTokenJS, UserName,AccUserName;
```

```
String testStr=null;
AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
if ( AccUserName == null)
{
        AccessTokenJS = (String)request.getParameter("accTokenName");
        session.setAttribute( "sessionToken", AccessTokenJS );
//      out.println("<BR>Session Token: " + AccessTokenJS);
        UserName = request.getParameter("accUserName");
        session.setAttribute( "sessionUserName", UserName );
}
//AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<h3>You are Logged in as <B>: " + AccUserName + "</B></h3>");
//out.println("<BR>Retreived Session Token: " + AccessTokenJSession);
//<a href="javascript:logoutFacebook()">Logout from Facebook Account</a>
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
%>
<h3>
</h3>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
          <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">

          <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
```

```
<%
//response.getWriter().write(r.toString()+"<br/>");
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");
        Query  qry;;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl,compExample;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
          //else {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        // read the model from the file
        //"?T cm:topic ?topicStr.FILTER regex (?topicStr, \""+ content+"\", \"i\"). "+
        //"?competence dc:title ?ttl. "+
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                "PREFIX cm:<http://www.cmodel.com/elements/> "+
                "SELECT DISTINCT ?ttl ?competence ?orderNo ?compExample WHERE { "+
                "?T cm:hasCompetence ?competence. "+
                "?competence dc:title ?ttl. "+
                //"?competence cm:hasExample ?compExample. "+
                "?competence cm:hasOrder ?orderNo. "+
                " } ORDER BY ?orderNo";
        //out.println("<BR><U>Query for selecting competences for <B>"+content +" </U></B> is
<BR><BR>"+ queryString +" <BR><BR>");
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                 soln = rs.nextSolution() ;
                 r = soln.getResource("competence") ;
                 ttl = soln.getLiteral("ttl") ;
                 //compExample = soln.getLiteral("compExample") ;
                 out.println("<details><summary> <font size='6' color='blue'>"+
(ttl.getString()).replace("\"", "") + "</font> </summary> <BR>");
                 //out.println("URIs of Competence Title: "+r+ " <BR>");
           // out.println("<B>Example:</B><BR> "+compExample+ " <BR><BR>");
                Query  qry2;;
                QueryExecution qe2 ;
                ResultSet rs2 ;
                Literal ttl2;
                Literal cap2;
                Literal sm2;
                QuerySolution soln2;
                Resource c2;
                String queryString2;
                queryString2 =         "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                "PREFIX cm:<http://www.cmodel.com/elements/> "+
                "SELECT DISTINCT ?scomp ?ttl2 ?orderNo WHERE { "+
                "?comp1 dc:title ?titleStr.FILTER regex (?titleStr, "+  ttl +", \"i\"). "+
```

```
"?comp1 cm:hasSubCompetence ?scomp. "+
"?scomp dc:title ?ttl2. "+
"?scomp cm:hasOrder ?orderNo. "+
" } ORDER BY ?orderNo";
//out.println("Title: "+ queryString2 + " <BR>");
qry2 = QueryFactory.create(queryString2);
qe2 = QueryExecutionFactory.create(qry2, model);
rs2 = qe2.execSelect();
for ( ; rs2.hasNext() ; )
{
soln2 = rs2.nextSolution() ;
c2 = soln2.getResource("scomp") ;
ttl2 = soln2.getLiteral("ttl2") ;
//out.println("<BR>URIs of Competence 222 Title: "+c2+ " ");
out.println("<details><summary><font size='5' color='green'>"+
(ttl2.getString()).replace("\"", "") + " </font> </summary><BR>");
Query  qry3;;
QueryExecution qe3 ;
ResultSet rs3 ;
Literal ttl33;
Literal cap3;
Literal smtype, smtitle, smExample, smConn, smDomain;
QuerySolution soln3;
Resource c3,smR;
String queryString3
queryString3 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
"PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
"PREFIX cm:<http://www.cmodel.com/elements/> "+
"SELECT DISTINCT ?sscomp ?ttl33 ?smR ?smtype ?smtitle ?smDConnection
?smDomain ?smExample WHERE { "+
"?comp2 dc:title ?titleStr.FILTER regex (?titleStr, "+  ttl2 +", \"i\"). "+
"?comp2 cm:hasSubCompetence ?sscomp. "+
"?sscomp dc:title ?ttl33. "+
"?sscomp cm:hasSubjectMatter ?smR. "+   // subjectMatter
"?smR cm:SubMatterType ?smtype. "+      // subject matter has type
"?smR dc:title ?smtitle. "+             // subject matter has title
"?smR cm:hasExample ?smExample. "+              // subject matter has title
" } ";
//out.println("Title: "+ queryString2 + " <BR>");
qry3 = QueryFactory.create(queryString3);
qe3 = QueryExecutionFactory.create(qry3, model);
rs3 = qe3.execSelect();
for ( ; rs3.hasNext() ; )
{
soln3 = rs3.nextSolution() ;
c3 = soln3.getResource("sscomp") ;
smR = soln3.getResource("smR") ;
ttl33 = soln3.getLiteral("ttl33") ;
smtitle = soln3.getLiteral("smtitle") ;
smtype = soln3.getLiteral("smtype") ;
smExample = soln3.getLiteral("smExample") ;
out.println("<details><summary> ==><font size='4' color='red'>"+ (ttl33.getString()).replace("\"", "") + "
</font></summary> <BR>");
//subject matter title is name
//out.println("<BR>Subject Matter is <B>: "+smtype+ "</B>, ");
//out.println("<BR>Example is <B>: "+smExample+ "</B>, ");
Query  qry4,qry5,qry6;
QueryExecution qe4,qe5,qe6, qe7,qe8;
ResultSet rs4, rs5, rs6 ;
```

```
Literal factName, factValue, attName,attValue, factConnect,conConn, conceptName, domain,
domainCon ;
Literal cap4,cap5;
Literal smtype4, smtype5, smtitle4,smtitle5;
Literal procName, procNameConn, situation, goalConn, goal;
Literal stepNo, stepNameValue  ;
QuerySolution soln4,soln5,soln6, soln7, soln8;
Resource smR4, smR5;
String queryString4, queryString5, queryString6;
String smtypeStr;
String smFact="Fact";
String smConcept="Concept";
String smProcedure="Procedure";
                if ( smFact.equals(smtype.toString()) )
{
        //out.println("Its FACT");
          queryString4 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
          "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
          "PREFIX cm:<http://www.cmodel.com/elements/> "+
          "SELECT DISTINCT ?fName ?fValue ?fConnect WHERE { "+
          "?subMatterFact dc:title ?fTitleStr.FILTER regex (?fTitleStr, "+  smtitle +", \"i\"). "+
          "?subMatterFact cm:hasFactPair ?smFactPair. "+
          "?smFactPair cm:factName ?fName. "+
          "?smFactPair cm:factValue ?fValue. "+
          "?smFactPair cm:hasConnection ?fConnect. "+
          " } ";
                qry4 = QueryFactory.create(queryString4);
                qe4 = QueryExecutionFactory.create(qry4, model);
                rs4 = qe4.execSelect();
                for ( ; rs4.hasNext() ; )
                        {
                soln4 = rs4.nextSolution() ;
                factName = soln4.getLiteral("fName") ;
                factConnect = soln4.getLiteral("fConnect");
                factValue = soln4.getLiteral("fValue") ;
          out.println("<BR>"+ factName + " ");
                out.println(" <B>"+ factConnect + "</B>");
                out.println(" "+ factValue + " ");
                }
          qe4.close();
          out.println("<BR>");
                }
                else if ( smProcedure.equals(smtype.toString()) )
                {  //procedure
                queryString6 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                "PREFIX cm:<http://www.cmodel.com/elements/> "+
                "SELECT DISTINCT ?procedureName ?pNameCon ?goal ?goalCon ?situation  WHERE {
"+              "?subMatter2 dc:title ?procedureName.FILTER regex (?procedureName, "+  smtitle +",
\"i\"). "+
"?subMatter2 cm:hasProcNameCon ?pNameCon. "+
"?subMatter2 cm:hasSituation ?situation. "+
"?subMatter2 cm:hasGoalCon ?goalCon. "+
"?subMatter2 cm:hasGoal ?goal. "+
" } ";
qry6 = QueryFactory.create(queryString6);
qe7 = QueryExecutionFactory.create(qry6, model);
rs6 = qe7.execSelect();
for ( ; rs6.hasNext() ; )
{         soln7 = rs6.nextSolution() ;
```

```
procName = soln7.getLiteral("procedureName") ;
procNameConn = soln7.getLiteral("pNameCon") ;
        situation = soln7.getLiteral("situation") ;
        goalConn = soln7.getLiteral("goalCon") ;
        goal = soln7.getLiteral("goal");
        out.println("<BR>"+ procName + " ");
        .println(" <B>"+ procNameConn + "</B> ");
        out.println(" "+ situation + " ");
        out.println("<B> "+ goalConn + "</B> ");
        out.println(" "+ goal + " ");
         out.println("<BR><BR> This procedure has the following steps: <BR> ");
                qe7.close();
                queryString6 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                        "SELECT DISTINCT ?stepNo ?stepNameValue  WHERE { "+
                        "?subMatter2 dc:title ?procedureName.FILTER regex (?procedureName, "+  smtitle
+", \"i\"). "+
                        "?subMatter2 cm:hasProcedureStep ?smProcedure. "+
                        "?smProcedure cm:stepNum ?stepNo. "+
                        "?smProcedure cm:stepName ?stepNameValue. " +
                                " } ORDER BY ?stepNo ";
                                qry6 = QueryFactory.create(queryString6);
                                        qe8 = QueryExecutionFactory.create(qry6, model);
                                                rs6 = qe8.execSelect();
                                for ( ; rs6.hasNext() ; )
                                {
        soln8 = rs6.nextSolution() ;
        stepNo = soln8.getLiteral("stepNo") ;
                 stepNameValue = soln8.getLiteral("stepNameValue") ;
                out.println("<BR>"+ stepNo + " ");
                out.println("<B>"+ stepNameValue + "</B>");
                                 }
                qe8.close();
                out.println("<BR>");
                                }
                                else
                                {
                        //out.println("Its CONCEPT");
                          //out.println(" with following characteristics <BR>");
                queryString5 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                        "SELECT DISTINCT ?conceptName ?domainName ?domainCon ?attName
?attValue  WHERE { "+
        "?subMatter2 dc:title ?conceptName.FILTER regex (?conceptName, "+  smtitle +", \"i\"). "+
        "?subMatter2 cm:hasDomainConn ?domainCon. "+
        "?subMatter2 cm:hasDomain ?domainName. "+
        " } ";
qry5 = QueryFactory.create(queryString5);
= QueryExecutionFactory.create(qry5, model);
rs5 = qe5.execSelect();
for ( ; rs5.hasNext() ; )
{
        soln5 = rs5.nextSolution() ;
        conceptName = soln5.getLiteral("conceptName") ;
        domain = soln5.getLiteral("domainName") ;
        domainCon = soln5.getLiteral("domainCon");

        out.println("<BR>"+ conceptName + " ");
```

```
        out.println(" <B>"+ domainCon + "</B> ");
        out.println(""+ domain + " where :<BR>");
                }
                qe5.close();
        queryString5 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
        "PREFIX cm:<http://www.cmodel.com/elements/> "+
        "SELECT DISTINCT ?conceptName ?conceptConn ?attName ?attValue  WHERE { "+
        "?subMatter2 dc:title ?conceptName.FILTER regex (?conceptName, "+  smtitle +", \"i\"). "+
        "?subMatter2 cm:hasCharactertics ?smChar. "+
        "?smChar cm:attributeName ?attName. "+
        "?smChar cm:attributeValue ?attValue. " +
        "?smChar cm:hasConnection ?conceptConn. " +
                " } ";
        qry5 = QueryFactory.create(queryString5);
                qe6 = QueryExecutionFactory.create(qry5, model);
                rs5 = qe6.execSelect();
for ( ; rs5.hasNext() ; )
{ soln6 = rs5.nextSolution() ;
attName = soln6.getLiteral("attName") ;
attValue = soln6.getLiteral("attValue") ;
conConn = soln6.getLiteral("conceptConn");
out.println("<BR>"+ attName + " ");
out.println("<B>"+ conConn + "</B>");
out.println(""+ attValue + " <BR>");
}
qe6.close();
out.println("<BR>");
}
out.println("<BR>"+smExample+ "<BR>");
out.println("<BR></details> ");
}
qe3.close();
out.println("<BR><BR></details>");
               }
                qe2.close();
                out.println("<BR><BR></details><BR>");
   }
 out.println("<BR>");
 qe.close();
%>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
<BR>
</body>
</html>
```

A.3 Java Programming Code for Viewing, Adding, and Deleting Resources

Programming code for viewing resources:

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
```

```
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
    </script>

</head>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>

<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");

String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>

<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>

    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
            <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">

            <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
```

```
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
        <form action="viewResource.jsp" method="GET">
    <BR>
        <center>
        Select from drop down list and click on 'View Resource' to view resource links.
        <BR> <BR>
        <select name="selCompForView" >
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                        "SELECT DISTINCT ?ttl ?competence WHERE { "+
                "?T cm:hasCompetence ?competence. "+
                        "?competence dc:title ?ttl. "+
                                        " } ";
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                soln = rs.nextSolution() ;
                r = soln.getResource("competence") ;
                ttl = soln.getLiteral("ttl") ;
                out.println("<option value='"+ ttl + "'>"+ ttl + "</option>");
                Query  qry2;
                QueryExecution qe2 ;
                ResultSet rs2 ;
                Literal ttl2;
                Literal cap2;
                Literal sm2;
                QuerySolution soln2;
                Resource c2;
                String queryString2;
                queryString2 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
```

```
                                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
"+
                                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                                        "SELECT DISTINCT ?scomp ?ttl2 WHERE { "+
                                        "?comp1 cm:hasSubCompetence ?scomp. "+
                                        "?scomp dc:title ?ttl2. "+
                                        " } ";
                    qry2 = QueryFactory.create(queryString2);
                    qe2 = QueryExecutionFactory.create(qry2, model);
                    rs2 = qe2.execSelect();
                    for ( ; rs2.hasNext() ; )
                    {
                            soln2 = rs2.nextSolution() ;
                            c2 = soln2.getResource("scomp") ;
                            ttl2 = soln2.getLiteral("ttl2") ;
                            out.println("<option value='"+ ttl2 + "'>"+ ttl2 + "</option>");
                    }
                    qe2.close();
  }

  out.println("</select>");
      out.println("<BR>");
%>
<BR><BR>
<input type="submit" value="View Resource" />
</form>
      </center>
      </td>
      <td width="20%" style="vertical-align:top">
      <%
      AccUserName = (String)session.getAttribute("sessionUserName");
  out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
      %>
      <BR>
      <a href="javascript:logoutFacebook()">Logout from Facebook</a>
      </td>
 </tr>
</table>
</center>
<BR>
</body>
</html>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
         FB.init({
           appId:'242427255928014', cookie:true,
           status:true, xfbml:true
         });
         FB.logout(function() {
           // Reload the same page after logout
           // window.location.reload();
```

```
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
           });
         }
      </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
String selectedCompetence;
selectedCompetence = request.getParameter("selCompForView");
//out.println(selectedCompetence);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
           <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
           <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
```

```
	</td>
    <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("addedResources.rdf");
	Query  qry;
	QueryExecution qe ;
	ResultSet rs ;
	Literal creator;
	Literal compTitle;
	Literal url;
	Literal adDate;
	QuerySolution soln;
	Resource r;
	File f = new File(fileName);
	InputStream in = new FileInputStream(f);
	if ( in == null )
	{ throw new IllegalArgumentException("File is not found" );}
	//else  {outt.println(" File successfully openned\n");  }
	Model model = ModelFactory.createDefaultModel();
	model.read(in,null);
	String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
	"PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
	"PREFIX cm:<http://www.cmodel.com/elements/> "+
	"SELECT DISTINCT ?adDate ?url ?compTitle ?creator  WHERE { "+
		"?addedRes cm:hasCreator ?creator. "+
		"?addedRes cm:hasCompTitle ?compTitle.FILTER regex (?compTitle, "+
selectedCompetence +", \"i\"). "+
		"?addedRes cm:hasDate ?adDate. "+
		"?addedRes cm:hasURL ?url. "+
		" } ORDER BY ?compTitle ";
	qry = QueryFactory.create(queryString);
	//out.println("<BR>"+ queryString + "");
	qe = QueryExecutionFactory.create(qry, model);
	rs = qe.execSelect();
	int rsSize = 0;
	for ( ; rs.hasNext() ; )
	{
		rsSize = rsSize+1;
		soln = rs.nextSolution() ;
		//r = soln.getResource("competence") ;
		creator = soln.getLiteral("creator") ;
		compTitle = soln.getLiteral("compTitle") ;
		adDate = soln.getLiteral("adDate") ;
		url = soln.getLiteral("url") ;
      //out.println("<form action='delSelectedResource.jsp' method='GET'> ");
		out.println("<BR> Resource added for <b> "+ compTitle + " </b> by <b>"+ creator + "
</b> on "+ adDate + "");
		//out.println("<BR>"+ creator + "");
		//out.println("<BR>"+ adDate + "");
		out.println("<BR><a href='" + url + "' >" + url + "</a><BR><BR>");
/*
out.println("<input type='hidden' name='selDeleteCompetence' value='"+ compTitle + "'/>");
out.println("<input type='hidden' name='selDeleteCreator' value='"+ creator + "'/>");
out.println("<input type='hidden' name='selDeleteURL' value='"+ url + "'/>");
out.println("<input type='submit' value='Delete This Resource' />");
out.println("</form>");
*/

	}
```

```
          out.println("<BR><BR>");
    qe.close();
if (rsSize == 0)
{
out.println("<BR> No additional resources has been added to " + selectedCompetence );
}
%>
<BR>
          </td>
                    <td width="20%" style="vertical-align:top">
          <%
          AccUserName = (String)session.getAttribute("sessionUserName");
    out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
          %>
          <BR>
          <a href="javascript:logoutFacebook()">Logout from Facebook</a>
          </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Programming code for adding resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
         FB.init({
           appId:'242427255928014', cookie:true,
           status:true, xfbml:true
         });
         FB.logout(function() {
           // Reload the same page after logout
```

```
            // window.location.reload();
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
function validateForm() {
    var x = document.forms["form1"]["resURL"].value;
          var reurl = /http:\/\/[A-Za-z0-9\.-]{3,}\.[A-Za-z]{3}/;
          if ( !reurl.test(x) )
          {
              alert("Please enter valid URL including http://");
       return false;
          }
}

     </script>
</head>
<center>
          <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
          response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
<td width="25%" style="vertical-align:top">
          <BR>
          <a href="home.jsp">Home Page</a>
          <BR><BR>
          Task Competences
          <ul style="list-style-type:disc">
              <li>   <a href="compList.jsp">View Task Competencees</a></li>
                   <li><a href="selResourceView.jsp">View Related Resources</a></li>
                   <li><a href="addResource.jsp">Add Related Resources</a></li>
                   <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Collaborative Working Compentences
          <ul style="list-style-type:disc">

              <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                   <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                   <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                   <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
```

```
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
        <BR>
        <form name="form1" action="saveRes.jsp" onsubmit="return validateForm()"  method="GET">
        Select item from the list:      <select name="compItem" >
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                             "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                             "PREFIX cm:<http://www.cmodel.com/elements/> "+
                             "SELECT DISTINCT ?ttl ?competence WHERE { "+
                             "?T cm:hasCompetence ?competence. "+
                             "?competence dc:title ?ttl. "+
                             " } ";
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                soln = rs.nextSolution() ;
                r = soln.getResource("competence") ;
                ttl = soln.getLiteral("ttl") ;
                out.println("<option value='"+ ttl + "'>"+ ttl + "</option>");
                Query  qry2;
                QueryExecution qe2 ;
                ResultSet rs2 ;
                Literal ttl2;
                Literal cap2;
                Literal sm2;
                QuerySolution soln2;
                Resource c2;
                String queryString2;
                queryString2 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
```

```
                "PREFIX cm:<http://www.cmodel.com/elements/> "+
                "SELECT DISTINCT ?scomp ?ttl2 WHERE { "+
                "?comp1 cm:hasSubCompetence ?scomp. "+
                "?scomp dc:title ?ttl2. "+
                " } ";
                        qry2 = QueryFactory.create(queryString2);
                        qe2 = QueryExecutionFactory.create(qry2, model);
                        rs2 = qe2.execSelect();
                        for ( ; rs2.hasNext() ; )
                        {
                                soln2 = rs2.nextSolution() ;
                                c2 = soln2.getResource("scomp") ;
                                ttl2 = soln2.getLiteral("ttl2") ;
                                out.println("<option value='"+ ttl2 + "'>"+ ttl2 + "</option>");
                        }
                        qe2.close();
  }

  out.println("</select>");
        out.println("<BR>");
  qe.close();
%>
<BR>
Enter URL of the resource (including http:).
<br>
<input type="text" name="resURL" size="65">
<BR><BR>
<input type="submit" value="Add Resource" />
</form>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
  out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Programming code for saving resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Property"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
<%@ page import="java.util.Date"%>
<%@ page import="java.text.DateFormat"%>
<%@ page import="java.text.SimpleDateFormat"%>
<%@ page import="java.util.Calendar"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
    </script>
```

```
</head>
<body>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
        </center>
<BR><BR>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String selectedCompetence, resourceURL;
selectedCompetence = request.getParameter("compItem");
resourceURL = (String)request.getParameter("resURL");
//out.println(selectedCompetence);
//out.println(resourceURL);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
            <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
            <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("addedResources.rdf");
```

```
        String NS = "http://www.cmodel.com/elements/";
        String randURI = "http://www.cmodel.com/elements/randURI";
        randURI = randURI + Math.random();
        //outt.println(" <BR> random uri" + randURI);
        String timeStamp = new SimpleDateFormat("dd/MM/yyyy
HH:mm:ss").format(Calendar.getInstance().getTime());
        //("yyyyMMdd_HHmmss")
        //outt.println(" <BR> random uri" + timeStamp);
        Query  qry;;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        File fout = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
          //else {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        OutputStream os = new FileOutputStream(fout);
        Resource AddedResource = model.createResource(randURI);
        Property competenceTitle = model.createProperty(NS, "hasCompTitle");
        Property creater = model.createProperty(NS, "hasCreator");
        Property addedResourceURL = model.createProperty(NS, "hasURL");
        Property dated = model.createProperty(NS, "hasDate");
        Literal compTitle = model.createLiteral(selectedCompetence);
        Literal resCreator = model.createLiteral(AccUserName);
        Literal addedResURL = model.createLiteral(resourceURL);
        Literal addDate = model.createLiteral(timeStamp);
        AddedResource.addLiteral(competenceTitle, compTitle);
        AddedResource.addLiteral(creater, resCreator);
        AddedResource.addLiteral(addedResourceURL, addedResURL);
        AddedResource.addLiteral(dated, addDate);
        model.write(os);
        in.close();
        //os.close();
        out.println("<BR>You have successfully added resource for " + selectedCompetence );
%>
        </td>
        <td width="20%" style="vertical-align:top">
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
</body>
</html>
```

Programming code for deleting resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
```

```
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
    </script>
</head>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
<td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
          <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
          <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
```

```
    <td width="55%" style="vertical-align:top">
          <form action="viewResourceDelete.jsp" method="GET">
          <BR>
          <center>
          Select item from the list to view its related resources for deletion.
          <BR> <BR>
                    <select name="selCompForView" >
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");
          Query  qry;
          QueryExecution qe ;
          ResultSet rs ;
          Literal ttl;
          Literal cap;
          Literal sm;
          QuerySolution soln;
          Resource r;
          File f = new File(fileName);
          InputStream in = new FileInputStream(f);
          if ( in == null )
          { throw new IllegalArgumentException("File is not found" );}
          //else  {outt.println(" File successfully openned\n");  }
          Model model = ModelFactory.createDefaultModel();
          model.read(in,null);
          String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
          "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
          "PREFIX cm:<http://www.cmodel.com/elements/> "+
          "SELECT DISTINCT ?ttl ?competence WHERE { "+
          "?T cm:hasCompetence ?competence. "+
          "?competence dc:title ?ttl. "+
          " } ";
          qry = QueryFactory.create(queryString);
          qe = QueryExecutionFactory.create(qry, model);
          rs = qe.execSelect();
          for ( ; rs.hasNext() ; )
          {
                    soln = rs.nextSolution() ;
                    r = soln.getResource("competence") ;
                    ttl = soln.getLiteral("ttl") ;
                    out.println("<option value='"+ ttl + "'>"+ ttl + "</option>");
                    Query  qry2;
                    QueryExecution qe2 ;
                    ResultSet rs2 ;
                    Literal ttl2;
                    Literal cap2;
                    Literal sm2;
                    QuerySolution soln2;
                    Resource c2;
                    String queryString2;
                    queryString2 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                                      "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
"+
                                                      "PREFIX cm:<http://www.cmodel.com/elements/> "+
                                                      "SELECT DISTINCT ?scomp ?ttl2 WHERE { "+
                                                      "?comp1 cm:hasSubCompetence ?scomp. "+
                                                      "?scomp dc:title ?ttl2. "+
                                                      " } ";
                              qry2 = QueryFactory.create(queryString2);
```

```
                        qe2 = QueryExecutionFactory.create(qry2, model);
                        rs2 = qe2.execSelect();
                        for ( ; rs2.hasNext() ; )
                        {
                                soln2 = rs2.nextSolution() ;
                                c2 = soln2.getResource("scomp") ;
                                ttl2 = soln2.getLiteral("ttl2") ;
                                out.println("<option value='"+ ttl2 + "'>"+ ttl2 + "</option>");
                        }
                        qe2.close();
   }

   out.println("</select>");
        out.println("<BR>");
%>
<BR><BR>
<input type="submit" value="View Resource" />
</center>
</form>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
```

```
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
      </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
          response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
String selectedCompetence;
selectedCompetence = request.getParameter("selCompForView");
//out.println(selectedCompetence);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
          <BR>
          <a href="home.jsp">Home Page</a>
          <BR><BR>
          Task Competences
          <ul style="list-style-type:disc">
              <li>   <a href="compList.jsp">View Task Competencees</a></li>
                    <li><a href="selResourceView.jsp">View Related Resources</a></li>
                    <li><a href="addResource.jsp">Add Related Resources</a></li>
                    <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Collaborative Working Compentences
          <ul style="list-style-type:disc">

              <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                    <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                    <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                    <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
          <li><a href="fbookGroup.jsp">Group Information</a></li>
          <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
          <li><a href="memberCompetence.jsp">Competences of Members</a></li>
          </ul>
          <BR><BR>
          Notes about Group Members
          <ul style="list-style-type:disc">
          <li><a href="addNote.jsp">Add Note</a></li>
```

```
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("addedResources.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal creator;
        Literal compTitle;
        Literal url;
        Literal adDate;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                "PREFIX cm:<http://www.cmodel.com/elements/> "+
                "SELECT DISTINCT ?adDate ?url ?compTitle ?creator  WHERE { "+
                "?addedRes cm:hasCreator ?creator. FILTER regex (?creator, '"+  AccUserName +"', \"i\").
"+
                "?addedRes cm:hasCompTitle ?compTitle.FILTER regex (?compTitle, "+
selectedCompetence +", \"i\"). "+
                "?addedRes cm:hasDate ?adDate. "+
                "?addedRes cm:hasURL ?url. "+
                " } ORDER BY ?compTitle ";
        qry = QueryFactory.create(queryString);
        //out.println("<BR>"+ queryString + "");
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        int rsSize = 0;
        for ( ; rs.hasNext() ; )
        {
                rsSize = rsSize+1;
                soln = rs.nextSolution() ;
                //r = soln.getResource("competence") ;
                creator = soln.getLiteral("creator") ;
                compTitle = soln.getLiteral("compTitle") ;
                adDate = soln.getLiteral("adDate") ;
                url = soln.getLiteral("url") ;
out.println("<form action='delSelectedResource.jsp' method='GET'> ");
                out.println("<BR> Resource added for <b> "+ compTitle + " </b> by <b>"+ creator + "
</b> on "+ adDate + "");
                //out.println("<BR>"+ creator + "");
                //out.println("<BR>"+ adDate + "");
                out.println("<BR><a href='" + url + "' >" + url + "</a><BR><BR>");
out.println("<input type='hidden' name='selDeleteCompetence' value='"+ compTitle + "'/>");
out.println("<input type='hidden' name='selDeleteCreator' value='"+ creator + "'/>");
out.println("<input type='hidden' name='selDeleteURL' value='"+ url + "'/>");
out.println("<input type='submit' value='Delete This Resource' />");
out.println("</form>");
```

```
            }
            out.println("<BR><BR>");
    qe.close();
if (rsSize == 0)
{
out.println("<BR> You have not added any resources to delete for " + selectedCompetence );
}
%>
<BR>
            </td>
            <td width="20%" style="vertical-align:top">
            <%
            AccUserName = (String)session.getAttribute("sessionUserName");
    out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
            %>
            <BR>
            <a href="javascript:logoutFacebook()">Logout from Facebook</a>
            </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Appendix B

This appendix shows all programming code related to collaborative working ontology.

B.1 RDF Code for Building Collaborative Working Ontology

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:ccm="http://www.cmodel.com/cwc/elements/">

<rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/CollaborativeWorkingCompetence">
<ccm:hasCWCCategory>
<rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/comp/Planning">
<ccm:cwccTitle>"Planning"</ccm:cwccTitle>
<ccm:cwccExplanation>A student will be able to lead and manage the group</ccm:cwccExplanation>
<ccm:hasCWCompetence>Draw directions to accomplish task successfully</ccm:hasCWCompetence>

<ccm:hasCWCompetence>Listen to members and rise discussions</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Deal with persuasion</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Remind Other to use collaborative skills</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Respond to failure</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Building and maintaining trust with members</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Resolve conflicts</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Ask for feedback from members and share it in order to perform the
task</ccm:hasCWCompetence>
</rdf:Description>
</ccm:hasCWCCategory>
<ccm:hasCWCCategory>
<rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/comp/Negotiation">
<ccm:cwccTitle>"Negotiation"</ccm:cwccTitle>
<ccm:cwccExplanation>A student will be able to plan</ccm:cwccExplanation>
<ccm:hasCWCompetence>assign tasks between members including (leader, planner and negotiator)
</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Accurately estimate time and effort required to complete a
task</ccm:hasCWCompetence>
<ccm:hasCWCompetence>track the progress of the group</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Maintain adequate preparation time for scheduled
meetings/deadlines</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Ensure completing given task</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Summarising and reporting the progress</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Notify others for changes or any problem in timely
manner</ccm:hasCWCompetence>
</rdf:Description>
</ccm:hasCWCCategory>
<ccm:hasCWCCategory>
<rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/comp/Leadership">
<ccm:cwccTitle>"Leadership"</ccm:cwccTitle>
<ccm:cwccExplanation>A student will be able to negotiate</ccm:cwccExplanation>
<ccm:hasCWCompetence>Dealing with non-contributing members</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Encouraging members</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Deal with embarrassment</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Smiling</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Eye contact</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Reassuring nods and gestures</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Letting them know that you found what they said
interesting</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Saying something positive about their
contribution</ccm:hasCWCompetence>
```

<ccm:hasCWCompetence>Keep each other informed about development</ccm:hasCWCompetence>

</rdf:Description>
</ccm:hasCWCCategory>
<ccm:hasCWCCategory>
<rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/comp/CommonSharedSkills">
<ccm:cwccTitle>"Common Shared Skills"</ccm:cwccTitle>
<ccm:cwccExplanation>All students will be able to share common skills</ccm:cwccExplanation>
<ccm:hasCWCompetence>Ask for help</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Give/Accept a compliment</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Accept criticism</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Avoid trouble with others</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Say/Accept NO</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Criticise ideas not people</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Take turn</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Take responsibility</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Ignore distractions</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Apologies</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Explain to others your achievement</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Share resources / knowledge of subject area with members</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Check your understanding of given task with others</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Explain your contribution to others</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Summarise the achievement</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Support Group decisions even if not in total agreement</ccm:hasCWCompetence>
<ccm:hasCWCompetence>Listening to each others</ccm:hasCWCompetence>
<ccm:hasCWCompetence> Have fun</ccm:hasCWCompetence>
</rdf:Description>
</ccm:hasCWCCategory>
</rdf:Description>
</rdf:RDF>

B.2 Programming Code for Retrieving Collaborative Working Ontology Content

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>
<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>
<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>
<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
</head>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
     </script>
<body>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
%>
<BR>
<BR>
```

```
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
           <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
           <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("gcmodel.rdf");
        Query  qry,qry2;
        QueryExecution qe,qe2;
        ResultSet rs,rs2;
        Literal cwccTitle;
        Literal cwccExp, cwComp;
        QuerySolution soln,soln2;
        Resource r;
    Resource c2;
        String queryString,queryString2;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );
        }
          //else {  outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        queryString =           "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                        "PREFIX ccm:<http://www.cmodel.com/cwc/elements/> "+
```

```
                        "SELECT DISTINCT ?cwccTitle ?cwccExp WHERE { "+
                        "?CWC ccm:hasCWCCategory ?CWCCat. "+
                        "?CWCCat ccm:cwccTitle ?cwccTitle. "+
                        "?CWCCat ccm:cwccExplanation ?cwccExp. "+
                        " } ";
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                soln = rs.nextSolution() ;
                cwccTitle = soln.getLiteral("cwccTitle") ;
                cwccExp = soln.getLiteral("cwccExp") ;
                //out.println("Competence Category :<B> "+ cwccTitle + " </B>");
                out.println("<details><summary><font size='6' color='blue'>"+ cwccExp +
"</font></summary><BR><BR>")
                queryString2 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                                        "PREFIX ccm:<http://www.cmodel.com/cwc/elements/> "+
                                        "SELECT DISTINCT ?cwComp ?cwccExp WHERE { "+
                                        "?CWC ccm:hasCWCCategory ?CWCCat. "+
                                        "?CWCCat ccm:cwccTitle ?cwccttl.FILTER regex (?cwccttl, "+
cwccTitle +", \"i\"). "+
                                        "?CWCCat ccm:hasCWCompetence ?cwComp. "+
                                        " } ";
                //out.println("Title: "+ queryString2 + " <BR>");
                        qry2 = QueryFactory.create(queryString2);
                        qe2 = QueryExecutionFactory.create(qry2, model);
                        rs2 = qe2.execSelect();
                        out.println("<ul>");
                        for ( ; rs2.hasNext() ; )
                        {
                                soln2 = rs2.nextSolution() ;
                                cwComp = soln2.getLiteral("cwComp") ;
                                out.println("<li>"+ cwComp + "</li><BR>");
                        }
                        out.println("</ul></details>");
                        qe2.close();
                        out.println("<BR><BR>");
        }
 qe.close();
%>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</h3>
</body>
</html>
```

B.3 Java Programming Code for Viewing, Adding, and Deleting Resources from Collaborative Working Ontology

Programming code for viewing resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
      <title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
       FB.init({
         appId:'242427255928014', cookie:true,
         status:true, xfbml:true
```

```
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
    </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
          <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">

          <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
```

```
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>

        </td>
    <td width="55%" style="vertical-align:top">
        <form action="cwViewResource.jsp" method="GET">
                <select name="cwSelCompForView" >
                    <option value="Lead and Manage">Lead and Manage</option>
                    <option value="Negotiate">Negotiate</option>
                        <option value="Plan">Plan</option>
                        <option value="Common Skills">Common Skills</option>
          </select>
<%
/*
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                        "SELECT DISTINCT ?ttl ?competence WHERE { "+
                        "?T cm:hasCompetence ?competence. "+
                        "?competence dc:title ?ttl. "+
                        " } ";
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                soln = rs.nextSolution() ;
                r = soln.getResource("competence") ;
                ttl = soln.getLiteral("ttl") ;
                out.println("<option value='"+ ttl + "'>"+ ttl + "</option>");
                Query  qry2;
                QueryExecution qe2 ;
                ResultSet rs2 ;
                Literal ttl2;
                Literal cap2;
                Literal sm2;
                QuerySolution soln2;
                Resource c2;
                String queryString2;
                queryString2 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
"+
```

```
                                                "PREFIX cm:<http://www.cmodel.com/elements/> "+
                                                "SELECT DISTINCT ?scomp ?ttl2 WHERE { "+
                                                "?comp1 cm:hasSubCompetence ?scomp. "+
                                                "?scomp dc:title ?ttl2. "+
                                                " } ";
                              qry2 = QueryFactory.create(queryString2);
                              qe2 = QueryExecutionFactory.create(qry2, model);
                              rs2 = qe2.execSelect();
                              for ( ; rs2.hasNext() ; )
                              {
                                     soln2 = rs2.nextSolution() ;
                                     c2 = soln2.getResource("scomp") ;
                                     ttl2 = soln2.getLiteral("ttl2") ;
                                     out.println("<option value='"+ ttl2 + "'>"+ ttl2 + "</option>");
                              }
                              qe2.close();
  }

  out.println("</select>");
      out.println("<BR>");
*/
%>
<BR><BR>
<input type="submit" value="View Added Resources" />
</form>
      </td>
      <td width="20%" style="vertical-align:top">
      <%
      AccUserName = (String)session.getAttribute("sessionUserName");
  out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
      %>
      <BR>
      <a href="javascript:logoutFacebook()">Logout from Facebook</a>
      </td>
 </tr>
</table>
</center>
<BR>
</body>
</html>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
            // Or uncomment the following line to redirect
```

```
            window.location = "index.jsp";
          });
        }
      </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
          response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
String selectedCompetence;
selectedCompetence = request.getParameter("cwSelCompForView");
//out.println(selectedCompetence);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
          <BR>
          <a href="home.jsp">Home Page</a>
          <BR><BR>
          Task Competences
          <ul style="list-style-type:disc">
             <li>   <a href="compList.jsp">View Task Competencees</a></li>
                    <li><a href="selResourceView.jsp">View Related Resources</a></li>
                    <li><a href="addResource.jsp">Add Related Resources</a></li>
                    <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Collaborative Working Compentences
          <ul style="list-style-type:disc">
             <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                    <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                    <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                    <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
          <li><a href="fbookGroup.jsp">Group Information</a></li>
          <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
          <li><a href="memberCompetence.jsp">Competences of Members</a></li>
          </ul>
          <BR><BR>
          Notes about Group Members
          <ul style="list-style-type:disc">
          <li><a href="addNote.jsp">Add Note</a></li>
          <li><a href="viewNotes.jsp">View Notes</a></li>
          </ul>
```

```
        </td>
   <td width="70%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cwAddedResources.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal creator;
        Literal compTitle;
        Literal url;
        Literal adDate;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                        "SELECT DISTINCT ?adDate ?url ?compTitle ?creator  WHERE { "+
                        "?addedRes cm:hasCreator ?creator. "+
                        "?addedRes cm:hasCWCompTitle ?compTitle.FILTER regex (?compTitle, '"+
selectedCompetence +"', \"i\"). "+
                        "?addedRes cm:hasDate ?adDate. "+
                                "?addedRes cm:hasURL ?url. "+
                                " } ORDER BY ?compTitle ";
        qry = QueryFactory.create(queryString);
        //out.println("<BR>"+ queryString + "");
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        int rsSize = 0;
        for ( ; rs.hasNext() ; )
        {
                rsSize = rsSize+1;
                soln = rs.nextSolution() ;
                //r = soln.getResource("competence") ;
                creator = soln.getLiteral("creator") ;
                compTitle = soln.getLiteral("compTitle") ;
                adDate = soln.getLiteral("adDate") ;
                url = soln.getLiteral("url") ;
//out.println("<form action='cwDelSelectedResource.jsp' method='GET'> ");
                out.println("<BR> Resource added for <b> "+ compTitle + " </b> by <b>"+ creator + "
</b> on "+ adDate + "");
                //out.println("<BR>"+ creator + "");
                //out.println("<BR>"+ adDate + "");
                out.println("<BR><a href='" + url + "' >" + url + "</a><BR><BR>");
/*
out.println("<input type='hidden' name='selDeleteCompetence' value='"+ compTitle + "'/>");
out.println("<input type='hidden' name='selDeleteCreator' value='"+ creator + "'/>");
out.println("<input type='hidden' name='selDeleteURL' value='"+ url + "'/>");
out.println("<input type='submit' value='Delete This Resource' />");
out.println("</form>");
*/
        }
        out.println("<BR><BR>");
```

```
    qe.close();
if (rsSize == 0)
{
out.println("<BR> No additional resources has been added to " + selectedCompetence );
}
%>
<BR>
          </td>
          <td width="20%" style="vertical-align:top">
          <%
          AccUserName = (String)session.getAttribute("sessionUserName");
    out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
          %>
          <BR>
          <a href="javascript:logoutFacebook()">Logout from Facebook</a>
          </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Programming code for adding resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
         FB.init({
           appId:'242427255928014', cookie:true,
           status:true, xfbml:true
         });
         FB.logout(function() {
           // Reload the same page after logout
           // window.location.reload();
```

```
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
function validateForm() {
    var x = document.forms["form1"]["cwResURL"].value;
          var reurl = /http:\/\/[A-Za-z0-9\.-]{3,}\.[A-Za-z]{3}/;
          if ( !reurl.test(x) )
          {
              alert("Please enter valid URL including http://");
        return false;
          }
}
            </script>
</head>
<center>
          <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
          response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
     <td width="25%" style="vertical-align:top">
          <BR>
          <a href="home.jsp">Home Page</a>
          <BR><BR>
          Task Competences
          <ul style="list-style-type:disc">
              <li>   <a href="compList.jsp">View Task Competencees</a></li>
                   <li><a href="selResourceView.jsp">View Related Resources</a></li>
                   <li><a href="addResource.jsp">Add Related Resources</a></li>
                   <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Collaborative Working Compentences
          <ul style="list-style-type:disc">
              <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                   <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                   <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                   <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
          <li><a href="fbookGroup.jsp">Group Information</a></li>
          <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
          <li><a href="memberCompetence.jsp">Competences of Members</a></li>
```

```
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
        <form name="form1" action="cwSaveRes.jsp" onsubmit="return validateForm()"
method="GET">
                <select name="compItem" >
                    <option value="Lead and Manage">Lead and Manage</option>
                    <option value="Negotiate">Negotiate</option>
                        <option value="Plan">Plan</option>
                        <option value="Common Skills">Common Skills</option>
          </select>
        <BR><BR>
    Enter URL of the resource (including http:) :
<br>
<input type="text" name="cwResURL" size="65">
<BR><BR>
<input type="submit" value="Add Resource" />
</form>
<%
/*
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("gcmodel.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                             "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                             "PREFIX cm:<http://www.cmodel.com/elements/> "+
                             "SELECT DISTINCT ?ttl ?competence WHERE { "+
                             "?T cm:hasCompetence ?competence. "+
                             "?competence dc:title ?ttl. "+
                             " } ";
        queryString =        "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                             "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                             "PREFIX ccm:<http://www.cmodel.com/cwc/elements/> "+
                             "SELECT DISTINCT ?cwccTitle ?cwccExp WHERE { "+
                             "?CWC ccm:hasCWCCategory ?CWCCat. "+
                             "?CWCCat ccm:cwccTitle ?cwccTitle. "+
                             "?CWCCat ccm:cwccExplanation ?cwccExp. "+
                             " } ";
```

```
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                soln = rs.nextSolution() ;
                r = soln.getResource("competence") ;
                ttl = soln.getLiteral("ttl") ;
                out.println("<option value='"+ ttl + "'>"+ ttl + "</option>");
                Query  qry2;
                QueryExecution qe2 ;
                ResultSet rs2 ;
                Literal ttl2;
                Literal cap2;
                Literal sm2;
                QuerySolution soln2;
                Resource c2;
                String queryString2;
                queryString2 =          "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
"
                                        "PREFIX cm:<http://www.cmodel.com/elements/> "+
                                        "SELECT DISTINCT ?scomp ?ttl2 WHERE { "+
                                        "?comp1 cm:hasSubCompetence ?scomp. "+
                                        "?scomp dc:title ?ttl2. "+
                                        " } ";
                        qry2 = QueryFactory.create(queryString2);
                        qe2 = QueryExecutionFactory.create(qry2, model);
                        rs2 = qe2.execSelect();
                        for ( ; rs2.hasNext() ; )
                        {
                                soln2 = rs2.nextSolution() ;
                                c2 = soln2.getResource("scomp") ;
                                ttl2 = soln2.getLiteral("ttl2") ;
                                out.println("<option value='"+ ttl2 + "'>"+ ttl2 + "</option>");
                        }
                        qe2.close();
   }
   out.println("</select>");
        out.println("<BR>");
   qe.close();
*/
%>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Programming code for saving added resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Property"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
<%@ page import="java.util.Date"%>
<%@ page import="java.text.DateFormat"%>
<%@ page import="java.text.SimpleDateFormat"%>
<%@ page import="java.util.Calendar"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
      <title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
    </script>
```

```
</head>
<body>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<BR><BR>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<h3>You are Logged in as <B>: " + AccUserName + "</B></h3>");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String selectedCompetence, resourceURL;
selectedCompetence = request.getParameter("compItem");
resourceURL = (String)request.getParameter("cwResURL");
//out.println(selectedCompetence);
//out.println(resourceURL);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
           <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
           <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
   <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cwAddedResources.rdf");
```

```
        String NS = "http://www.cmodel.com/elements/";
        String randURI = "http://www.cmodel.com/elements/randURI";
        randURI = randURI + Math.random();
        //outt.println(" <BR> random uri" + randURI);
        String timeStamp = new SimpleDateFormat("dd/MM/yyyy
HH:mm:ss").format(Calendar.getInstance().getTime());
        //("yyyyMMdd_HHmmss")
        //outt.println(" <BR> random uri" + timeStamp);
        Query  qry;;
        QueryExecution qe ;
        ResultSet rs ;
        Literal ttl;
        Literal cap;
        Literal sm;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        File fout = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
          //else {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        OutputStream os = new FileOutputStream(fout);
        Resource AddedResource = model.createResource(randURI);
        Property competenceTitle = model.createProperty(NS, "hasCWCompTitle");
        Property creater = model.createProperty(NS, "hasCreator");
        Property addedResourceURL = model.createProperty(NS, "hasURL");
        Property dated = model.createProperty(NS, "hasDate");
        Literal compTitle = model.createLiteral(selectedCompetence);
        Literal resCreator = model.createLiteral(AccUserName);
        Literal addedResURL = model.createLiteral(resourceURL);
        Literal addDate = model.createLiteral(timeStamp);
        AddedResource.addLiteral(competenceTitle, compTitle);
        AddedResource.addLiteral(creater, resCreator);
        AddedResource.addLiteral(addedResourceURL, addedResURL);
        AddedResource.addLiteral(dated, addDate);
        model.write(os);
        in.close();
        //os.close();
        out.println("<BR>You have successfully added resource for " + selectedCompetence );
%>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
</body>
</html>
```

Programming code for deleting added resources

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
```

```
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
    </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
          <li>   <a href="compList.jsp">View Task Competencees</a></li>
              <li><a href="selResourceView.jsp">View Related Resources</a></li>
              <li><a href="addResource.jsp">Add Related Resources</a></li>
              <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
          <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
              <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
              <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
              <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
```

```
    <td width="55%" style="vertical-align:top">
          <form action="cwViewResourceDelete.jsp" method="GET">
                    <select name="cwSelCompForView" >
                        <option value="Lead and Manage">Lead and Manage</option>
                        <option value="Negotiate">Negotiate</option>
                              <option value="Plan">Plan</option>
                              <option value="Common Skills">Common Skills</option>
             </select>
<%
/*
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cmodel.rdf");
          Query  qry;
          QueryExecution qe ;
          ResultSet rs ;
          Literal ttl;
          Literal cap;
          Literal sm;
          QuerySolution soln;
          Resource r;
          File f = new File(fileName);
          InputStream in = new FileInputStream(f);
          if ( in == null )
          { throw new IllegalArgumentException("File is not found" );}
          //else  {outt.println(" File successfully openned\n");  }
          Model model = ModelFactory.createDefaultModel();
          model.read(in,null);
          String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                               "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                               "PREFIX cm:<http://www.cmodel.com/elements/> "+
                               "SELECT DISTINCT ?ttl ?competence WHERE { "+
                               "?T cm:hasCompetence ?competence. "+
                               "?competence dc:title ?ttl. "+
                               " } ";
          qry = QueryFactory.create(queryString);
          qe = QueryExecutionFactory.create(qry, model);
          rs = qe.execSelect();
          for ( ; rs.hasNext() ; )
          {
                    soln = rs.nextSolution() ;
                    r = soln.getResource("competence") ;
                    ttl = soln.getLiteral("ttl") ;
                    out.println("<option value='"+ ttl + "'>"+ ttl + "</option>");
                    Query  qry2;
                    QueryExecution qe2 ;
                    ResultSet rs2 ;
                    Literal ttl2;
                    Literal cap2;
                    Literal sm2;
                    QuerySolution soln2;
                    Resource c2;
                    String queryString2;
                    queryString2 =         "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                                   "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#>
"+
                                                   "PREFIX cm:<http://www.cmodel.com/elements/> "+
                                                   "SELECT DISTINCT ?scomp ?ttl2 WHERE { "+
                                                   "?comp1 cm:hasSubCompetence ?scomp. "+
                                                   "?scomp dc:title ?ttl2. "+
```

```
                                    " } ";
                  qry2 = QueryFactory.create(queryString2);
                  qe2 = QueryExecutionFactory.create(qry2, model);
                  rs2 = qe2.execSelect();
                  for ( ; rs2.hasNext() ; )
                  {
                        soln2 = rs2.nextSolution() ;
                        c2 = soln2.getResource("scomp") ;
                        ttl2 = soln2.getLiteral("ttl2") ;
                        out.println("<option value='"+ ttl2 + "'>"+ ttl2 + "</option>");
                  }
                  qe2.close();
  }
  out.println("</select>");
      out.println("<BR>");
*/
%>
<BR><BR>
<input type="submit" value="View Added Resources" />
</form>
      </td>
      <td width="20%" style="vertical-align:top">
      <%
      AccUserName = (String)session.getAttribute("sessionUserName");
  out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
      %>
      <BR>
      <a href="javascript:logoutFacebook()">Logout from Facebook</a>
      </td>
 </tr>
</table>
</center>
<BR>
</body>
</html>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
       FB.init({
         appId:'242427255928014', cookie:true,
         status:true, xfbml:true
       });
       FB.logout(function() {
         // Reload the same page after logout
         // window.location.reload();
         // Or uncomment the following line to redirect
```

```
            window.location = "index.jsp";
          });
        }
      </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
String selectedCompetence;
selectedCompetence = request.getParameter("cwSelCompForView");
//out.println(selectedCompetence);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
          <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
          <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
```

```
   <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("cwAddedResources.rdf");
        Query  qry;
        QueryExecution qe ;
        ResultSet rs ;
        Literal creator;
        Literal compTitle;
        Literal url;
        Literal adDate;
        QuerySolution soln;
        Resource r;
        File f = new File(fileName);
        InputStream in = new FileInputStream(f);
        if ( in == null )
        { throw new IllegalArgumentException("File is not found" );}
        //else  {outt.println(" File successfully openned\n");  }
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);
        String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                             "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                             "PREFIX cm:<http://www.cmodel.com/elements/> "+
                             "SELECT DISTINCT ?adDate ?url ?compTitle ?creator  WHERE { "+
                             "?addedRes cm:hasCreator ?creator. FILTER regex (?creator, '"+
AccUserName +"', \"i\")."+
                             "?addedRes cm:hasCWCompTitle ?compTitle.FILTER regex (?compTitle,
'"+  selectedCompetence +"', \"i\"). "+
                                    "?addedRes cm:hasDate ?adDate. "+
                                    "?addedRes cm:hasURL ?url. "+
                                    " } ORDER BY ?compTitle ";
        qry = QueryFactory.create(queryString);
        //out.println("<BR>"+ queryString + "");
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        int rsSize = 0;
        for ( ; rs.hasNext() ; )
        {
                rsSize = rsSize+1;
                soln = rs.nextSolution() ;
                //r = soln.getResource("competence") ;
                creator = soln.getLiteral("creator") ;
                compTitle = soln.getLiteral("compTitle") ;
                adDate = soln.getLiteral("adDate") ;
                url = soln.getLiteral("url") ;
        out.println("<form action='cwDelSelectedResource.jsp' method='GET'> ");
                out.println("<BR> Resource added for <b> "+ compTitle + " </b> by <b>"+ creator + "
</b> on "+ adDate + "");
                //out.println("<BR>"+ creator + "");
                //out.println("<BR>"+ adDate + "");
                out.println("<BR><a href='" + url + "' >" + url + "</a><BR><BR>");
out.println("<input type='hidden' name='selDeleteCompetence' value='"+ compTitle + "'/>");
out.println("<input type='hidden' name='selDeleteCreator' value='"+ creator + "'/>");
out.println("<input type='hidden' name='selDeleteURL' value='"+ url + "'/>");
out.println("<input type='submit' value='Delete This Resource' />");
out.println("</form>");
        }
        out.println("<BR><BR>");
   qe.close();
```

```
if (rsSize == 0)
{
out.println("<BR> You have not added any additional resources to <b>" + selectedCompetence + "</B>
to delete");
}
%>
<BR>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Appendix C

This appendix shows all programming code related to generating content from Facebook.

C.1 Programming code for generating content from Facebook

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
```

```
         FB.init({
           appId:'242427255928014', cookie:true,
           status:true, xfbml:true
         });
         FB.logout(function() {
           // Reload the same page after logout
           // window.location.reload();
           // Or uncomment the following line to redirect
           window.location = "index.jsp";
         });
       }
     </script>
</head>
<center>
          <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Session Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
          <BR>
          <a href="home.jsp">Home Page</a>
          <BR><BR>
          Task Competences
          <ul style="list-style-type:disc">
              <li>   <a href="compList.jsp">View Task Competencees</a></li>
                    <li><a href="selResourceView.jsp">View Related Resources</a></li>
                    <li><a href="addResource.jsp">Add Related Resources</a></li>
                    <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Collaborative Working Compentences
          <ul style="list-style-type:disc">
              <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                    <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                    <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                    <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
          <li><a href="fbookGroup.jsp">Group Information</a></li>
          <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
          <li><a href="memberCompetence.jsp">Competences of Members</a></li>
          </ul>
          <BR><BR>
```

```
            Notes about Group Members
            <ul style="list-style-type:disc">
            <li><a href="addNote.jsp">Add Note</a></li>
            <li><a href="viewNotes.jsp">View Notes</a></li>
            </ul>
            </td>
    <td width="55%" style="vertical-align:top">
<%
Group group1 = facebookClient.fetchObject("1389599304636880",Group.class);
out.println("<BR><BR>The Group Name is : " + group1.getName() );
Connection<User> gmem = facebookClient.fetchConnection("1389599304636880/members", User.class,
Parameter.with("Fields","name,last_name,first_name,email,bio,gender"));
out.println("<BR>Total number of members in the <B>"+ group1.getName() + " </B> is : <B>" +
gmem.getData().size() +"</B><BR><BR>");
%>
</td>
<td width="20%" style="vertical-align:top">
<%
AccUserName = (String)session.getAttribute("sessionUserName");
    out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
%>
<BR>
<a href="javascript:logoutFacebook()">Logout from Facebook</a>
</td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
         FB.init({
           appId:'242427255928014', cookie:true,
           status:true, xfbml:true
         });
         FB.logout(function() {
           // Reload the same page after logout
           // window.location.reload();
           // Or uncomment the following line to redirect
```

```
         window.location = "index.jsp";
        });
      }
    </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Session Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
          <BR>
          <a href="home.jsp">Home Page</a>
          <BR><BR>
          Task Competences
          <ul style="list-style-type:disc">
             <li>   <a href="compList.jsp">View Task Competencees</a></li>
                    <li><a href="selResourceView.jsp">View Related Resources</a></li>
                    <li><a href="addResource.jsp">Add Related Resources</a></li>
                    <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Collaborative Working Compentences
          <ul style="list-style-type:disc">

             <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                    <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                    <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                    <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
          <li><a href="fbookGroup.jsp">Group Information</a></li>
          <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
          <li><a href="memberCompetence.jsp">Competences of Members</a></li>
          </ul>
          <BR><BR>
          Notes about Group Members
          <ul style="list-style-type:disc">
          <li><a href="addNote.jsp">Add Note</a></li>
          <li><a href="viewNotes.jsp">View Notes</a></li>
          </ul>
          </td>
```

```
   <td width="55%" style="vertical-align:top">
<H3>Here is information about Facebook Group members</h3>
<%
//you can get app accesstoken as well
//FacebookClient facebookClient = new DefaultFacebookClient("xxxxxxxxxxxxx");
//User user = facebookClient.fetchObject("me",User.class);
///////////////////////////
/*
User user = facebookClient.fetchObject("10205005786562018",User.class);
out.println("<BR><BR> Your NAME: " + user.getName());
out.println("<BR>Your LAST NAME: " + user.getLastName());
out.println("<BR>USER Bio: " + user.getBio());
out.println("<BR>USER About: " + user.getAbout());
out.println("<BR>USER Email: " + user.getEmail());

user = facebookClient.fetchObject("799363766798787",User.class);
out.println("<BR><BR> Your NAME: " + user.getName());
out.println("<BR>Your LAST NAME: " + user.getLastName());
out.println("<BR>USER Bio: " + user.getBio());
out.println("<BR>USER About: " + user.getAbout());
out.println("<BR>USER Email: " + user.getEmail());

user = facebookClient.fetchObject("10205872332825891",User.class);
out.println("<BR><BR> Your NAME: " + user.getName());
out.println("<BR>Your LAST NAME: " + user.getLastName());
out.println("<BR>USER Bio: " + user.getBio());
out.println("<BR>USER About: " + user.getAbout());
out.println("<BR>USER Email: " + user.getEmail());
*/
/////////////////////////////////////////////
Group group1 = facebookClient.fetchObject("1389599304636880",Group.class);
//out.println("<BR><BR>The Group Name is : " + group1.getName() );
Connection<User> gmem = facebookClient.fetchConnection("1389599304636880/members", User.class,
Parameter.with("Fields","name,last_name,first_name,email,bio,gender"));

//out.println("<BR>Total number of members in the <B>"+ group1.getName() + " </B> is : <B>" +
gmem.getData().size() +"</B><BR><BR>");

for (User u : gmem.getData())
{
  out.println("<BR><BR> Member Name : <B>"+u.getName());
  out.println("</b><BR> Member Gender : "+u.getGender());
  out.println("<BR> Member Bio : "+u.getBio());
  out.println("<BR> Member Contact Email : "+u.getEmail());
  //out.println("<BR> User ID : "+u.getId());
  out.println("<BR>");

  //out.println("<BR> :"+u.getLastName());
  //out.println("<BR> :"+u.getFirstName());
  //out.println("<BR> :"+u.getAbout());
  //out.println("<BR> :"+u.getUsername());
}
//*******************************************************************************
*****
//*******************************************************************************
*****
//*******************************************************************************
*****
//Connection<Group> myGroups = facebookClient.fetchConnection("me/groups", Group.class);
```

```
//out.println("<BR>My Groups: " + myGroups.getData().size());
/*
Connection<User> myFriends = facebookClient.fetchConnection("me/friends", User.class);
Connection<Post> myFeed = facebookClient.fetchConnection("me/feed", Post.class);
out.println("Count of my friends: " + myFriends.getData().size());
out.println("First item in my feed: " + myFeed.getData().get(0));
// Connections support paging and are iterable
for (List<Post> myFeedConnectionPage : myFeed)
  for (Post post : myFeedConnectionPage)
    out.println("Post: " + post);
*/
/*
    String userEmail = user.getEmail();
    com.restfb.Connection<User> myFriends = facebookClient.fetchConnection("me/friends", User.class);
    System.out.println("Count of my friends: " + myFriends.getData().size());
    for(User friend: myFriends.getData()){
        System.out.println("Friends id and name: "+friend.getId()+" , "+friend.getName());
        myFacebookFriendList.add(friend.getName());
    }
*/
/*
//Facebook facebook = new FacebookFactory().getInstance();
//facebook.setOAuthAppId(appId, appSecret);
//facebook.setOAuthPermissions("email,publish_stream, id, name, first_name, last_name");
//facebook.setOAuthAccessToken(new AccessToken(accessToken, null));
*/
/*                  ResponseList<Friend> friends =
(ResponseList<Friend>)request.getSession().getAttribute("friends");
                    for(Friend friend : friends) {
                              out.write(friend.getName()+"<br />");
                              String id = friend.getId();
                              URL url = new
URL("http://graph.facebook.com/"+id+"?fields=picture.width(500)");
                              ObjectMapper mapper = new ObjectMapper();
                              Map<String, Object> map = mapper.readValue(url, Map.class);
                              String json = map.get("picture").toString();
                              String prefix = "{data={url=";
                              String noPrefix = json.substring(json.indexOf(prefix) + prefix.length());
                              String parts[] = noPrefix.split(",");
                              String picUrl = parts[0];
                              out.write("<img src=\""+picUrl+"\"/><br />");
                    }
*/
%>
          </td>
          <td width="20%" style="vertical-align:top">
          <%
          AccUserName = (String)session.getAttribute("sessionUserName");
    out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
          %>
          <BR>
          <a href="javascript:logoutFacebook()">Logout from Facebook</a>

          </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
            // Or uncomment the following line to redirect
```

```
        window.location = "index.jsp";
       });
      }
    </script>
</head>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
out.println("<BR>Retreived Session Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<h3>
<a href="javascript:logoutFacebook()">Logout from Facebook Account</a>
</h3>
<BR>
<BR>
<center>
<table border="0" style="width:90%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
           <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
           <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
```

```
        </td>
    <td width="70%" style="vertical-align:top">
Please use the Databases' course Facebook Group members' information given below to decide about the
your potential project group members for  Database assignment.
<BR>
You can select choose your project group members based on the profile information. You can  use the
given contact email  address in the profile information of the members to contact the potential group
member for a request to join your group.
<BR>
<BR>
<%
//you can get app accesstoken as well
//FacebookClient facebookClient = new DefaultFacebookClient("xxxxxxxxxxxxx");
//User user = facebookClient.fetchObject("me",User.class);
/////////////////////////////
/*
User user = facebookClient.fetchObject("10205005786562018",User.class);
out.println("<BR><BR> Your NAME: " + user.getName());
out.println("<BR>Your LAST NAME: " + user.getLastName());
out.println("<BR>USER Bio: " + user.getBio());
out.println("<BR>USER About: " + user.getAbout());
out.println("<BR>USER Email: " + user.getEmail());

user = facebookClient.fetchObject("799363766798787",User.class);
out.println("<BR><BR> Your NAME: " + user.getName());
out.println("<BR>Your LAST NAME: " + user.getLastName());
out.println("<BR>USER Bio: " + user.getBio());
out.println("<BR>USER About: " + user.getAbout());
out.println("<BR>USER Email: " + user.getEmail());

user = facebookClient.fetchObject("10205872332825891",User.class);
out.println("<BR><BR> Your NAME: " + user.getName());
out.println("<BR>Your LAST NAME: " + user.getLastName());
out.println("<BR>USER Bio: " + user.getBio());
out.println("<BR>USER About: " + user.getAbout());
out.println("<BR>USER Email: " + user.getEmail());
*/
/////////////////////////////////////////////////////
Group group1 = facebookClient.fetchObject("1389599304636880",Group.class);
out.println("<BR><BR>The Group Name is : " + group1.getName() );

Connection<User> gmem = facebookClient.fetchConnection("1389599304636880/members", User.class,
Parameter.with("Fields","name,last_name,first_name,email,bio,gender"));

out.println("<BR>Total number of members in the <B>"+ group1.getName() + " </B> is : <B>" +
gmem.getData().size() +"</B><BR><BR>");

for (User u : gmem.getData())
{
   out.println("<BR><BR> Member Name : <B>"+u.getName());
   out.println("</b><BR> Member Gender : "+u.getGender());
   out.println("<BR> Member Skills (from Bio Section) : "+u.getBio());
   out.println("<BR> Member Contact Email : "+u.getEmail());
   //out.println("<BR> User ID : "+u.getId());
   out.println("<BR>");

   //out.println("<BR> :"+u.getLastName());
   //out.println("<BR> :"+u.getFirstName());
   //out.println("<BR> :"+u.getAbout());
   //out.println("<BR> :"+u.getUsername());
```

```
}
//*************************************************************************************
*****
//*************************************************************************************
*****
//*************************************************************************************
*****
//Connection<Group> myGroups = facebookClient.fetchConnection("me/groups", Group.class);
//out.println("<BR>My Groups: " + myGroups.getData().size());
/*
Connection<User> myFriends = facebookClient.fetchConnection("me/friends", User.class);
Connection<Post> myFeed = facebookClient.fetchConnection("me/feed", Post.class);
out.println("Count of my friends: " + myFriends.getData().size());
out.println("First item in my feed: " + myFeed.getData().get(0));
// Connections support paging and are iterable
for (List<Post> myFeedConnectionPage : myFeed)
  for (Post post : myFeedConnectionPage)
    out.println("Post: " + post);
*/
/*
    String userEmail = user.getEmail();
    com.restfb.Connection<User> myFriends = facebookClient.fetchConnection("me/friends", User.class);
    System.out.println("Count of my friends: " + myFriends.getData().size());
    for(User friend: myFriends.getData()){
        System.out.println("Friends id and name: "+friend.getId()+" , "+friend.getName());
        myFacebookFriendList.add(friend.getName());
    }
*/
/*
//Facebook facebook = new FacebookFactory().getInstance();
//facebook.setOAuthAppId(appId, appSecret);
//facebook.setOAuthPermissions("email,publish_stream, id, name, first_name, last_name");
//facebook.setOAuthAccessToken(new AccessToken(accessToken, null));
*/
/*              ResponseList<Friend> friends =
(ResponseList<Friend>)request.getSession().getAttribute("friends");
                for(Friend friend : friends) {
                        out.write(friend.getName()+"<br />");
                        String id = friend.getId();
                        URL url = new
URL("http://graph.facebook.com/"+id+"?fields=picture.width(500)");
                        ObjectMapper mapper = new ObjectMapper();
                        Map<String, Object> map = mapper.readValue(url, Map.class);
                        String json = map.get("picture").toString();
                        String prefix = "{data={url=";
                        String noPrefix = json.substring(json.indexOf(prefix) + prefix.length());
                        String parts[] = noPrefix.split(",");
                        String picUrl = parts[0];
                        out.write("<img src=\""+picUrl+"\"/><br />");
                }
*/
%>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

C.2 RDF Code for group members' competence

```
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
  xmlns:foaf="http://xmlns.com/foaf/0.1/"
xmlns:ccm="http://www.cmodel.com/cwc/elements/">

<rdf:Description rdf:about="http://www.example.com/students/student1">
<foaf:name>"STudent1"</foaf:name>
<ccm:hasCWCCategory>none</ccm:hasCWCCategory>
</rdf:Description>

<rdf:Description rdf:about="http://www.example.com/students/student2">
<foaf:name>"STudent2"</foaf:name>
<ccm:hasCWCCategory>Data normalisation</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Planning</ccm:hasCWCCategory>
</rdf:Description>

<rdf:Description rdf:about="http://www.example.com/students/student3">
<foaf:name>"STudent3"</foaf:name>
<ccm:hasCWCCategory>Databases</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Planning</ccm:hasCWCCategory>
</rdf:Description>

<rdf:Description rdf:about="http://www.example.com/students/student6">
<foaf:name>"STudent4"</foaf:name>
<ccm:hasCWCCategory>Analysis</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Higher Education</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Modeling</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Research</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Security</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Software Engineering</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Teaching</ccm:hasCWCCategory>
</rdf:Description>

<rdf:Description rdf:about="http://www.example.com/students/student4">
<foaf:name>"STudent5"</foaf:name>
<ccm:hasCWCCategory>none</ccm:hasCWCCategory>
</rdf:Description>

<rdf:Description rdf:about="http://www.example.com/students/student5">
<foaf:name>"STudent6"</foaf:name>
<ccm:hasCWCCategory>Communication</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Entity-relationship model</ccm:hasCWCCategory>
<ccm:hasCWCCategory>MySQLi</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Normalisation</ccm:hasCWCCategory>
<ccm:hasCWCCategory>Planning</ccm:hasCWCCategory>
</rdf:Description>
</rdf:RDF>
```

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
</head>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
      </script>
<body>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<BR><BR>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
        response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
%>
```

```
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
<td width="25%" style="vertical-align:top">
	<BR>
	<a href="home.jsp">Home Page</a>
	<BR><BR>
	Task Competences
	<ul style="list-style-type:disc">
	   <li>   <a href="compList.jsp">View Task Competencees</a></li>
		<li><a href="selResourceView.jsp">View Related Resources</a></li>
		<li><a href="addResource.jsp">Add Related Resources</a></li>
		<li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
	</ul>
	<BR><BR>
	Collaborative Working Compentences
	<ul style="list-style-type:disc">

	   <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
		<li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
		<li><a href="cwAddResource.jsp">Add Related Resources</a></li>
		<li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
	</ul>
	<BR><BR>
	Facebook Group and Member Information
	<ul style="list-style-type:disc">
	<li><a href="fbookGroup.jsp">Group Information</a></li>
	<li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
	<li><a href="memberCompetence.jsp">Competences of Members</a></li>
	</ul>
	<BR><BR>
	Notes about Group Members
	<ul style="list-style-type:disc">
	<li><a href="addNote.jsp">Add Note</a></li>
	<li><a href="viewNotes.jsp">View Notes</a></li>
	</ul>
	</td>
    <td width="55%" style="vertical-align:top">
<%
//response.getWriter().write(r.toString()+"<br/>");
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("studentSkills.rdf");
	Query  qry,qry2;
	QueryExecution qe,qe2;
	ResultSet rs,rs2;
	Literal sname;
	Literal cwComp;
	QuerySolution soln,soln2;
	Resource r;
    Resource c2;
	String queryString,queryString2;
	File f = new File(fileName);
	InputStream in = new FileInputStream(f);
	if ( in == null )
	{ throw new IllegalArgumentException("File is not found" );
	}
	   //else {  outt.println(" File successfully openned\n");  }
```

```
        Model model = ModelFactory.createDefaultModel();
        model.read(in,null);

        queryString =                   "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                                        "PREFIX ccm:<http://www.cmodel.com/cwc/elements/> "+
                                        "PREFIX foaf:<http://xmlns.com/foaf/0.1/>" +
                                        "SELECT DISTINCT ?sname WHERE { "+
                                        "?Student foaf:name ?sname. "+

                                                        " } ";
        qry = QueryFactory.create(queryString);
        qe = QueryExecutionFactory.create(qry, model);
        rs = qe.execSelect();
        for ( ; rs.hasNext() ; )
        {
                soln = rs.nextSolution() ;
                sname = soln.getLiteral("sname") ;
                out.println("Student Name :<B> "+ sname + " </B><BR>Group Competences: <BR>");
                //out.println(" <B>"+ cwccExp + " </B> <BR><BR>");
                queryString2 = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                        "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                                        "PREFIX ccm:<http://www.cmodel.com/cwc/elements/> "+
                                        "PREFIX foaf:<http://xmlns.com/foaf/0.1/>" +
                                        "SELECT DISTINCT ?cwComp WHERE { "+
                                        "?Student foaf:name ?sname.FILTER regex (?sname, "+ sname +",
\"i\"). "+
                                        "?Student ccm:hasCWCCategory ?cwComp. "+
                                        " } ";
                //out.println("Title: "+ queryString2 + " <BR>");
                        qry2 = QueryFactory.create(queryString2);
                        qe2 = QueryExecutionFactory.create(qry2, model);
                        rs2 = qe2.execSelect();
                        for ( ; rs2.hasNext() ; )
                        {
                                soln2 = rs2.nextSolution() ;
                                cwComp = soln2.getLiteral("cwComp") ;
                                out.println("<B>"+ cwComp + " </B><BR>");
                                //          
                        }
                        qe2.close();
                        out.println("<BR><BR>");
        }
 qe.close();
%>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

C.3 Programming Code for Making and Saving Notes

Programming code for adding notes

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
```

```
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
function validateForm() {
    var x = document.forms["form1"]["resURL"].value;
           var reurl = /http:\/\/[A-Za-z0-9\.-]{3,}\.[A-Za-z]{3}/;
           if ( !reurl.test(x) )
           {
               alert("Please enter valid URL including http://");
        return false;
           }
}
     </script>
</head>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
//out.println("<BR><BR><h3>You are Logged in as : <B>" + AccUserName +"</B></h3>");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
  <td width="25%" style="vertical-align:top">
           <BR>
           <a href="home.jsp">Home Page</a>
           <BR><BR>
           Task Competences
           <ul style="list-style-type:disc">
               <li>   <a href="compList.jsp">View Task Competencees</a></li>
                      <li><a href="selResourceView.jsp">View Related Resources</a></li>
                      <li><a href="addResource.jsp">Add Related Resources</a></li>
                      <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
           </ul>
           <BR><BR>
           Collaborative Working Compentences
           <ul style="list-style-type:disc">
               <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                      <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                      <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                      <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
           </ul>
           <BR><BR>
           Facebook Group and Member Information
           <ul style="list-style-type:disc">
```

```
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
        <form name="form1" action="saveNote.jsp" onsubmit="return validateForm()"  method="GET">
        Select Member:
                <select name="memberName" >
<%
Group group1 = facebookClient.fetchObject("1389599304636880",Group.class);
//out.println("<BR><BR>The Group Name is : " + group1.getName() );
Connection<User> gmem = facebookClient.fetchConnection("1389599304636880/members", User.class,
Parameter.with("Fields","name,last_name,first_name,email,bio,gender"));
//out.println("<BR>Total number of members in the <B>"+ group1.getName() + " </B> is : <B>" +
//gmem.getData().size() +"</B><BR><BR>");
for (User u : gmem.getData())
   out.println("<option value='"+ u.getName() + "'>"+ u.getName() + "</option>");
%>
</select>
<BR><BR>
Add details:
<br>
<textarea cols="60" rows="5" name="note">
</textarea>
<BR><BR>
<input type="submit" value="Save Note" />
</form>
        </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
    out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
</body>
</html>
```

Programming code for saving notes

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Property"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
<%@ page import="java.util.Date"%>
<%@ page import="java.text.DateFormat"%>
<%@ page import="java.text.SimpleDateFormat"%>
<%@ page import="java.util.Calendar"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
       FB.init({
         appId:'242427255928014', cookie:true,
         status:true, xfbml:true
       });
       FB.logout(function() {
         // Reload the same page after logout
         // window.location.reload();
         // Or uncomment the following line to redirect
         window.location = "index.jsp";
       });
      }
    </script>
```

```
</head>
<body>
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<BR><BR>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String selectedName, enteredNote;
selectedName = request.getParameter("memberName");
enteredNote = (String)request.getParameter("note");
//out.println(selectedName);
//out.println("<BR>"+enteredNote);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
           <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
           <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
        </ul>
        </td>
    <td width="55%" style="vertical-align:top">
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("notes.rdf");
        String NS = "http://www.cmodel.com/elements/";
        String randURI = "http://www.cmodel.com/elements/randNoteURI";
```

```
	randURI = randURI + Math.random();
	//outt.println(" <BR> random uri" + randURI);
String timeStamp = new SimpleDateFormat("dd/MM/yyyy
HH:mm:ss").format(Calendar.getInstance().getTime());
	//("yyyyMMdd_HHmmss")
	//outt.println(" <BR> random uri" + timeStamp);
	Query  qry;;
	QueryExecution qe ;
	ResultSet rs ;
	Literal ttl;
	Literal cap;
	Literal sm;
	QuerySolution soln;
	Resource r;
	File f = new File(fileName);
	InputStream in = new FileInputStream(f);
	if ( in == null )
	{ throw new IllegalArgumentException("File is not found" );}
	  //else {outt.println(" File successfully openned\n");  }
	Model model = ModelFactory.createDefaultModel();
	model.read(in,null);
	Resource AddedNote = model.createResource(randURI);
	Property note = model.createProperty(NS, "hasAddedNote");
	Property abtMember = model.createProperty(NS, "aboutMember");
	Property creater = model.createProperty(NS, "hasCreator");
	Property dated = model.createProperty(NS, "hasDate");
	Literal noteLiteral = model.createLiteral(enteredNote);
	Literal aboutMemberLiteral = model.createLiteral(selectedName);
	Literal noteCreator = model.createLiteral(AccUserName);
	Literal addDate = model.createLiteral(timeStamp);
	AddedNote.addLiteral(note, noteLiteral);
	AddedNote.addLiteral(creater, noteCreator);
	AddedNote.addLiteral(abtMember, aboutMemberLiteral);
	AddedNote.addLiteral(dated, addDate);
	File fout = new File(fileName);
	OutputStream os = new FileOutputStream(fout);
	model.write(os);
	in.close();
	//os.close();
	out.println("<BR>You have successfully one note resource for " + selectedName );
%>
	</td>
	<td width="20%" style="vertical-align:top">
	</td>
	<td width="20%" style="vertical-align:top">
	<%
	AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
	%>
	<BR>
	<a href="javascript:logoutFacebook()">Logout from Facebook</a>
	</td>
  </tr>
</table>
</center>
</body>
</html>
```

Programming code for viewing notes

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<%@ page import="com.restfb.Connection"%>
<%@ page import="com.restfb.DefaultFacebookClient"%>
<%@ page import="com.restfb.DefaultJsonMapper"%>
<%@ page import="com.restfb.Facebook"%>
<%@ page import="com.restfb.FacebookClient"%>
<%@ page import="com.restfb.FacebookClient.AccessToken"%>
<%@ page import="com.restfb.JsonMapper"%>
<%@ page import="com.restfb.Parameter"%>
<%@ page import="com.restfb.json.JsonArray"%>
<%@ page import="com.restfb.json.JsonObject"%>
<%@ page import="com.restfb.types.Page"%>
<%@ page import="com.restfb.types.Post"%>
<%@ page import="com.restfb.types.Url"%>
<%@ page import="com.restfb.types.User"%>
<%@ page import="com.restfb.types.Group"%>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
        <title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
```

```
        // Or uncomment the following line to redirect
        window.location = "index.jsp";
       });
     }
   </script>
</head>
<center>
        <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<body>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
String AccessTokenJSession = (String)session.getAttribute("sessionToken");
//out.println("<BR>Retreived Seesion Token: " + AccessTokenJSession);
String appId="242427255928014";
String appSecret="ed57ae49f7aff3cb68a16678b0e8375f";
FacebookClient facebookClient = new DefaultFacebookClient(AccessTokenJSession, appSecret);
//String selectedCompetence;
//selectedCompetence = request.getParameter("selCompForView");
//out.println(selectedCompetence);
%>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
    <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
          <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">

          <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Facebook Group and Member Information
        <ul style="list-style-type:disc">
        <li><a href="fbookGroup.jsp">Group Information</a></li>
        <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
        <li><a href="memberCompetence.jsp">Competences of Members</a></li>
        </ul>
        <BR><BR>
        Notes about Group Members
        <ul style="list-style-type:disc">
        <li><a href="addNote.jsp">Add Note</a></li>
        <li><a href="viewNotes.jsp">View Notes</a></li>
```

```
          </ul>
          </td>
    <td width="55%" style="vertical-align:top">
<h3> Notes about the Group Members </h3>
<BR><BR>
<%
PrintWriter outt = response.getWriter();
String fileName=getServletContext().getRealPath("notes.rdf");
          Query  qry;
          QueryExecution qe ;
          ResultSet rs ;
          Literal creator;
          Literal noteLiteral;
          Literal adDate;
          Literal memberLiteral;
          String prevMember="";
          QuerySolution soln;
          Resource r;
          File f = new File(fileName);
          InputStream in = new FileInputStream(f);
          if ( in == null )
          { throw new IllegalArgumentException("File is not found" );}
          //else  {outt.println(" File successfully openned\n");  }
          Model model = ModelFactory.createDefaultModel();
          model.read(in,null);
          String queryString = "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                                          "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                                          "PREFIX cm:<http://www.cmodel.com/elements/> "+
                                          "SELECT DISTINCT ?adDate ?note ?creator ?member  WHERE { "+
                                          "?addedNote cm:hasCreator ?creator. "+
                                          "?addedNote cm:hasAddedNote ?note. "+
                                          "?addedNote cm:hasDate ?adDate. "+
                                          "?addedNote cm:aboutMember ?member. "+
                                          " } ORDER BY ?member ";
          qry = QueryFactory.create(queryString);
          //out.println("<BR>"+ queryString + "");
          qe = QueryExecutionFactory.create(qry, model);
          rs = qe.execSelect();
          int rsSize = 0;
          int noteNo = 0;
          for ( ; rs.hasNext() ; )
          {
                    rsSize = rsSize+1;
                    soln = rs.nextSolution() ;
                    //r = soln.getResource("competence") ;
                    creator = soln.getLiteral("creator") ;
                    noteLiteral = soln.getLiteral("note") ;
                    adDate = soln.getLiteral("adDate") ;
                    memberLiteral = soln.getLiteral("member") ;
       //out.println("<form action='delSelectedResource.jsp' method='GET'> ");
                    if ( !prevMember.equals(memberLiteral.toString())   )
                    {
                              noteNo = 1;
                              out.println("<BR><BR><BR> <b> " + memberLiteral + ": </b> <BR> <i>Note "+
noteNo +": </i>" + noteLiteral + "<i> (by "+ creator + ", "+ adDate + ")</i>");
                    }
                    else
                    {
                              noteNo = noteNo + 1;
```

```
                    out.println("<BR> <i>Note "+ noteNo +" :</i> "+ noteLiteral + "  <i>(  by "+
creator + ", "+ adDate + ")</i>");
              }
     prevMember = memberLiteral.toString();
/*
out.println("<input type='hidden' name='selDeleteCompetence' value='"+ compTitle + "'/>");
out.println("<input type='hidden' name='selDeleteCreator' value='"+ creator + "'/>");
out.println("<input type='hidden' name='selDeleteURL' value='"+ url + "'/>");
out.println("<input type='submit' value='Delete This Resource' />");
out.println("</form>");
*/
       }
       out.println("<BR><BR>");
  qe.close();
if (rsSize == 0)
{
out.println("<BR> No note has been added");
}
%>
<BR>
       </td>
              <td width="20%" style="vertical-align:top">
       <%
       AccUserName = (String)session.getAttribute("sessionUserName");
  out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
       %>
       <BR>
       <a href="javascript:logoutFacebook()">Logout from Facebook</a>
       </td>
 </tr>
</table>
</center>
<BR>
</body>
</html>
```

Appendix D

This appendix shows all programming code related to signing in/ out via Facebook.

D.1 Programming code for logging into Facebook and logging out

```
<!DOCTYPE html>
<html>
<head>
<%
session.invalidate();
%>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>Intended Learning Outcomes (ILOs) Application</title>
</head>
<body>
<center>
<h1>Welcome to Intended Learning Outcomes (ILOs) Application</h1>
<BR>
<h3>Thank you for your participation in the research experiment</h3>
</center>
<center>
<BR><BR>
Please use your Facebook account to login..
<BR><BR>
<script>
  // This is called with the results from from FB.getLoginStatus().
  function statusChangeCallback(response) {
    console.log('statusChangeCallback');
    console.log(response);
    // The response object is returned with a status field that lets the
    // app know the current login status of the person.
    // Full docs on the response object can be found in the documentation
    // for FB.getLoginStatus().
    if (response.status === 'connected') {
      // Logged into your app and Facebook.
      testAPI();
    } else if (response.status === 'not_authorized') {
      // The person is logged into Facebook, but not your app.
      document.getElementById('status').innerHTML = 'Please log ' +
        'into this app.';
    } else {
      // The person is not logged into Facebook, so we're not sure if
      // they are logged into this app or not.
      document.getElementById('status').innerHTML = 'Please log ' +
        'into Facebook.';
    }
  }

  // This function is called when someone finishes with the Login
  // Button.  See the onlogin handler attached to it in the sample
  // code below.
  function checkLoginState() {
    FB.getLoginStatus(function(response) {
      statusChangeCallback(response);
    });
  }
  window.fbAsyncInit = function() {
  FB.init({
```

```
   appId      : '242427255928014',
   cookie     : true,  // enable cookies to allow the server to access
                    // the session
   xfbml      : true,  // parse social plugins on this page
   version    : 'v2.2' // use version 2.2
 });
 // Now that we've initialized the JavaScript SDK, we call
 // FB.getLoginStatus().  This function gets the state of the
 // person visiting this page and can return one of three states to
 // the callback you provide.  They can be:
 //
 // 1. Logged into your app ('connected')
 // 2. Logged into Facebook, but not your app ('not_authorized')
 // 3. Not logged into Facebook and can't tell if they are logged into
 //    your app or not.
 //
 // These three cases are handled in the callback  function.
 FB.getLoginStatus(function(response) {
   statusChangeCallback(response);
 });
 };
 // Load the SDK asynchronously
 (function(d, s, id) {
   var js, fjs = d.getElementsByTagName(s)[0];
   if (d.getElementById(id)) return;
   js = d.createElement(s); js.id = id;
   js.src = "//connect.facebook.net/en_US/sdk.js";
   fjs.parentNode.insertBefore(js, fjs);
 }(document, 'script', 'facebook-jssdk'));
 // Here we run a very simple test of the Graph API after login is
 // successful.  See statusChangeCallback() for when this call is made.
 function testAPI() {
   console.log('Welcome!  Fetching your information.... ');
   FB.api('/me', function(response) {
     console.log('Successful login for: ' + response.name);
          var access_token =   FB.getAuthResponse()['accessToken'];
          var access_name =   response.name;
     document.getElementById('status').innerHTML =
       'Thanks for logging in, <B>' + response.name + '<B>! <BR>';  //+ access_token;
                document.getElementById('accToken').value= access_token;
                document.getElementById('username').value = access_name;
                //document.getElementById('tokendisplay').innerHTML = access_token;
   });
 }
 //
</script>
<!--
 Below we include the Login Button social plugin. This button uses
 the JavaScript SDK to present a graphical Login button that triggers
 the FB.login() function when clicked.
-->
<fb:login-button scope="public_profile,email,user_about_me" onlogin="checkLoginState();">
</fb:login-button>
<div id="status">
</div>
<BR><BR>
Once your login is successful, please click on the 'Proceed to the application'
<BR><BR>
<div id="tokendisplay">
</div>
```

```
<BR><BR><BR>
<form action="home.jsp" method="POST">
<input type="hidden" id="accToken" name="accTokenName"/>
<input type="hidden" id="username" name="accUserName"/>
<input type="submit" value="Proceed to the application" />
</form>
</center>
</body>
</html>
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>

<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>

<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
   <script src="http://connect.facebook.net/en_US/all.js"></script>
   <script type="text/javascript">
      function logoutFacebook() {
        FB.init({
          appId:'242427255928014', cookie:true,
          status:true, xfbml:true
        });
        FB.logout(function() {
          // Reload the same page after logout
          // window.location.reload();
          // Or uncomment the following line to redirect
          window.location = "index.jsp";
        });
      }
     </script>
</head>
<body>
```

```
<center>
<h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<%
String AccessTokenJS,UserName;
String AccUserName, AccessTokenJSession;  // AccUserName is Session Variable
        AccessTokenJS = (String)request.getParameter("accTokenName");
        UserName = request.getParameter("accUserName");
        //retrieve session variable as well.
   AccUserName = (String)session.getAttribute("sessionUserName");
   //out.println("FORM USER NAME IS " + UserName + "<BR>");
        //out.println("Session variable name IS " + AccUserName + "<BR>");
        if ( AccUserName == null && UserName == "")//if session is null, send back.
         {
                response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
         }
        if ( AccUserName == null )
                {
                   session.setAttribute( "sessionToken", AccessTokenJS );
                        session.setAttribute( "sessionUserName", UserName );
                }

/*
if ( AccUserName == null)
{
    if ( UserName == null )
         {
                response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
         }
         else
         {
                   session.setAttribute( "sessionToken", AccessTokenJS );
                        session.setAttribute( "sessionUserName", UserName );
         }
}
*/
AccessTokenJSession = (String)session.getAttribute("sessionToken");
AccUserName = (String)session.getAttribute("sessionUserName");
%>
<h3>
</h3>
<BR>
<BR>
<center>
<table border="1" style="width:100%">
  <tr>
   <td width="25%" style="vertical-align:top">
        <BR>
        <a href="home.jsp">Home Page</a>
        <BR><BR>
        Task Competences
        <ul style="list-style-type:disc">
           <li>   <a href="compList.jsp">View Task Competencees</a></li>
                <li><a href="selResourceView.jsp">View Related Resources</a></li>
                <li><a href="addResource.jsp">Add Related Resources</a></li>
                <li><a href="selResourceViewDelete.jsp">Delete Related Resources</a></li>
        </ul>
        <BR><BR>
        Collaborative Working Compentences
        <ul style="list-style-type:disc">
```

```
            <li><a href="gwComp.jsp">View Collaborative Working Compentences</a></li>
                <li><a href="cwSelResourceView.jsp">View Related Resources</a></li>
                <li><a href="cwAddResource.jsp">Add Related Resources</a></li>
                <li><a href="cwSelResourceViewDelete.jsp">Delete Related Resources</a></li>
          </ul>
          <BR><BR>
          Facebook Group and Member Information
          <ul style="list-style-type:disc">
          <li><a href="fbookGroup.jsp">Group Information</a></li>
          <li><a href="fbookGroupMembers.jsp">Information about Members</a></li>
          <li><a href="memberCompetence.jsp">Competences of Members</a></li>
          </ul>
          <BR><BR>
          Notes about Group Members
          <ul style="list-style-type:disc">
          <li><a href="addNote.jsp">Add Note</a></li>
          <li><a href="viewNotes.jsp">View Notes</a></li>
          </ul>
          </td>
    <td width="55%" style="vertical-align:top">
<h2>Application overview: </h2>
This application assists you to find information about given assignment through number of structured
competences. In addition, it provides you with necessary information to work together in effective way.
Moreover, it provides you with some social skills about your colleagues such as skills in order to form
more effective groups.

<h2>Scenario: </h2>
Robin a student on the database module and sees the assignment set by Edrees in the Facebook Group as
a general post. Robin is looking to form a Group with various competences to help to complete the
assignment. In order to complete this task, Robin has to complete following activities in the ILOs
Application:

<ol  type="a">
<li>Knowing all task competences.
</li>
<li>Knowing what is required for working collaboratively
</li>
<li>Knowing various competences of all students
</li>
<li>Making connections between task competences and potential Group members in order to form
effective group of four members.
</li>
</ol>
<h2>Knowledge domain in the application</h2>
Normalisation
<h2>Application section: </h2>
<ol>
<li>Task competences: to explore a number of competences with related subject matter. Additional
resources can be added and viewed or deleted by their original creators. </li>
<li>
Collaborative working competences:  to explore what is required to work collaboratively in effective way.
In addition, information is provided on how to preform each collaborative competence.  Additional
resources can be added and viewed or deleted by their original creators.
</li>
<li>
Facebook Group and member information: to find out how many members in the groups, what are their
skills?
</li>
<li>
```

```
Notes about Group members: This is to update any progress or performance about each member to be visible to others such as which group they belong, additional skills or assigned tasks to each one.
</li>
</ol>

You should be able to answer the given assignment based on provided information. In addition, you should be able to work collaboratively through provided competences. The information about your colleagues could help you to form effective groups based on task competences and collaborative competences when compare with available member skills
   </td>
        <td width="20%" style="vertical-align:top">
        <%
        AccUserName = (String)session.getAttribute("sessionUserName");
   out.println("You are Logged in as :<BR><B> " + AccUserName + "</B>");
        %>
        <BR>
        <a href="javascript:logoutFacebook()">Logout from Facebook</a>
        </td>
  </tr>
</table>
</center>
<BR>
<BR>
</body>
</html>

<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
   pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>Collaborative Working Comptences: Facebook Logout</title>
</head>
<center>
<h1>You have successfully logout from the Facebook</h1>
</center>
<body>
<%
sesssion.invalidate();
%>
<h3>
<center>
Thank you very much for your participation in the research experiment about Collaborative Working Comptences
 </center>
</h3>
</body>
</html>
```

Appendix E

This appendix shows all related materials to First experiment.

E.1 Pre-test and Post-test form

Answer the following questions in 5 minutes ONLY

1- Match the elements in Group A with appropriate content in Group B by writing the number of the Group A element against the corresponding entry in Group B

Group A

1) First Normal Form
2) Second Normal Form
3) Third Normal Form
4) Fourth Normal Form
5) Fifth Normal Form

Group B

( ) Get rid of any columns that hold the same data
( ) Each row must be unique
( ) Get rid of data not dependent on every part Primary key
( ) No non-key attribute should be dependent on another non-key attribute
( ) Split up data that can be split.

2- Choose the correct answer

a) Normalisation provides rules that help:

(a) Organise those data efficiently
(b) Eliminate redundant data
(c) Ensure that only related data are stored in a table
(d) None of these rules
(e) All of the given rules
(f) I do not know.

b) The following table

OrderNumber	CustomerName	CustomerAddress	ProductID	ProductName	Quantity	PriceEach
1	John Smith	8 Yewbeam Avanue, Cambridge, CB2 1QY	43	Basket	1	7.80
			32	Box	4	6.50
2	Fred Roberts	64 Bone Street, Ipswich, IP2 4DF	32	Box	2	6.50
			54	Chair	4	30.50
			12	Desk	1	45.60
3	George Jones	78 Church Street, Sheffield, S4 6GF	43	Basket	3	7.80
			15	Table	1	35.70

- **is in:**

(a) 1NF
(b) 2NF
(c) 3NF
(d) 4NF
(e) 0NF
(f) All of the above
(g) None of the above.

E.2 Model Answer for assignments

Model answer:

Normalisation Questions (First assignment):

1) Give the definition of normalisation (1 Mark)

Normalisation **is** a techniques used when designing a database. Normalisation involves a multi-step process with aim to reduce data redundancy and to help eliminate data anomalies that can result from such redundancy.

2) Summarise the steps of normalisation by explaining the requirements of each. (3 Marks)

1- Normalise to First Normal Form (0.5 mark)

- Identify Primary Key (0.25 mark)
- Remove Repeating Group of Data (0.25 mark)

2-Normalise to Second Normal form (0.5 mark)

- Normalise to First Normal Form (0.25 mark)
- Remove Partial Dependency (0.25 mark)

3- Normalise to Third Normal Form (0.5 mark)

- Normalise to Second Normal Form (0.25 mark)
- Remove Functional Dependency (0.25 mark)

3) Normalise the un-normalise database table below to Third Normal Form. (5 Marks)

Order no.	**Agent name**	**Agent address**	**Delivery ID**	**Dispatch date**	**Goods ID**	**Description**	**Quantity dispatched**	**Quantity outstanding**
101	Warehouse	141 Briton Street	223	01/02/2015	881	phone case, batteries	2	3
					885	headset	1	2
102	NBC	7 University Road	224	04/05/2015	882	shampoo	6	6
103	D-Shop	2 Winn Road	225	06/03/2015	883	DVDs	1	2
104	J.C.	88 Atlantic Close	226	28/06/2015	884	books	7	3
					888	magazines	3	5

First Normal Form (1NF)	Second Normal Form (2NF)	Third Normal Form (3NF)	
Order Number (PK)	Order Number (PK)	Order Number (PK) (0.25 mark)	
Agent Name	Agent Name	Agent Name (FK)	(1 Mark)
Agent Address	Agent Address	Delivery ID	
Delivery ID	Delivery ID	Despatch date	
Despatch date	Despatch date		
		Agent Name (PK) (0.25 mark)	(1 Mark)
Order Number (PK)	Order Number (PK)	Agent Address	
Goods ID (FK)	Goods ID (FK)		
Description	Quantity dispatched	Order Number (PK) (0.25 mark)	
Quantity dispatched	Quantity Outstanding	Goods ID (FK)	
Quantity Outstanding		Quantity dispatched	(1 Mark)
	Goods ID (PK)	Quantity Outstanding	
	Description		
		Goods ID (PK) (0.25 mark)	
		Description	(1 Mark)

4) Compare partial dependency and functional dependency, giving examples. (6 Marks)

Partial dependency:

* Normalisation Processes for Second Normal Form **(1 Mark)**

* Non- key attributes of each column Must Depends on every part of the primary key **(1 Mark)**

** ANY EXAMPLES THAT FIT IN 2NF **(1 Mark)**

Functional Dependency

* Normalisation Processes for Third Normal Form **(1 Mark)**

* There are no non-key attributes that depend on another non-key attribute **(1 Mark)**

** ANY EXAMPLES THAT FIT IN 3NF **(1 Mark)**

5) Critically evaluate whether the following two tables fit Third Normal Form, and identify any elements that do not meet the requirements. (5 Marks)

Evaluation mention to: *(in any format of explanation)*

- Tables are not in 3 NF **(1 Mark)**
- Functional dependency **(1 Mark)**
- Student ID as primary key, must has following elements name, DoB, postcode. **(1 Mark)**
- Others elements in table such as street, state, city depend on Post code as primary key **(1 Mark)**

Student_Detail **(0.50 Mark)**

Student ID (PK)	**Student name**	**Date of Birth**	**Postcode (FK)**

Address_Table **(0.50 Mark)**

Post Code (PK)	**Street**	**State**	**City**

<u>Group Work Questions (Second assignment):</u>

1) Name three important skills essential in all group work. (3 Marks)

- A student will be able to plan **(1 Mark)**
- A student will be able to lead and manage the group **(1 Mark)**
- A student will be able to negotiate **(1 Mark)**

2) Explain how to act responsibly when working as part of a group. (2 Mark s)

Any format of explanation which can mention to:

- Check your understanding of given task with others
- Explain to others your achievement
- Summarise the achievement
- Meet deadlines
- Discussion
- Help others
- Improve of group work
- Finish given tasks
- Encourage others
- Fun environment
- Listen to each other's
- ………

3) Imagine that you have the role of negotiator in a group in which some members of the group are not taking their work seriously, and that this is presenting difficulties. Identify two or three steps that you would take to address this issue. (3 Marks)

Any format of explanation which can mention to:

- Saying something positive about their contribution
- Dealing with non-contributing members
- Deal with embarrassment
- Keep each other informed about development

- Letting them know that you found what they said interesting
- Encouraging members
- Reassuring nods and gestures
- Smiling
- Eye contact

4) Compare the roles of leader and planner in undertaking effective group work. (6 Marks)

Any format of explanation which can mention to:

Planner: (3 Marks)

- Notify others for changes or any problem in timely manner
- Summarising and reporting the progress
- Ensure completing given task
- Maintain adequate preparation time for scheduled meetings/deadlines
- track the progress of the group
- Accurately estimate time and effort required to complete a task
- assign tasks between members including (leader, planner and negotiator)

Leader: (3 Marks)

- Deal with persuasion
- Building and maintaining trust with members
- Listen to members and rise discussions
- Draw directions to accomplish task successfully
- Resolve conflicts
- Remind Other to use collaborative skills
- Respond to failure
- Ask for feedback from members and share it in order to perform the task

5) Imagine there are a few members in your group who do not complete their tasks by the deadline. Some ideas have been suggested by the group to address the issue: (6 Marks)

- **Ignore them by being less friendly and reducing communication**
- **Discuss and establish timelines on which ALL members agree**
- **Level a criticism at these members and withhold group findings until they have something to contribute**
- **At each meeting ask each member to present a progress report on what they have completed since the previous session.**

Critically evaluate these ideas and explain what could be done to improve the performance of members who do not meet deadlines. In addition, identify a better way to address the issue.

Looking for:

Ideas 1+3 could be wrong *(with any formation of explanation which can give reasons based on given group work skills* **(1 Mark)**

Ideas 2+4 could be correct (*with any formation of explanation which can give reasons based on given group work skills)* **(1 Mark)**

Group of student should continue rise discussion and give solution based on given skills for group work in any format. **(2 Marks)**

They also should mention to roles of negotiator, planner, leader …. **(2 Marks)**

E.3 Training documents for APP Users and Non-APP Users

Training document (APP Users)

Introduction and Terms of Definitions

1- Introduction

The aim of this research is to evaluate an application that helps students to work collaboratively on a given assignment. The application contains information (competences) about how to answer the assignment successfully. In addition, it provides information (competences) on how to work effectively as a group. Moreover, the application makes your Facebook Profile information, such as professional skills, available to your colleagues in order for them to compare both assignment and group work competences when forming a study group. So, there are two types of competences: the first for the technical task, which is Normalisation, and the second for collaborative working.

What is competence?

Competence is the ability to perform a particular activity to a prescribed standard.

Competence

Competence is designed to specify the range of competence element/nodes for a particular knowledge domain. In general, competence consists of a capability verb and the subject matter, for example '***design a simple entity relationship diagram (ERD)***'. The capability that the student must perform is ***design*** and the subject matter is ***ERD***. Competence involves sub and sub sub-competences to perform the main competence. For example, to design ERD the student may need to know the description of ERD. So, the sub-competence is ***describe the ERD.*** In addition, the student may need to know the description of the logical model, so they have to be able to describe the ERD. In this case the sub sub-competence is ***describe logical model***. In short, to achieve Competence A, we need to perform Competence B. Also, Competence B involves Competence C. This is hierarchy of competences.

What is subject matter?

Subject matter is the content that describes or explains a specific competence. It provides students with further explanation on how to perform the competence.

Training document (Non-APP Users)

Introduction and Terms of Definitions

1- Introduction

The aim of this research is to evaluate a paper-based text document that helps students to work collaboratively on a given assignment. The document contains information (competences) about how to answer the assignment successfully. In addition, it provides information (competences) on how to work effectively as a group. Moreover, you should explore others Facebook Profiles information, such as professional skills in order to compare both assignment and group work competences when forming a study group. So, there are two types of competences: the first for the technical task, which is Normalisation, and the second for collaborative working.

What is competence?

Competence is the ability to perform a particular activity to a prescribed standard.

Competence

Competence is designed to specify the range of competence element/nodes for a particular knowledge domain. In general, competence consists of a capability verb and the subject matter, for example '***design a simple entity relationship diagram (ERD)***'. The capability that the student must perform is ***design*** and the subject matter is ***ERD***. Competence involves sub and sub sub-competences to perform the main competence. For example, to design ERD the student may need to know the description of ERD. So, the sub-competence is ***describe the ERD.*** In addition, the student may need to know the description of the logical model, so they have to be able to describe the ERD. In this case the sub sub-competence is ***describe logical model***. In short, to achieve Competence A, we need to perform Competence B. Also, Competence B involves Competence C. This is hierarchy of competences.

What is subject matter?

Subject matter is the content that describes or explains a specific competence. It provides students with further explanation on how to perform the competence.

E.4 Scinario for APP Users and Non-APP Users

Scenario (APP Users)

1. Overview:

Assume you are a student on a Database and Database Applications module at University of X. The module has a Facebook Group called Database and Database Applications. The teacher has asked all students undertaking the module to join the Group and has posted an assignment to the Group that requires group working. You will be given an application integrated with the Facebook Group that contains information on how to answer the assignment, how to work as a group and some social information about the members of Facebook Group, such as their professional skills and bio content, such as gender, to help form an effective sub-group. Your task is to explore a number of competences culminating in completing the given assignment successfully. Apart from this, you need to find out what group work is required and explore a number of competences for working together with colleagues in an effective way. Moreover, you need to be aware of your colleagues' skills and other information that could be matched or enhanced, if possible, through both the assignment and group work, then communicate with them to form a sub-group of **five members** to consider the given information as thoroughly. Once the sub-group is formed, you should name it and make notes about it and your membership by means of the application.

Scenario (Non-APP Users)

1. Overview:

Assume you are a student on a Database and Database Applications module at University of X. The module has a Facebook Group called Database and Database Applications. The teacher has asked all students undertaking the module to join the Group and has posted an assignment to the Group that requires group working. You will be given paper text documents that contains information on how to answer the assignment, how to work as a group. You should access some social information about the members of Facebook Group through their profiles, such as professional skills, bio content, and gender, to help form an effective sub-group. Your task is to explore a number of competences culminating in completing the given assignment successfully. Apart from this, you need to find out what group work is required and explore a number of competences for working together with colleagues in an effective way. Moreover, you need to be aware of your colleagues' skills and other information that could be matched or enhanced, if possible, through both the assignment and group work, then communicate with them to form a sub-group of **five members** to consider the given information as thoroughly. Once the sub-group is formed, you should name it and make notes about it and your membership by general post inside Facebook Group.

E.5 Instructions for APP Users and Non-APP Users

Instructions: (App Users)

- If you are not already a Facebook user, please register at **https://www.facebook.com/**:
    - You will see on the main Facebook page **'Create an account'**
    - Enter your first name, surname and email address and confirm it, choose a password for your account and enter your date of birth.
    - Now you are a Facebook user.
- If you already have an account with Facebook, please log in and update your personal Profile with your professional skills and make it 'Public':
    - Go to **'Edit Profile'** (left-hand side under your Facebook name, beside your profile photo, if you have one)
    - Click on **'Work and Education'**
    - Go to **'Professional Skills'** and click **'Add a professional skill'**
    - Enter your skills and save the changes
    - Based on your prior skills, add those of the following skills that you can to your professional skills:
        - Normalisation; database keys; coding; MYSQL; entity relationships.
        - Planning activities; leading groups; managing groups; negotiation with others; public relationships; monitoring people; arranging things; communication skills.
    - If you want to share your skills with others and allow the application to read them, make sure you choose '**Public**' from the list below the professional skills section. Also, Go to **Settings** > **Apps** > **Apps**, **Websites and Plug-ins**, and make it **ENABLED.**
- Search for the **Database and Database applications** group in Facebook and ask to join the group.
- Give the invigilator a few seconds to update the application with your current skills. If you want to add new skills or make modifications, simply send a Facebook message to the Group admin, Edrees Alkinani, to make these updates.
- Now, please log in to the ILOs App at **(http://alkinani.ecs.soton.ac.uk:8080) Using Chrome browser** with your Facebook username and password. This information is secure, because it originates from and is verified by the official Facebook site.
- Find out what is required to undertake the assignment by clicking **(View Task Competences)**, the group work **(View collaborative working competences)**, and further available information about the Facebook Group and member skills **(Group information, Information about members, and competences of Members)**.
- You are required to form sub-group of (**five**) simply by communicating with others via Facebook's Group messaging service. Click 'Message' (right-hand side of the Group) and select 'Member'.
- Once your sub-group is formed, give it a name and make notes about yourself and your sub-group under (**Add Note**)
- Work on the assignment collaboratively using the information available from the application.
- Since it is collaborative work, you may need to add additional resources to a specific competence and share them with group members at (**Add Related Resources**):

- Select a specific competence
- Enter the resource in given space as URL and click ‘Add Resource’
- The resource will be added and shown with your Facebook name, and date and time you added it
- You can only delete resources that you have added from ‘**Delete Related Resources**’ –after selecting the competence, click ‘Delete this resource’
- If you have a document or file without a URL, simple attach it in the Facebook Group, copy the URL and tag it with related the competence in Applications.
- You can view additional resources for specific competences at (**View Related Resources**). You need to select a competence and click ‘**View Resources**’, then you will be able to see who added the resources and when
- The same applies for viewing, adding, deleting collaborative working competences.

- You are also asked to use Facebook Group features to collaborate with your colleagues:
  - Group messaging services – use as ‘Private’ to include all Group members to chat about the project
  - Post to all colleagues and the teacher
  - Discuss and respond to post via comments under each post
  - Create events for meetings
  - Ask questions and add polling options, if required
  - Share necessary photos/videos, for example from YouTube, and tag them with the competence relating to the application
  - Do not forget to update notes about members such as progress, tasks assigned and anything related to group work via the application. You should select the name, write descriptions and save notes. The person who adds the notes and time will be visible to Group members.

Once you finish the assignment, please submit it via the messaging service to ***Edrees Alkinani*** as the admin of the Facebook Group or hand it to invigilator in the session.

Instructions: (Non-APP Users)

- If you are not already a Facebook user, please register at **https://www.facebook.com/**:
  - You will see on the main Facebook page **'Create an account'**
  - Enter your first name, surname and email address and confirm it, choose a password for your account and enter your date of birth.
  - Now you are a Facebook user.
- If you already have an account with Facebook, please log in and update your personal Profile with your professional skills and make it 'Public':
  - Go to **'Edit Profile'** (left-hand side under your Facebook name, beside your profile photo, if you have one)
  - Click on **'Work and Education'**
  - Go to **'Professional Skills'** and click **'Add a professional skill'**
  - Enter your skills and save the changes
  - Based on your prior skills, add those of the following skills that you can to your professional skills:
    - Normalisation; database keys; coding; MYSQL; entity relationships.
    - Planning activities; leading groups; managing groups; negotiation with others; public relationships; monitoring people; arranging things; communication skills.
  - If you want to share your skills with others, make sure you choose '**Public'** from the list below the professional skills section.
- Search for the **Databases and Database applications** group in Facebook and ask to join the group.
- Find out what is required to undertake the assignment, the group work, and further available information about the Facebook Group and member skills **by checking given documents and access others profiles.**
- You are required to form sub-group of (**five**) simply by communicating with others via Facebook's Group messaging service. Click 'Message' (right-hand side of the Group) and select 'Member' or talk to them face to face.
- Once your sub-group is formed, give it a name and make notes about yourself and your sub-group as general post in Facebook Group.
- Work on the assignment collaboratively using the given information available from the documents.
- Since it is collaborative work, you may need to add additional resources to a specific competence and share them with group members at Facebook Group.
- You are also asked to use Facebook Group features to collaborate with your colleagues:
  - Group messaging services – use as 'Private' to include all Group members to chat about the project
  - Post to all colleagues and the teacher
  - Discuss and respond to post via comments under each post
  - Create events for meetings
  - Ask questions and add polling options, if required
  - Share necessary photos/videos, for example from YouTube, and tag them with the competence relating to the application

Once you finish the assignment, please submit it via the messaging service to ***Edrees Alkinani*** as the admin of the Facebook Group or hand it to invigilator in the session.

E.6 Assignments Questions for Normalisation and Group Work

Normalisation Assignment:

Form groups of five to answer the following questions:

1) Give the definition of normalisation.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

2) Summarise the steps of normalisation by explaining the requirements of each.

……………………………………………………………………………………………………

……………………………………………………………………………………………………

……………………………………………………………………………………………………

3) Normalise the un-normalised database table below to Third Normal Form.

Order no.	**Agent name**	**Agent address**	**Delivery ID**	**Dispatch data**	**Goods ID**	**Description**	**Quantity dispatched**	**Quantity outstanding**
101	Warehouse	141 Briton Street	223	01/02/2015	881	phone case, batteries	2	3
					885	headset	1	2
102	NBC	7 University Road	224	04/05/2015	882	shampoo	6	6
103	D-Shop	2 Winn Road	225	06/03/2015	883	DVDs	1	2
104	J.C.	88 Atlantic Close	226	28/06/2015	884	books	7	3
					888	magazines	3	5

4) Compare partial dependency and functional dependency, giving examples.

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

5) Critically evaluate whether the following two tables fit Third Normal Form, and identify any elements that do not meet the requirements.

Student_Detail

Student ID	**Student name**	**City**	**Postcode**
5689	John	Southampton	SO18 9RW
2356	Robin	Cardiff	WX45 7QW
1852	Neil	Manchester	PL94 2NY
3657	David	Portsmouth	ZX44 1QR

Address_Table

Student ID	**Street**	**State**	**Date of birth**
5689	Briton Street	Hampshire	24 Mar 1985
2356	Winn Road	Wales	09 Dec 1990
1852	University Road	North	19 Jan 1989
3657	Pacific Close	Hampshire	29 Jul 1995

……………………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………………………………………………………………………

Group Work Assignment:

Form groups of five to answer the following questions:

1) Name three important skills essential in all group work.

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

2) Explain how to act responsibly when working as part of a group.

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

3) Imagine that you have the role of negotiator in a group in which some members of the group are not taking their work seriously, and that this is presenting difficulties. Identify two or three steps that you would take to address this issue.

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

4) Compare the roles of leader and planner in undertaking effective group work.

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

5) Imagine there are a few members in your group who do not complete their tasks by the deadline. Some ideas have been suggested by the group to address the issue:

- Ignore them by being less friendly and reducing communication
- Discuss and establish timelines on which ALL members agree
- Level a criticism at these members and withhold group findings until they have something to contribute
- At each meeting ask each member to present a progress report on what they have completed since the previous session.

Critically evaluate these ideas and explain what could be done to improve the performance of members who do not meet deadlines. In addition, identify a better way to address the issue.

…………………………………………………………………………………………………
…………………………………………………………………………………………………
…………………………………………………………………………………………………

E.7 Questionnaires

Questionnaire A:

The purpose of questionnaire A is to evaluate the task competences (Normalisation). The results will help us to compare competence that given in the application and written on paper as plain text. In addition, the results will help us to confirm whether task competence influenced learning results.

Questions	scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Using competences allowed you to plan your learning activities					
Using competences structure allowed you to know which sub and sub-sub competences to access					
Using competences allowed you to explore the content of normalisation quickly					
Using competences provided you with a logical sequence to perform the assignment					
Using competences structure allowed you to return easily to the previous point in the competences structure					
Using competences allowed you to know where is your current situation in the assignment					
Using competences provided you with steps on how to accomplish the assignment					
Using competences allowed you to know what is required to achieve each competence					
Using competences structure enabled you to distinguish between the main competence, sub-competences and sub sub-competences					
Using competences allowed you to know what specific subject matter is related to a competence					
Using competences enabled you to find specific resources for a competence					
It is clear how to use competences					
Competences need further explanation from a teacher					
The structure of the subject matter of normalisation is clear					
The subject matter needs further explanation from the teacher					
The structure of competences is difficult to follow					

Questions	scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Representing competences is a good idea					
identifying competences makes an assignment interesting					
A student will be able to add resources to specific competence in a structured way					
It is easy to find additional resources for a competence					
Resources are structured according to a competence					
A student will be able to find out who added resources and when, after a while					
It is useful to know who added resources and when					
Resources added by students are helpful					
Students will be able to track the performance of their colleagues					

Questionnaire B:

The purpose of questionnaire B is to evaluate the collaborative working (group work competences). The results will help us to compare competence that given in the application and written in a paper as plain text. In addition, the results will help us to confirm whether collaborative working influenced learning results.

Questions	scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Using group working competences allowed you to plan your learning activities					
Using structure of group working competences allowed you to know which competence and related explanation to access					
Using group working competences allowed you to explore the content of collaborative working quickly					
Using group working competences provided you with a logical sequence to work as a group effectively					
Using group working competences allowed you to return easily to the previous point in the competences structure					
Using group working competences allowed you to know where is your current situation in collaborative working					
Using group working competences provided you with steps on how to work as a group effectively					
Using group working competences allowed you to know what is required to perform each competence					
Using group working competences enabled you to distinguish between the main competence and related activities					
Using group working competences allowed you to know how specific activities relate to a competence					
Using group working competences enabled you to find specific resources to a competence					
It is clear how to use collaborative working competences					
Group working competences need further explanation from a teacher					
The structure of activities for each collaborative working competence is clear					

Questions	Scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
The structure of activities relating to each collaborative working competence needs further explanation from the teacher					
The structure of group working competences is difficult to follow					
Representing group working competences is a good idea					
identifying group working competences makes collaborative working interesting					
A student is able to add additional resources to specific group working competences					
It is easy to find additional resources for specific group working competence					
Resources are structured according to specific group working competences					
It is useful to know who added resources for group working and when					
Resources added by students for group working competences are helpful					
Groups are able to track the performance of their members					

Quetionnaire C:

The purpose of questionnaire C is to evaluate whether the group was working collaboratively. This also confirms whether group work had influence on gaining better learning results.

Questions	scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
The group has identified someone to plan the tasks between all members					
I was notified of any changes or problems					
I was given an estimate of the time to finish the task					
I summarised progress					
The group was tracked and monitored by someone					
The group identified someone to lead and mange					
The leader listened to each member					
The leader asked for feedback from members					
The leader responded to any failure in the group or resolved any conflict					
The leader suggested directions to accomplish the task successfully					
The leader reminded group members to use collaborative skills					
The leader created a trusted environment between members					
I was encouraged by others/someone					
There was someone to deal with non-contributing members					
I had positive support about my contribution					
The group exchanged messages					
The group scheduled meetings					
Members asked each other for help					
Members responded to each other					
Members contributed by adding additional resources					
Members held discussion					
Members shared findings with each other					
Members paid attention to the information or resources given					
Members checked their understanding of given task with each other					
Members explained their achievements to each other					

Questions	Scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Members listened to each other					
Members criticised ideas, not people					
Members apologised to each other for any mistakes or misunderstandings					
Members expressed their opinions					
Members said Yes, No					
Members accepted/confirmed Yes, No					
Members avoided trouble with each other					
Members took their turn and treated their responsibilities seriously					
Members supported each other					
Members enjoyed working together					
Members ignored distractions and focused on their work					

Questionnaire D:

The purpose of questionnaire D is to evaluate the professional skills of students from their Facebook profiles. The results will help us to make judgment on whether this provides better learning results based on their knowledge and prior skills. Also, it will be compared with students who do not use the application to generate students' skills.

Questions	scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
My sub-group members were appropriated based on their skills					
The skills of sub-group members are relevant to normalisation task					
The skills of sub-group members are relevant to databases in general					
The skills of sub-group members are relevant to collaborative working skills					
The sub-group members' skills are relevant to both task and collaborative working					
Skills of sub-group members did not match skills in either normalisation or collaborative working					
Members' prior skills contributed to assignment (Normalisation)					
Members' prior skills contributed group work (Collaborative working)					
Members' prior skills did not help with both assignment (Normalisation) and group work					
The content of assignment and group work were enough, so we did not depend on members' prior skills					
The content of assignment and group work were useful, so we updated our skills based on them and simulated the written activities					
I considered gender in forming sub-group					
I considered what have written in notes section about each members before choosing potential group members					
It was easy to compare the requirements of the normalisation task, collaborative working and students skills in order to form a sub-group					
It was easy to select potential sub-group members					
It was quick to formulate our sub-group					
Members skills were understandable					
It is good idea to represent students' skills					
Representing students' skills makes assignment interesting					

Questions	scale				
	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Representing students' skills is useless					
Representing students' skills are helpful to form a group					
Represent students' skills enhances decision to choose potential group members					
Representing other social information such as bio, educational and work information could help to form more effective groups					

E.8 Plain text documentation content for Non-APP Users

Task Competences

- Normalise to Third Normal Form
- Normalise to Second Normal Form
- Normalise to First Normal Form
- Remove Functional Dependency
- Remove partial dependency
- Remove repeating Group of data
- Identify primary key
- Define primary key
- List primary key characteristics
- List Repeating Group of data characteristics
- List partial dependency characteristics
- List functional Dependency characteristics
- List un-normalised form of database table characteristics
- List steps of Normalisation
- Define Normalisation
- Define un-normalised form

Subject Matter

Normalisation is a techniques used when designing a database. Normalisation involves a multi-step process with aim to reduce data redundancy and to help eliminate data anomalies that can result from such redundancy. Normalisation works through a series of stages, described as normal forms: the first three stages are referred to as: first normal form (1NF); second normal form (2NF); and third normal form (3NF)."

Un-normalised form is a table that contains one or more repeating groups of data"

Characteristics of Un-normalised form
There might be repeating fields
Data might be non-atomic
Data might be repeated
Table might not have a primary key

Primary Key is a key that uniquely identifies each record in a table

Characteristics of Primary Key:
Accessible: available when data created

It cannot contain null

Contains unique value: absolutely no duplicates

Stable: does not change overtime

Definitive: Value always exist

Factless: No hidden information

Minimal: fewest attribute necessary

Characteristics of Repeating Group of Data -- Process for 1NF:

Each data item cannot be broken down any further

Each field has an unique name

Each row is unique i.e. it has a primary key

There are no columns with repeated or similar data

Characteristics of Partial Dependency -- Processes for 2NF:

Non- key attributes must depends on every part of the primary key

The table must already in First Normal Form

Characteristics of Functional Dependency -- Processes for 3NF:

There are no non-key attributes that depend on another non-key attribute

The table must already in Second Normal Form

For example: Consider the following attributes for Table_Product (Product_ID , Color, Price) The table is not in First Normal Form because the [color] column may contain multiple values such as "red" and "green" in the same row. To bring this table to First Normal Form, we split the table into two tables and now we have the following results. Table_Product_Prince which contains (Product_ID, Price), Table_Product_Color which contains (Product_ID, Color). Now First normal Form is satisfied, as the columns on each table hold just one value.

For example: Consider Table_Purchase_detail with following attributes (Customer_ID, Store_ID, Purchase_Location). This table has a composite primary key [Customer ID, Store ID]. The non-key attribute is [Purchase Location]. In this case, [Purchase Location] only depends on [Store ID], which is only part of the primary key. Therefore, this table does not satisfy second normal form. To bring this table to Second Normal Form, we break the table into two tables, and now we have the following results. Table_Purchase which contains (Customer_ID, Store ID), and Table_Store (Store ID, Purchase_Location). What we have done is to remove the partial functional dependency that we initially had. Now, in the table [TABLE_STORE], the column [Purchase Location] is fully dependent on the primary key of that table, which is [Store ID].

For example: Consider the following attribute for Table_Book_Detail (Book_ID, Genre_ID, Genre_Type, Price). In the table able, [Book ID] determines [Genre ID], and [Genre ID] determines [Genre Type]. Therefore, [Book ID] determines [Genre Type] via [Genre ID] and we have transitive functional dependency, and this structure does not satisfy third normal form. To bring this table to third normal form, we split the table into two as follows: Table_Book which contains (Book_ID, Genre_ID, Price), and Table_Genere which contains (Genere_ID, Genre_Type). Now all non-key attributes are fully functional dependent only on the primary key. In [TABLE_BOOK], both [Genre ID] and [Price] are only dependent on [Book ID]. In [TABLE_GENRE], [Genre Type] is only dependent on [Genre ID].

Collaborative Working Competences

- A student will be able to lead and manage the group
- A student will be able to plan
- A student will be able to negotiate
- All students will be able to share common skills

Roles/behaviour/activities of previous competences

- Give/Accept a compliment
- Ask for help
- Ignore distractions
- Summarise the achievement
- Share resources / knowledge of subject area with members
- Have fun
- Explain your contribution to others
- Listening to each other's
- Apologies
- Accept criticism
- Take turn
- Avoid trouble with others
- Support Group decisions even if not in total agreement
- Say/Accept NO
- Check your understanding of given task with others
- Explain to others your achievement
- Criticise ideas not people
- Take responsibility
- Saying something positive about their contribution
- Dealing with non-contributing members
- Deal with embarrassment
- Keep each other informed about development
- Letting them know that you found what they said interesting
- Encouraging members
- Reassuring nods and gestures
- Smiling
- Eye contact
- Notify others for changes or any problem in timely manner
- Summarising and reporting the progress
- Ensure completing given task
- Maintain adequate preparation time for scheduled meetings/deadlines
- track the progress of the group
- Accurately estimate time and effort required to complete a task
- assign tasks between members including (leader, planner and negotiator)
- Deal with persuasion
- Building and maintaining trust with members
- Listen to members and rise discussions
- Draw directions to accomplish task successfully
- Resolve conflicts
- Remind Other to use collaborative skills
- Respond to failure
- Ask for feedback from members and share it in order to perform the task

Appendix F

This appendix shows all related materials to second experiment and additional study survey.

F.1 Presentation of Second Experiment

21/07/2016

UNIVERSITY OF Southampton

Structured Competences in Teaching

By:

Edrees Alkinani

eaa1g10@ecs.soton.ac.uk

Supervisory Team:

Associate Professor: Mr Lester Gilbert (lg3@ecs.soton.ac.uk)

Associate Professor: Dr Richard Crowder (rmc@ecs.soton.ac.uk)

Let's take an example of
a teaching topic about
Normalisation
&
Third Normal Form Processes

Desired competence to teach :

Normalising a database table to the Third Normal Form (3NF)

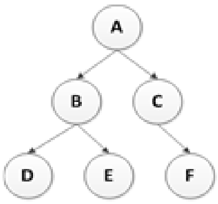
1

Competences: Style 1

- **Have a list of all competences that required to be learned:**

- Normalise an unnormalised database table to Third Normal Form
- Normalise to First Normal Form
- Normalise to Second Normal Form
- Remove functional dependency
- Remove repeating groups of data
- Remove partial dependency
- Identify the primary key
- Define Primary key
- List primary key characteristics
- List un-normalised form of database table characteristics
- List Repeating group of data characteristics
- List partial dependency characteristics
- List Functional dependency characteristics
- Define normalisation
- Define un-normalised form
- State the procedure of normalisation

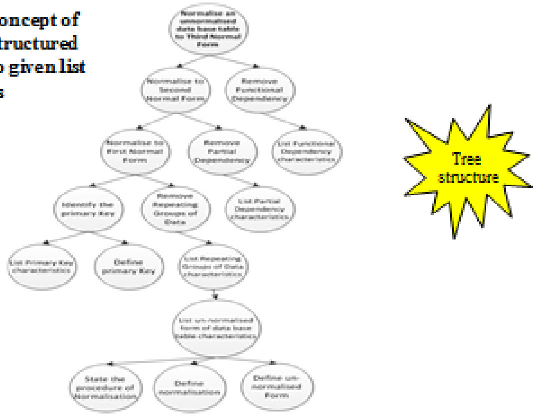
Ontological Structuring of Competences



Some competences require two or more **sub competences** to learn. To learn competence **A**, we need to learn both sub competences **B** and **C**. Competence **B** requires both competences **D** and **E** first to learn, the same for Competence **C** which requires first **F**.

Structured Competences: Style 2

Applying the concept of ontologically structured competences to given list of competences



Which of two representative styles of competences allows:

- Clearer goals for teaching?
- Clear and better sequence of teaching?
- Determine the knowledge level which should start with?

21/07/2016

Any Questions

Please Fill in the Questionnaires

&

Thank you very much for taking part in this study ☺

4

F.2 Participants Information

Ethics reference number: **ERGO**/FPSE/ **19364**	Version: 1	Date: 2016-02-25
Study Title: Enhancing E-learning by integrating knowledge management and social media		
Investigator: Edrees Alkinani (Eaa1g10@soton.ac.uk)		

Please read this information carefully before deciding to take part in this research. If you are happy to participate you will be asked to read consent information overleaf. Your participation is completely voluntary.

What is the research about? This is a research project that aims to improve teaching and learning situation by using knowledge management techniques and social media tools. The developed ontologically competences of specific topic may lead to better teaching performance in particular. The competence has a capability verb and subject matter content. Having main competence and sub competence in logical structure and order to reach specific point may enhance teaching performance instead of traditional competences.

Why have I been chosen? You have been approached because you are experienced in teaching undergraduate students in computing at universities.

What will happen to me if I take part? You will first be invited to attend a presentation by the researcher for 10 minutes only. Then you need to fill short questionnaires regarding teaching performance or effectiveness and using social media in educational environment in 10 minutes or so.

Are there any benefits in my taking part? It is expected that the study will add to current knowledge about using ontologically structured competences in teaching and learning. And then apply this new technique to your coming topic of teaching your students.

Are there any risks involved? There are no particular risks associated with your participation.

Will my data be confidential? Your answer to questionnaire will be anonymous. The study does not require any names of gender. The given rating scales to specific questions will be analysed without any indication to any person.

What happens if I change my mind? You may withdraw at any time and for any reason. You can leave the lecturer room at any time you wish.

What happens if something goes wrong? Should you have any concerns or complaint, if possible contact me (investigator e-mail: eaa1g10@ecs.soton.ac.uk).

F.3 Invitation Letter

Invitation letter for participants (academic teachers)

My name is Edrees Alkinani: I am a PhD student in Electronic and Computer Science at the University of Southampton. I am carrying out an experiment in order to evaluate ontologically structured competences in teaching situation. I would like to recruit volunteers for my experiment who do lecturing at universities and knowing the topic of Normalisation in Databases.

Aim of the experiment:

The aim of this experiment is to evaluate a new representative style of competences for teaching which is called ''Ontologically Structured Competences''. In teaching situation, the intended learning Outcomes or competences are giving as a list in course or module syllabus. There is no such structuring or guidance that tells the teacher how these competences should be performed. A new technique has been developed. This technique depends on ontology structure and defining of concepts. In this study, the competences of specific teaching topic will be developed ontologically. There will be a main competence which followed by sub and sub-sub competences. The whole competences of teaching a topic will be developed as a tree structure in such organise and order way. So, we would like to have your own evaluation as an academic teacher at universities of this new representative style of competences in teaching situation.

What is involved?

During the experiment, the following steps will be undertaken:

1- All participants (academic teachers) will be gathered in a lecturer room.
2- You will be given participants information if you have not had one.
3- You will be asked to read consent form information
4- You will be asked to leave the lecturer room if you are not happy to participate, otherwise stay where you are.
5- I will be giving a presentation about Structured Competences in teaching comparting with traditional Competences based on chosen topic (Normalisation).
6- You will be given questionnaires after the presentation is finished.
7- You will be asked to indicate your evaluation to given statements in questionnaires and answer some of general question about your teaching and using social media.
8- You will be asked to return your answers to the researcher and leave the lecturer room with thanks.

Date, time and venue:

Date: / / 2016 Time:

Venue:

How long is the experiment?

The presentation will take **10** minutes only. Filling questionnaires take also **10** minutes only.

What to do next?

If you are happy to participate, please read the participants information for further details and come along to pre-arranged venue.

F.4 Questionnaire for Second Experiment

Questions Related to Representative Styles of Competences

Using structured competences (style 2) when I teach a topic, instead of list of competences (style 1);	**Strongly disagree**	**Disagree**	**Neither agree nor disagree**	**Agree**	**Strongly agree**
will give me clearer goals in my teaching					
will give me a clear sequence in my teaching					
will enable me to determine at which level of knowledge I should start teaching					
will enable me to review regularly my students' acquired knowledge before moving to new points					
will enable me to deliver to my students subject matter that is better matched to competences					
will enable me to deliver to my students subject matter in great depth					
allows me to set assignments that link more directly to taught competences					
allows my students to obtain in good time feedback on their performance					
makes my teaching innovative					

Demographic questions regarding teaching experience

1) How long have you been teaching at the university?

……….. years

2) What is your position at the university?

Teaching Assistance	Lecturer	Assistance Professor	Associate Professor	Professor	Other (please specify)
□	□	□	□	□	……………

3) What subject area do you currently teach?

Computer Science	Information Technology	Information Systems	Education and Technology	Other (please specify)
□	□	□	□	……………

4) Do you have any suggestions for improving and modifying the structured competences (style 2)?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

F.5 Questionnaire for the Study Survey

If you have a Facebook account and familiar with Facebook groups, please continue answering questions

Statements	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A Facebook Group for my module allows me to increase interaction with my students about the topic in a less formal environment					
A Facebook Group increases the engagement with my course for my students					
A Facebook Group gives me an indication of students' difficulties with taught topics, especially when raising questions on specific points					
A Facebook Group encourages my students to conduct effective discussions					
A Facebook Group increases my students' motivation to learn					
A Facebook Group allows my students to pay more attention to the teaching topics					

Questions regarding your experience of using Facebook in teaching and learning

1) How often do you usually use social media tools to support your teaching?

Always	Often	Sometimes	Rarely	Never
□	□	□	□	□

2) What social media tools do you use in general?

- □ Facebook
- □ Twitter
- □ Google Plus
- □ LinkedIn
- □ Instagram
- □ Snapchat
- □ YouTube
- □ Periscope live
- □ Telegram
- □ WhatsApp
- □ Ask
- □ Other (please specify):
- □ Pinterest
- □ Tumblr
- □ VK
- □ Flickr
- □ Vine
- □ Kik
- □ Keek
- □ Reddit
- □ Scoop
- □ Meetup
- □ ClassMates

…………………………………………………………………………………………………
…………………………………………………………………………………………………

3) How often do you use Facebook in general?

Never	Once a month	Once a week	Once a day	five times a day	Almost continuously
◻	◻	◻	◻	◻	◻

4) Approximately, How many Facebook Groups have you joined for any purposes?

…………………………………………………

5) How often do you interact with joined Facebook Groups?

Never	Once a month	Once a week	Once a day	Five times a day	Almost continuously
◻	◻	◻	◻	◻	◻

6) How often do you use Facebook Groups for teaching purposes?

Never	Once a month	Once a week	Once a day	Seven times a day	Almost continuously
◻	◻	◻	◻	◻	◻

7) What tools do you use to interact with your students? You can choose more than one!

- ◻ Facebook
- ◻ Twitter
- ◻ Google Plus
- ◻ LinkedIn
- ◻ Instagram
- ◻ Snapchat
- ◻ YouTube
- ◻ Periscope live
- ◻ Telegram
- ◻ WhatsApp
- ◻ Ask
- ◻ Other (please specify):

- ◻ Pinterest
- ◻ Tumblr
- ◻ VK
- ◻ Flickr
- ◻ Vine
- ◻ Kik
- ◻ Keek
- ◻ Reddit
- ◻ Scoop
- ◻ Meetup
- ◻ ClassMates

……………………………………………………………………………………………………
……………………………………………………………………………………………………

8) If you already use a tool to interact with your students, what kind of interactions usually takes place between you and your students? You can choose more than one!

Events announcements	Teaching materials	Assignments	Other (Please specify)
◻	◻	◻	…………………………

Thank you very much for taking part in this study!

Appendix G

This appendix shows the analysis results for researcher marking the assignments compared to an independent marker

G.1 Marking for groups of both assignments by the researcher

Conditions					
APP Users			**Non-APP Users**		
Group Name	**Assignment**	**Groups Marks**	**Group Name**	**Assignment**	**Groups Marks**
A	NM	20	F	NM	9
	GW	20		GW	10
B	NM	19	G	NM	4.5
	GW	20		GW	7.5
C	NM	20	H	NM	3.5
	GW	20		GW	6
D	NM	10	I	NM	5
	GW	14		GW	14
E	NM	15.5	J	NM	20
	GW	18		GW	20

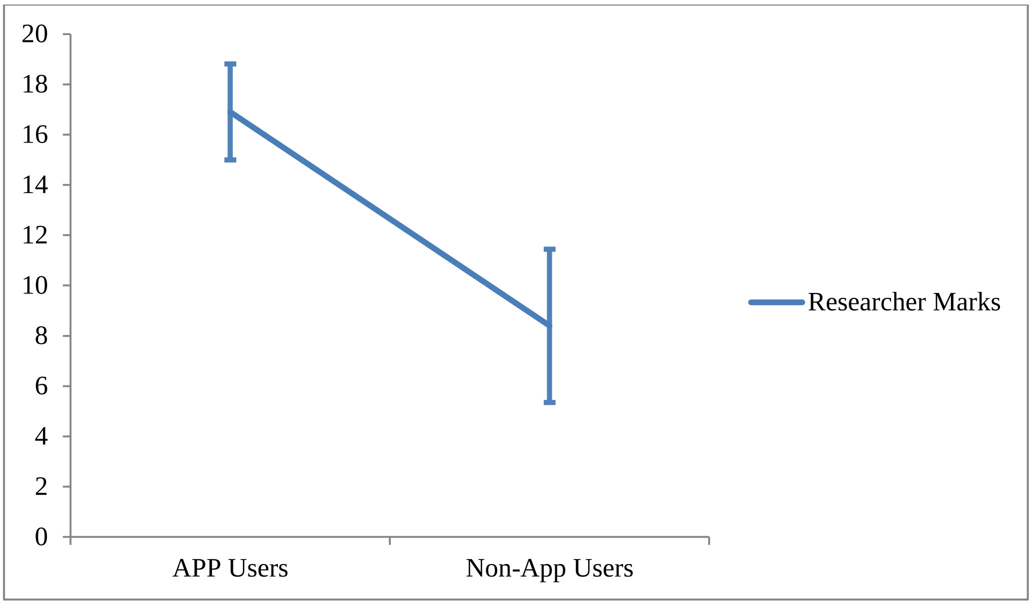
Mean and standard deviation with error of total marks based on researcher marking

Condition		N	Mean	Std. Deviation	Std. Error Mean
Normalisation Marks (NM)	App users	5	16.9	3.9	1.7
	Non-app users	5	8.4	5.6	2.5
Group Work Marks (GW)	App users	5	18.4	2.6	1.1
	Non-app users	5	11.5	5.8	2.5

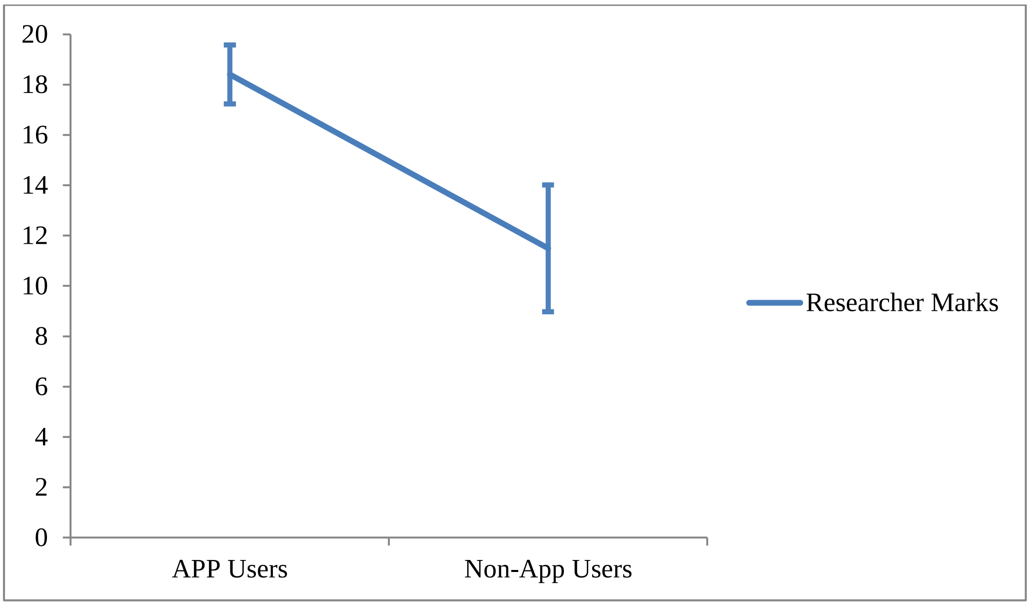
Independent sample t-test for equality of means and level of significance based on researcher marking

		t-test for Equality of Means				
		t	df	p	Mean Difference	Std. Error Difference
Normalisation Marks	Equal variances assumed	2.362	8	.046	8.5	3.6
Group Work Marks	Equal variances assumed	2.485	8	.038	7.2	2.8

Profile of mean for Normalisation assignment as total marks for groups in both conditions based on researcher marking

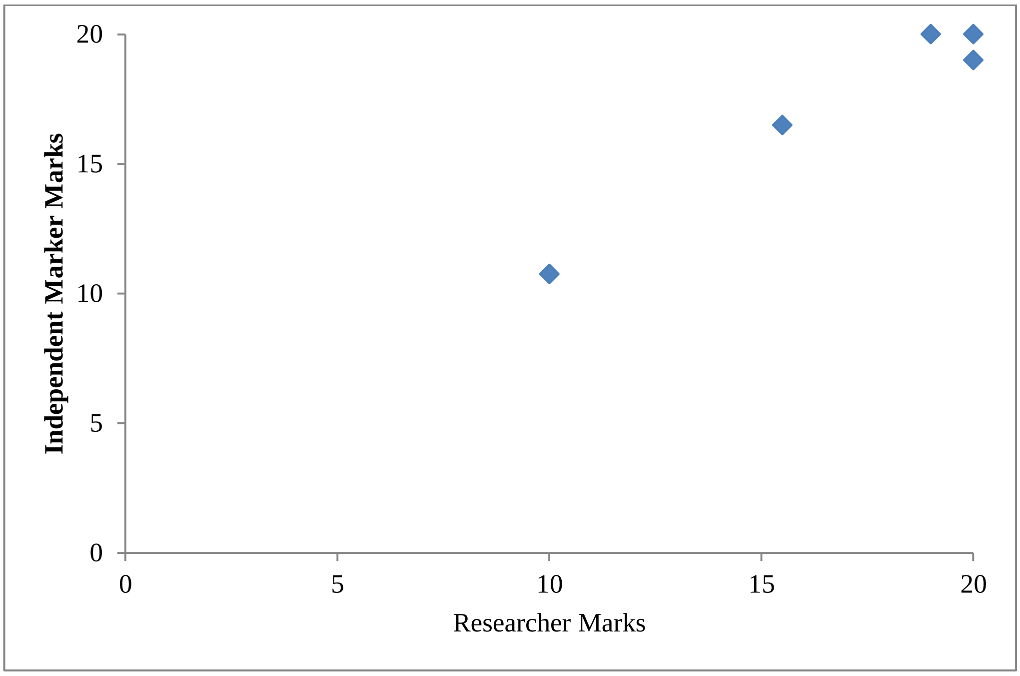


Profile of mean for Group Work assignment as total marks for groups in both conditions based on researcher marking

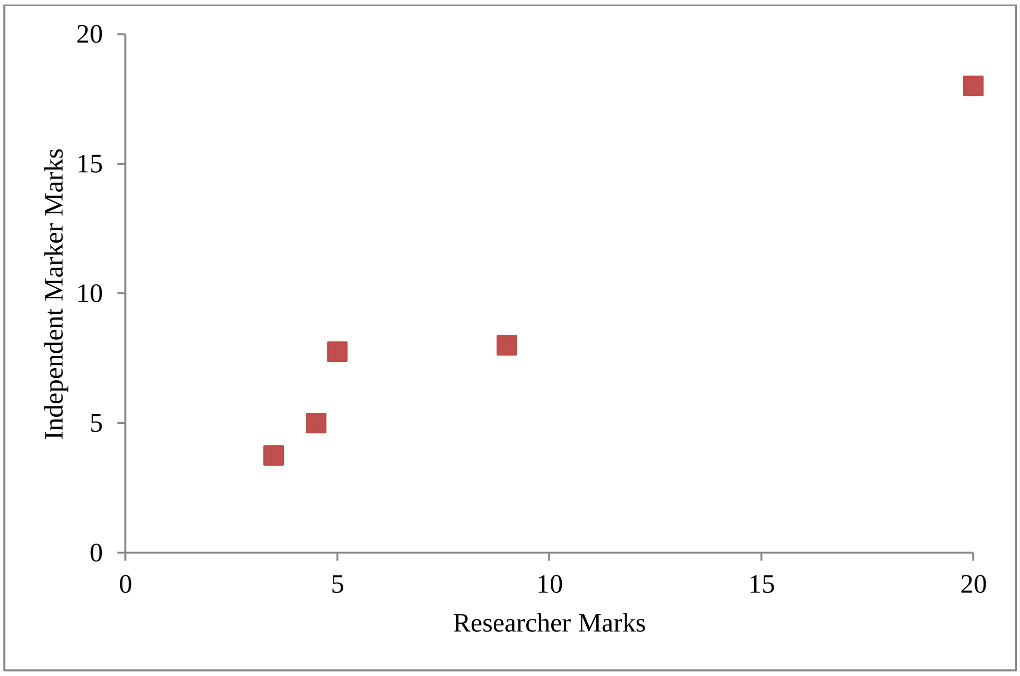


G.2 Correlation between researcher marks and independent marker marks

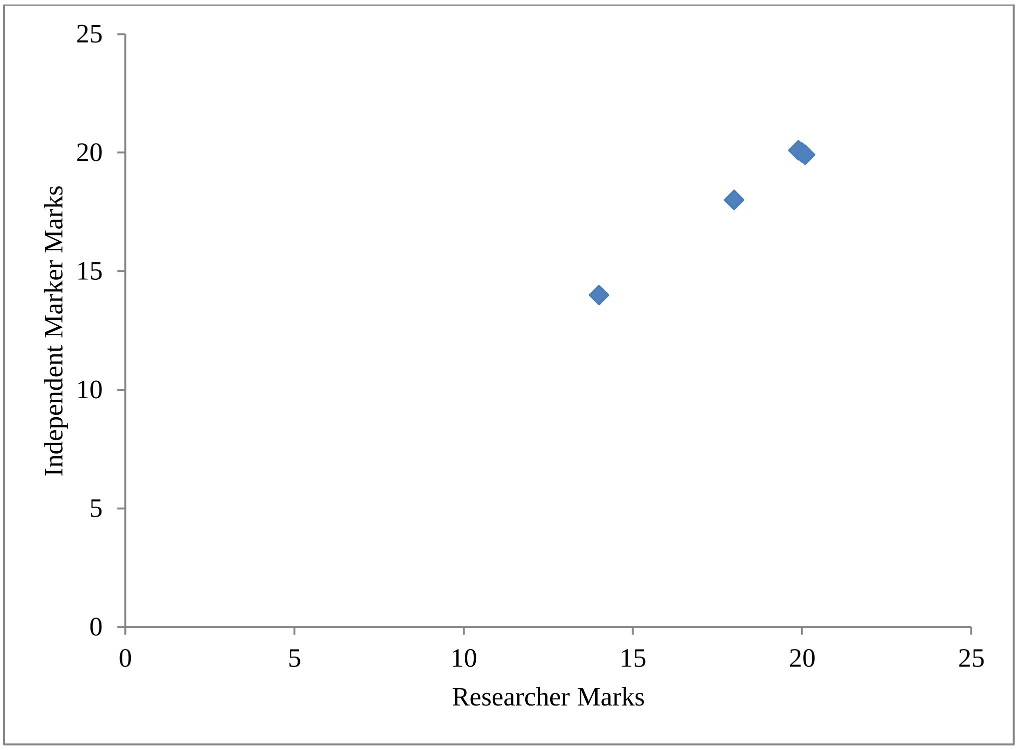
The scatter chart illustrating correlation between two individual markers when marking Normalisation assignment for Application users as groups



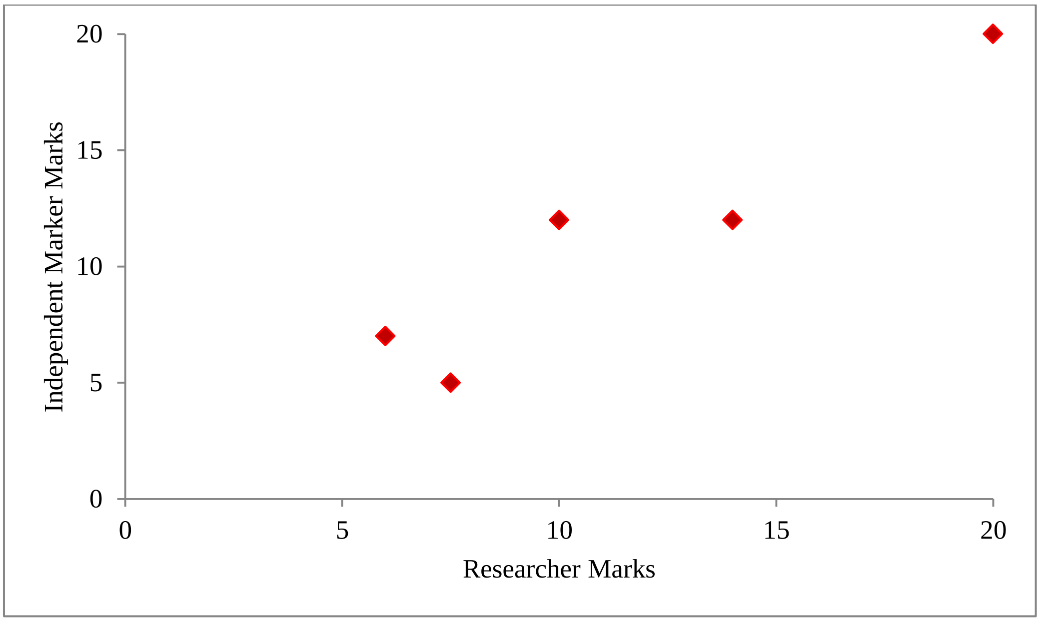
The scatter chart illustrating correlation between two individual markers when marking Normalisation assignment for Non-Application users as groups



The scatter chart illustrating correlation between two individual markers when marking Group Work assignment for Application users as groups



The scatter chart illustrating correlation between two individual markers when marking Group Work assignment for Non-Application users as groups



G.3 Each question's marks for the normalisation (NM) and group work (GW) assignments in each group under both conditions

Conditions							
App Users				Non-App Users			
Group Name	Assignment	Questions	Marks	Group Name	Assignment	Questions	Marks
A	NM	1	1	F	NM	1	1
		2	3			2	1.5
		3	5			3	0
		4	6			4	4
		5	5			5	1.5
	GW	1	3		GW	1	3
		2	2			2	2
		3	3			3	3
		4	6			4	1.5
		5	6			5	2.5
B	NM	1	1	G	NM	1	1
		2	3			2	1.5
		3	5			3	0
		4	6			4	2
		5	5			5	0.5
	GW	1	3		GW	1	3
		2	2			2	0.5
		3	3			3	0
		4	6			4	0
		5	6			5	1.5

Continued on next page

Conditions							
App Users				**Non-App Users**			
Group Name	**Assignment**	**Questions**	**Marks**	**Group Name**	**Assignment**	**Questions**	**Marks**
C	NM	1	1	H	NM	1	1
		2	3			2	1.5
		3	4			3	1.25
		4	6			4	0
		5	5			5	0
	GW	1	3		GW	1	3
		2	2			2	2
		3	3			3	0
		4	6			4	0
		5	6			5	2
D	NM	1	1	I	NM	1	1
		2	3			2	0
		3	1.25			3	1.25
		4	5.5			4	4
		5	0			5	1.5
	GW	1	3		GW	1	3
		2	2			2	2
		3	3			3	2
		4	6			4	5
		5	0			5	0
E	NM	1	1	J	NM	1	1
		2	3			2	3
		3	5			3	5
		4	4			4	5
		5	3.5			5	4
	GW	1	3		GW	1	3
		2	2			2	2
		3	3			3	3
		4	6			4	6
		5	4			5	6

G.4 The analysis of all individual variables for Normalisation evaluation

Mean and standard deviation of all dependent variables for evaluation of Normalisation competences

Variables	Condition	Mean	Std. Deviation	N
NM1	APP Users	4.64	.490	25
	Non-APP Users	2.80	.645	25
NM2	APP Users	4.6800	.47610	25
	Non-APP Users	1.7200	.61373	25
NM3	APP Users	4.6800	.47610	25
	Non-APP Users	1.8400	.62450	25
NM4	APP Users	4.6400	.48990	25
	Non-APP Users	1.7200	.61373	25
NM5	APP Users	4.4800	.58595	25
	Non-APP Users	1.8800	.66583	25
NM6	APP Users	4.5200	.58595	25
	Non-APP Users	1.7600	.66332	25
CM1	APP Users	4.6400	.48990	25
	Non-APP Users	1.7600	.59722	25
CM2	APP Users	4.6400	.48990	25
	Non-APP Users	1.7200	.61373	25
CM3	APP Users	4.6400	.48990	25
	Non-APP Users	1.7200	.61373	25
CM4	APP Users	4.6800	.47610	25
	Non-APP Users	1.7200	.61373	25
CM5	APP Users	4.6400	.48990	25
	Non-APP Users	1.7200	.61373	25
UM1	APP Users	4.4400	.65064	25
	Non-APP Users	2.0800	.70238	25
UM2	APP Users	3.8800	1.01325	25
	Non-APP Users	2.0000	.64550	25
UM3	APP Users	3.9200	.81240	25
	Non-APP Users	2.3600	.63770	25
UM4	APP Users	3.8000	.95743	25
	Non-APP Users	2.2800	.67823	25
UM5	APP Users	4.1600	.68799	25
	Non-APP Users	2.4800	.82260	25
AM1	APP Users	4.6400	.48990	25
	Non-APP Users	2.6400	.56862	25
AM2	APP Users	4.5600	.50662	25
	Non-APP Users	2.5200	.58595	25
AM3	APP Users	4.8000	.40825	25
	Non-APP Users	1.6800	.74833	25
AM4	APP Users	4.7600	.43589	25
	Non-APP Users	1.6400	.70000	25
AM5	APP Users	4.8000	.40825	25
	Non-APP Users	1.6400	.70000	25
AM6	APP Users	4.8000	.40825	25
	Non-APP Users	1.8800	.83267	25
AM7	APP Users	4.7600	.43589	25
	Non-APP Users	1.8800	.78102	25
AM8	APP Users	4.6400	.70000	25
	Non-APP Users	1.8400	.74610	25
AM9	APP Users	4.5600	.71181	25
	Non-APP Users	1.6800	.69041	25

G.5 The analysis of all individual variables for Group Work competences evaluation

Mean and standard deviation of all dependent variables for evaluation of Group Work competences

Variables	condition	Mean	Std. Deviation	N
NW1	APP Users	4.5600	.58310	25
	Non-APP Users	2.4000	1.04083	25
NW2	APP Users	4.6400	.48990	25
	Non-APP Users	1.6800	.69041	25
NW3	APP Users	4.6400	.48990	25
	Non-APP Users	1.6800	.69041	25
NW4	APP Users	4.6000	.50000	25
	Non-APP Users	1.6800	.69041	25
NW5	APP Users	4.6000	.50000	25
	Non-APP Users	1.6800	.69041	25
NW6	APP Users	4.6800	.47610	25
	Non-APP Users	1.6800	.69041	25
CW1	APP Users	4.6400	.48990	25
	Non-APP Users	1.7200	.67823	25
CW2	APP Users	4.6400	.48990	25
	Non-APP Users	1.7200	.67823	25
CW3	APP Users	4.6400	.48990	25
	Non-APP Users	1.6800	.69041	25
CW4	APP Users	4.6400	.48990	25
	Non-APP Users	1.6800	.69041	25
CW5	APP Users	4.6400	.48990	25
	Non-APP Users	1.6800	.69041	25
UW1	APP Users	4.4800	.65320	25
	Non-APP Users	2.1200	.72572	25
UW2	APP Users	4.0000	1.04083	25
	Non-APP Users	2.1600	.55377	25
UW3	APP Users	4.2800	.73711	25
	Non-APP Users	2.6400	.63770	25
UW4	APP Users	3.9600	.84063	25
	Non-APP Users	1.9600	.53852	25
UW5	APP Users	4.0800	.86217	25
	Non-APP Users	2.5600	.58310	25
AW1	APP Users	4.5200	.50990	25
	Non-APP Users	2.8400	.37417	25
AW2	APP Users	4.6400	.48990	25
	Non-APP Users	2.8400	.37417	25
AW3	APP Users	4.6800	.47610	25
	Non-APP Users	1.8800	.60000	25
AW4	APP Users	4.7200	.45826	25
	Non-APP Users	1.8400	.62450	25
AW5	APP Users	4.7600	.43589	25
	Non-APP Users	1.8400	.62450	25
AW6	APP Users	4.7600	.43589	25
	Non-APP Users	1.8400	.62450	25
AW7	APP Users	4.6800	.55678	25
	Non-APP Users	1.9200	.64031	25
AW8	APP Users	4.5600	.65064	25
	Non-APP Users	1.8400	.62450	25

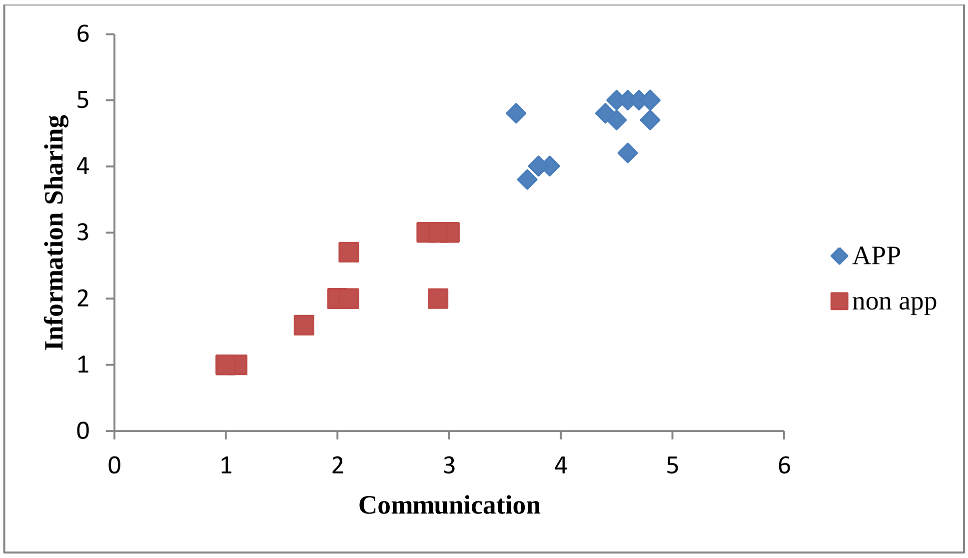
G.6 The analysis of all individual variables for actual groups collaborative working evaluation

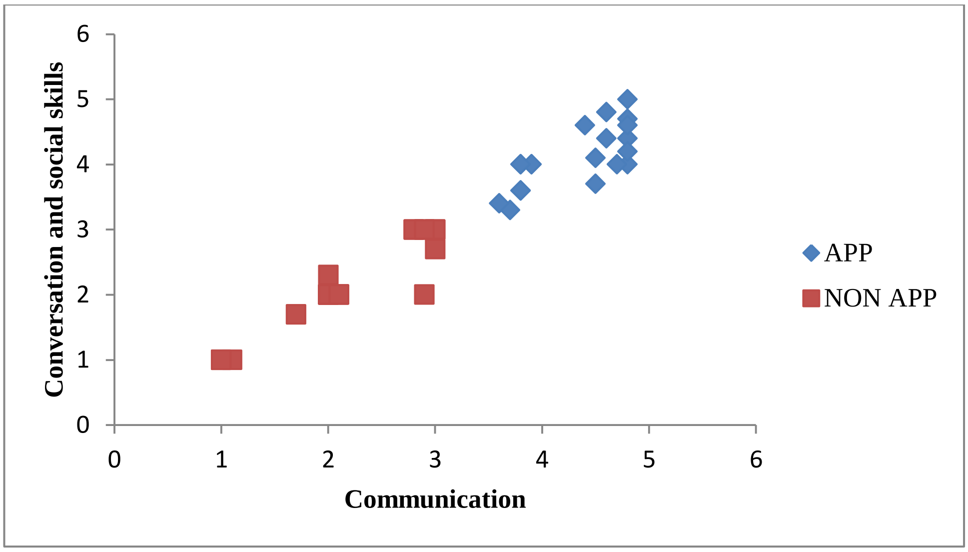
Mean and standard deviation of all dependent variables for evaluation of actual groups' collaborative working

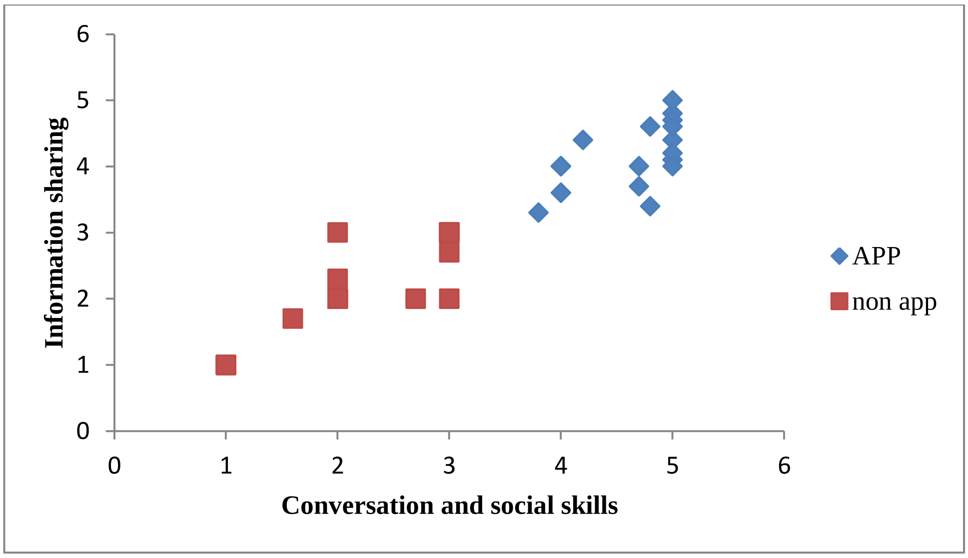
variable	Condition	Mean	Std. Deviation	N
CM1	APP Users	4.0000	1.25831	25
	Non-APP Users	2.4000	.91287	25
CM2	APP Users	3.9600	1.24097	25
	Non-APP Users	2.1600	.68799	25
CM3	APP Users	3.9200	1.22202	25
	Non-APP Users	2.1600	.68799	25
CM4	APP Users	4.0000	1.25831	25
	Non-APP Users	2.1200	.66583	25
CM5	APP Users	4.0400	1.24097	25
	Non-APP Users	2.1600	.68799	25
CM6	APP Users	3.9200	1.35154	25
	Non-APP Users	2.1600	.68799	25
CM7	APP Users	3.9200	1.32035	25
	Non-APP Users	2.2000	.81650	25
CM8	APP Users	3.9200	1.32035	25
	Non-APP Users	2.1200	.72572	25
CM9	APP Users	3.9200	1.32035	25
	Non-APP Users	2.1200	.72572	25
CM10	APP Users	3.8800	1.30128	25
	Non-APP Users	2.1200	.72572	25
CM11	APP Users	3.9200	1.32035	25
	Non-APP Users	2.1200	.72572	25
CM12	APP Users	3.8800	1.36382	25
	Non-APP Users	2.0800	.70238	25
CM13	APP Users	3.9200	1.35154	25
	Non-APP Users	2.1200	.72572	25
CM14	APP Users	3.8400	1.31276	25
	Non-APP Users	2.1200	.72572	25
CM15	APP Users	3.8000	1.32288	25
	Non-APP Users	2.2400	.77889	25
CM16	APP Users	4.2000	1.08012	25
	Non-APP Users	2.3200	.80208	25
CM17	APP Users	2.3200	.69041	25
	Non-APP Users	1.8800	.66583	25
IS1	APP Users	4.0800	1.11505	25
	Non-APP Users	2.2000	.70711	25
IS2	APP Users	4.0800	1.18743	25
	Non-APP Users	2.2000	.70711	25
IS3	APP Users	4.0400	1.27410	25
	Non-APP Users	2.1600	.68799	25
IS4	APP Users	4.0400	1.27410	25
	Non-APP Users	2.1200	.72572	25
IS5	APP Users	4.0400	1.27410	25
	Non-APP Users	2.1200	.72572	25
IS6	APP Users	4.0000	1.29099	25
	Non-APP Users	2.1200	.72572	25
IS7	APP Users	3.9600	1.24097	25

	Non-APP Users	2.0800	.70238	25
IS8	APP Users	3.9600	1.33791	25
	Non-APP Users	2.0800	.70238	25
CSK1	APP Users	3.9200	1.03763	25
	Non-APP Users	2.3200	.80208	25
CSK2	APP Users	4.0000	1.08012	25
	Non-APP Users	2.2000	.70711	25
CSK3	APP Users	3.9200	1.25565	25
	Non-APP Users	2.1600	.68799	25
CSK4	APP Users	3.4400	1.38684	25
	Non-APP Users	2.1200	.66583	25
CSK5	APP Users	3.2000	1.25831	25
	Non-APP Users	2.0400	.67577	25
CSK6	APP Users	3.2000	1.25831	25
	Non-APP Users	2.0400	.67577	25
CSK7	APP Users	3.5200	1.15902	25
	Non-APP Users	2.0800	.70238	25
CSK8	APP Users	3.8800	1.12990	25
	Non-APP Users	2.1200	.66583	25
CSK9	APP Users	3.8000	1.11803	25
	Non-APP Users	2.0800	.70238	25
CSK10	APP Users	3.8400	1.17898	25
	Non-APP Users	2.0400	.73485	25
CSK11	APP Users	3.8400	1.02794	25
	Non-APP Users	2.1200	.72572	25

G.7 Original scatter charts without dithering







G.8 The analysis of all individual variables for retrieved social information evaluation

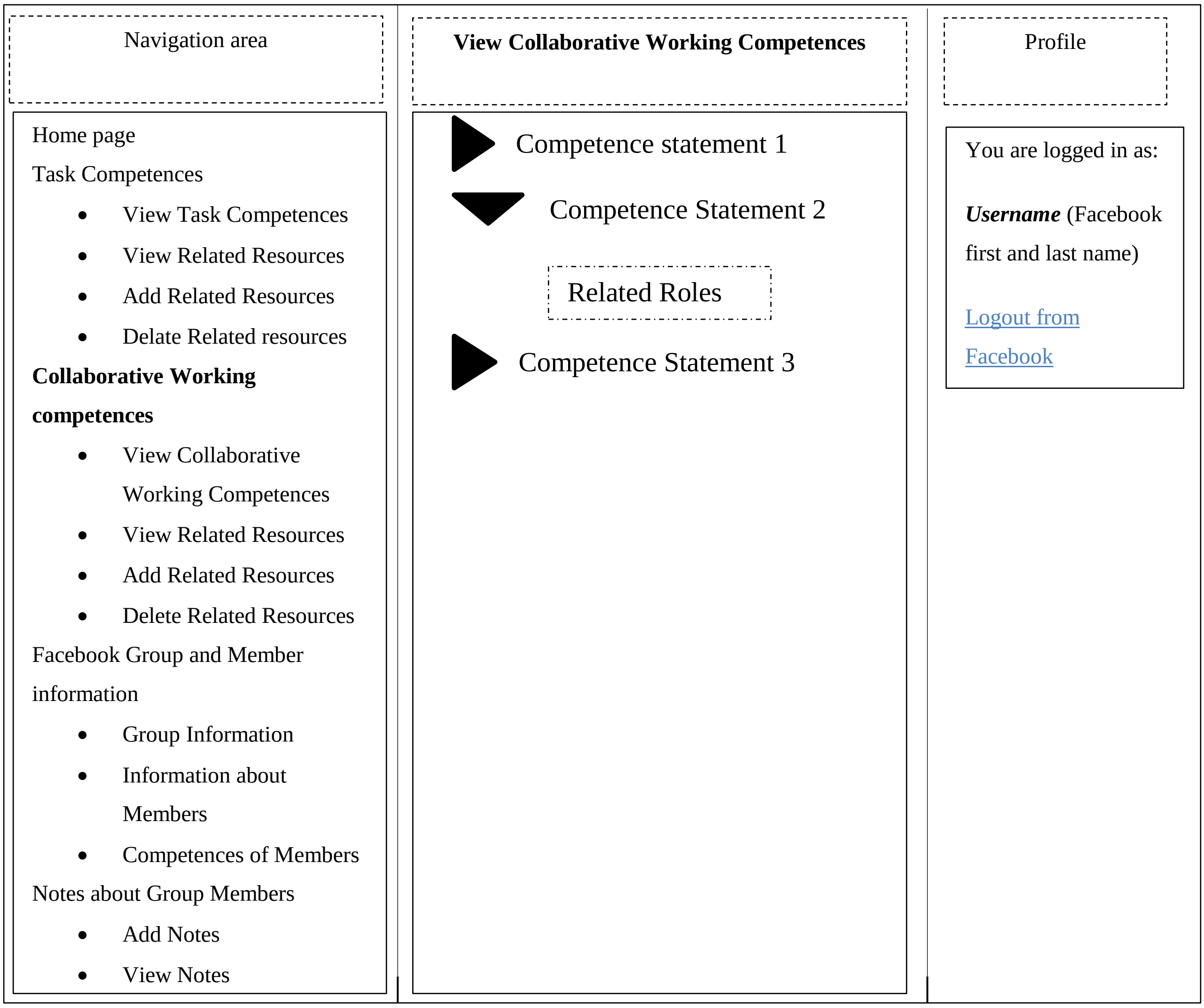
Mean and standard deviation of all dependent variables for evaluation of retrieved social information from students Facebook profiles

variables	condition	Mean	Std. Deviation	N
USI1	APP Users	2.4800	.77028	25
	Non-APP Users	1.4000	.50000	25
USI2	APP Users	1.7200	.45826	25
	Non-APP Users	1.4000	.50000	25
USI3	APP Users	3.6800	.74833	25
	Non-APP Users	1.4000	.50000	25
USI4	APP Users	1.6800	.47610	25
	Non-APP Users	1.4000	.50000	25
USI5	APP Users	1.4000	.50000	25
	Non-APP Users	1.4000	.50000	25
USI6	APP Users	4.8800	.33166	25
	Non-APP Users	4.6000	.50000	25
USI7	APP Users	1.6000	.57735	25
	Non-APP Users	1.4000	.50000	25
USI8	APP Users	1.6000	.57735	25
	Non-APP Users	1.4000	.50000	25
USI9	APP Users	3.8800	1.42361	25
	Non-APP Users	4.6000	.50000	25
USI10	APP Users	4.8000	.40825	25
	Non-APP Users	3.1200	.72572	25
USI11	APP Users	4.7600	.43589	25
	Non-APP Users	3.2000	.57735	25
EIS1	APP Users	4.8000	.40825	25
	Non-APP Users	1.4800	.77028	25
EIS2	APP Users	4.8400	.37417	25
	Non-APP Users	1.6800	.80208	25
EIS3	APP Users	4.8400	.37417	25
	Non-APP Users	1.8400	.74610	25
EIS4	APP Users	4.8400	.37417	25
	Non-APP Users	2.7600	1.16476	25
ATSK1	APP Users	4.8800	.33166	25
	Non-APP Users	2.4000	.81650	25
ATSK2	APP Users	4.9200	.27689	25
	Non-APP Users	2.2800	.73711	25
ATSK3	APP Users	5.0000	.00000	25
	Non-APP Users	1.4400	.65064	25
ATSK4	APP Users	4.9200	.27689	25
	Non-APP Users	2.8000	.57735	25
ATSK5	APP Users	5.0000	.00000	25
	Non-APP Users	2.7600	.59722	25
ATSK6	APP Users	5.0000	.00000	25
	Non-APP Users	2.6800	.62716	25
ATSK7	APP Users	4.2800	1.10000	25
	Non-APP Users	3.0800	.70238	25
ATSK8	APP Users	4.6000	.70711	25
	Non-APP Users	1.3600	.70000	25

Appendix H Storyboard and Implementation screen shots

This appendix shows some users interfaces and implantation screen shots of SMC application.

H.1 Design of Collaborative working interfaces



Page for exploring and viewing collaborative working competences which come from ontology database of collaborative working. The page allows students to explore a number of ontologically collaborative working competences with related roles for each competence, as structured in Figure 4-11. The page presents the ontologically competences in a tree structure to facilitate the navigation and consistency among competences and easy access to related roles.

Navigation area

Home page

Task Competences

- View Task Competences
- View Related Resources
- Add Related Resources
- Delate Related resources

Collaborative Working competences

- View Collaborative Working Competences
- View Related Resources
- Add Related Resources
- Delete Related Resources

Facebook Group and Member information

- Group Information
- Information about Members
- Competences of Members

Notes about Group Members

- Add Notes
- View Notes

View Related Resources to Collaborative Working Competences

Select a collaborative Working competence from drop down list and click 'View Resources' to view resource link

View added Resources

Resource added for '' ***Competence statement*** '' by **Username** on ***Date***, ***Time***
http:// (*a Link*)

Resource added for '' ***Competence statement*** '' by ***Username*** on ***Date***, ***Time***
http:// (*a Link*)

Resource added for '' ***Competence statement*** '' by **Username** on ***Date***, ***Time***
http:// (*a Link*)

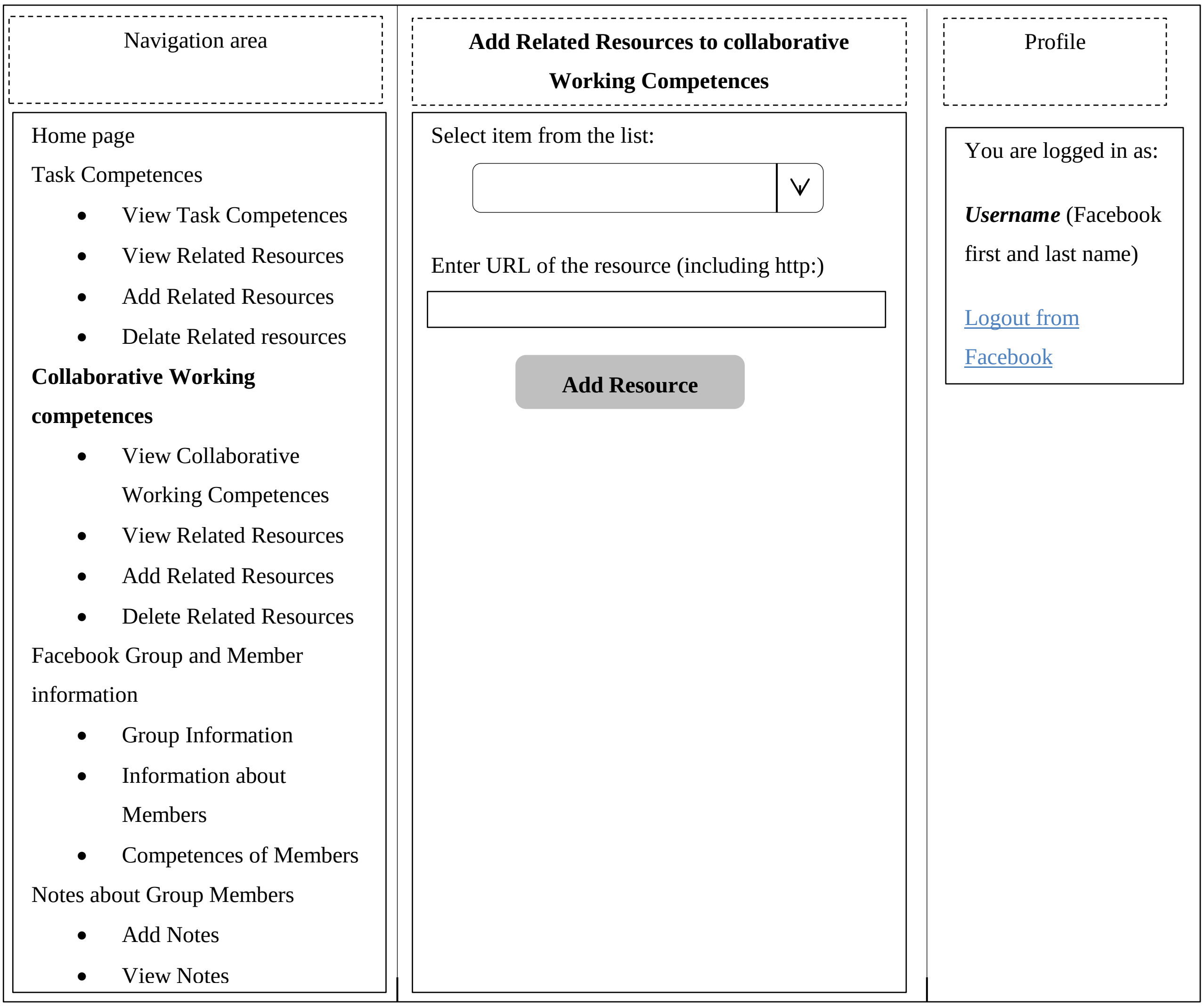
Profile

You are logged in as:

Username (Facebook first and last name)

Logout from Facebook

Page for finding resources related to specific collaborative working competence, with mention of who added the resources and when. All competences in the ontology, as described in Figure 4-11, will be generated in drop-down list. Students can find additional resources for a specific collaborative working competence for further explanation, understanding or behaviouring. In addition, there will be mention of who added the resources, with the date and time. All resources will be ontologically tagged with related collaborative working competence in order to facilitate future searches or generate a list of the structured resources.



Page for tagging resources with related collaborative working competences in a task competence ontology database. The page gives students or the teacher the ability to tag any useful resources with a specific collaborative working competence. This is achieved by selecting a collaborative working competence from a drop-down list, then entering a resource as a URL link. This will be saved in an ontology database for a specific collaborative working competence, with mention of who added it, the date and time.

Navigation area

Home page

Task Competences

- View Task Competences
- View Related Resources
- Add Related Resources
- Delate Related resources

Collaborative Working competences

- View Collaborative Working Competences
- View Related Resources
- Add Related Resources
- Delete Related Resources

Facebook Group and Member information

- Group Information
- Information about Members
- Competences of Members

Notes about Group Members

- Add Notes
- View Notes

Delete Related Resources of collaborative Working Competences

Select a competence from drop down list and click 'View Resources' to view added resources links and then delete your own added resources

View Resources

Resource added for '' ***Competence statement*** '' by **Username** on ***Date***, ***Time***

http:// (*a Link*)

Delete This Resource

Resource added for '' ***Competence statement*** '' by ***Username*** on ***Date***, ***Time***

http:// (*a Link*)

Resource added for '' ***Competence statement*** '' by **Username** on ***Date***, ***Time***

http:// (*a Link*)

Delete This Resource

Profile

You are logged in as:

Username (Facebook first and last name)

Logout from Facebook

Page for deleting own added resources for a collaborative working competences of collaborative working competence ontology. The page allows students to delete any resources that they added. After selecting a collaborative working competence from a drop-down list, the application will generate all related resources for that collaborative working competence. Only their own added resources will have the option to be deleted.

H.2 Implementation Screen Shots

This appendix shows the implementation screen shots of collaborative working ontology of SMC application

```xml
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:ccm="http://www.cmodel.com/cwc/elements/">


<rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/CollaborativeWorkingCompetence">


        <ccm:hasCWCCategory>
        <rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/comp/Planning">

            <ccm:cwccTitle>"Planning"</ccm:cwccTitle>
            <ccm:cwccExplanation>A student will be able to lead and manage the group</ccm:cwccExplanation>

            <ccm:hasCWCompetence>Draw directions to accomplish task successfully</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Listen to members and rise discussions</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Deal with persuasion</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Remind Other to use collaborative skills</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Respond to failure</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Building and maintaining trust with members</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Resolve conflicts</ccm:hasCWCompetence>
            <ccm:hasCWCompetence>Ask for feedback from members and share it in order to perform the task</ccm:hasCWCompetence>
        </rdf:Description>
        </ccm:hasCWCCategory>



        <ccm:hasCWCCategory>
        <rdf:Description rdf:about="http://www.cmodel.com/cwc/elements/comp/Negotiation">
                <ccm:cwccTitle>"Negotiation"</ccm:cwccTitle>
                <ccm:cwccExplanation>A student will be able to plan</ccm:cwccExplanation>

                <ccm:hasCWCompetence>assign tasks between members including (leader, planner and negotiator) </ccm:hasCWCompetence>
                <ccm:hasCWCompetence>Accurately estimate time and effort required to complete a task</ccm:hasCWCompetence>
                <ccm:hasCWCompetence>track the progress of the group</ccm:hasCWCompetence>
                <ccm:hasCWCompetence>Maintain adequate preparation time for scheduled meetings/deadlines</ccm:hasCWCompetence>
                <ccm:hasCWCompetence>Ensure completing given task</ccm:hasCWCompetence>
                <ccm:hasCWCompetence>Summarising and reporting the progress</ccm:hasCWCompetence>
                <ccm:hasCWCompetence>Notify others for changes or any problem in timely manner</ccm:hasCWCompetence>



        </rdf:Description>
        </ccm:hasCWCCategory>
```

Sample fragment of RDF code for building the collaborative working competence ontology

```
<%@ page language="java" contentType="text/html; charset=ISO-8859-1"
    pageEncoding="ISO-8859-1"%>
<!DOCTYPE html>
<%@ page import="java.io.PrintWriter" %>
<%@ page import = "com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import=" com.hp.hpl.jena.rdf.model.ModelFactory" %>

<%@ page import="java.io.IOException" %>
<%@ page import="java.io.InputStream" %>
<%@ page import="java.io.*"%>
<%@ page import="java.io.PrintWriter"%>
<%@ page import="javax.servlet.ServletContext"%>


<%@ page import="javax.servlet.ServletException"%>
<%@ page import="javax.servlet.http.HttpServlet"%>
<%@ page import="javax.servlet.http.HttpServletRequest"%>
<%@ page import="javax.servlet.http.HttpServletResponse"%>

<%@ page import="com.hp.hpl.jena.query.Query"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecution"%>
<%@ page import="com.hp.hpl.jena.query.QueryExecutionFactory"%>
<%@ page import="com.hp.hpl.jena.query.QueryFactory"%>
<%@ page import="com.hp.hpl.jena.query.QuerySolution"%>
<%@ page import="com.hp.hpl.jena.query.ResultSet"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Literal"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Resource"%>
<%@ page import="com.hp.hpl.jena.rdf.model.Model"%>
<%@ page import="com.hp.hpl.jena.rdf.model.ModelFactory"%>
<%@ page import="com.hp.hpl.jena.util.FileManager"%>
```

Sample fragment of programming code to set Java and Jena in order to extract data from the collaborative working ontology

```
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=ISO-8859-1">
<title>ILOs Application</title>
</head>
    <script src="http://connect.facebook.net/en_US/all.js"></script>
    <script type="text/javascript">
        function logoutFacebook() {
          FB.init({
            appId:'242427255928014', cookie:true,
            status:true, xfbml:true
          });
          FB.logout(function() {
            // Reload the same page after logout
            // window.location.reload();
            // Or uncomment the following line to redirect
            window.location = "index.jsp";
          });
        }
      </script>

<body>
<center>
    <h1>Intended Learning Outcomes (ILOs) Application</h1>
</center>
<%
String AccUserName = (String)session.getAttribute("sessionUserName");
if ( AccUserName == null )
    response.sendRedirect("http://alkinani.ecs.soton.ac.uk:8080/");
```

Sample fragment of programming code to authorise sign in before generating ontological collaborative working competences

```
String fileName=getServletContext().getRealPath("gcmodel.rdf");

    Query  qry,qry2;
    QueryExecution qe,qe2;
    ResultSet rs,rs2;
    Literal cwccTitle;
    Literal cwccExp, cwComp;
    QuerySolution soln,soln2;
    Resource r;
    Resource c2;
    String queryString,queryString2;

    File f = new File(fileName);
    InputStream in = new FileInputStream(f);
    if ( in == null )
    { throw new IllegalArgumentException("File is not found" );
    }
       //else {  outt.println(" File successfully openned\n");  }

    Model model = ModelFactory.createDefaultModel();
    model.read(in,null);

    queryString =           "PREFIX dc:<http://purl.org/dc/elements/1.1/> "+
                            "PREFIX rdf:<http://www.w3.org/1999/02/22-rdf-syntax-ns#> "+
                            "PREFIX gcm:<http://www.cmodel.com/cwc/elements/> "+
                            "SELECT DISTINCT ?cwccTitle ?cwccExp WHERE { "+
                                "?CWC gcm:hasCWCCategory ?CWCCat. "+
                                "?CWCCat gcm:cwccTitle ?cwccTitle. "+
                                "?CWCCat gcm:cwccExplanation ?cwccExp. "+
                            " } ";
```

Sample fragment of programming code for extracting data from collaborative working ontology via a SPARQL query

List of references

Alavi, M., & Leidner, D. E. (1999). Knowledge management systems: issues, challenges, and benefits. *Communications of the AIS*, *1*(February), 1–37.

Alexander, B. B. (2006). Web 2.0: A New Wave of Innovation for Teaching and Learning? *Educause Review*, *41*(2), 33–44.

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. ., Mayer, R. E., & Pintrich, P., R. (2000). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives* (abridged e.). Columbus, OH: Allyn & Bacon.

Avram, G. (2006). At the Crossroads of Knowledge Management and Social Software. *The Electronic Journal of Knowledge Management*, *4*(1), 1–10.

Baird, D. E., & Fisher, M. (2005). NEOMILLENNIAL USER EXPERIENCE DESIGN STRATEGIES : UTILIZING SOCIAL NETWORKING MEDIA TO SUPPORT " ALWAYS ON " LEARNING STYLES. *Journal of Educational Technology Systems*, *34*(1), 5–32.

Beckett, D., & McBride, B. (2004). RDF/XML Syntax Specification (Revised). *W3C Recommendation*, (10). Retrieved from http://www.w3.org/TR/2003/WD-rdf-syntax-grammar-20031010/

Beetham, H., & Sharpe, R. (2013). *An Introduction to Rethinking Pedagogy*. *Rethinking Pedagogy for a Digital Age: Designing for 21st Century Learning* (Second Edi.). New York, USA: Routledge Taylor and Francis Group.

Benjamins, V. R., & Fensel, D. (1998). Knowledge Management through Ontologies, 1–12.

Berners-lee, T. (1998). Why RDF model is different from the XML model. Retrieved May 19, 2016, from https://www.w3.org/DesignIssues/RDF-XML.html

Bhatt, G. D. (2001). Knowledge management in organizations: examining the interaction between technologies, techniques, and people. *Journal of Knowledge Management*, *5*(1), 68–75.

Biggs, J. (2003). *Aligning teaching and assessing to course objectives. Teaching and Learning in Higher Education: New Trends and Innovations*. April, University of Aveiro.

Biggs, J., & Tang, C. (2011). *Teaching for Quality Learning at University*. McGraw-Hill International.

Bloom, B. S. (1956). *Taxonomy of educational objectives*. *New York: David McKay* (Vol. 1).

Bodner, G., & Klobuchar, M. (2001). The many forms of constructivism. *Journal of Chemical Education, 78, 1107*.

Bosch, T. E., Preez, A., & Michell, L. (2009). Using online social networking for teaching and learning: Facebook use at the University of Cape Town. *Comunication: South African Journal for Communication Theory and Research*, *35*(2), 185–200.

Boulton, J. (2002). Web-Based Distance Education : Pedagogy , Epistemology , and Instructional Design. *Educational Communications and Technology*, 29. Retrieved from http://etad.usask.ca/802papers/boulton/boulton.pdf

Boulos, M. N., Maramba, I., & Wheeler, S. (2006). Wikis, blogs and podcasts: A new generation of Web-based tools for virtual collaborative clinical practice and education. *BMC Medical Education*, *6*(1), 41.

Brady, K. P., Holcomb, L. B., & Smith, B. V. (2010). The Use of Alternative Social Networking Sites in Higher Educational Settings : A Case Study of the E-Learning Benefits of Ning in Education. *Journal of Interactive Online Learning*, *9*(2), 151–170.

Bray, T., Hollander, D., Layman, A., Tobin, R., & Thompson, H. S. (2009). Namespaces in XML 1.0 (Third Edition). *W3C*. Retrieved May 19, 2016, from http://www.w3.org/TR/2009/REC-xml-names-20091208/

Bray, T., & Paoli, J. (1999). Extensible Markup Language (XML) 1.0 W3C Recommendation. *W3C*.

Brewster, C., Ciravegna, F., Wilks, Y., Court, R., & Street, P. (2002). User-Centred Ontology Learning for Knowledge Management Building Ontologies for Knowledge Management.

Bruner, J.S., 1966. *Toward a theory of instruction* (Vol. 59). Harvard University Press.

Carlson, D. (2001). *Modeling XML applications with UML: practical e-business applications*. Redwood City, CA, USA: Addison Wesley Longman Publishing Co.

Cheetham, G., & Chivers, G. (2005). Professions, competence and informal learning. *Journal of Interprofessional Care*, *20*(5), 569–570.

CLARK, J. (1999). XSL Transformations (XSLT) Version 1.0. *World Wide Web Consortium (W3C)*. Retrieved from http://www.w3.org/TR/xslt

Clark, J., & DeRose, S. (1999). XML path language (XPath) version 1.0. *W3C Recommendation*, 1–37.

Cole, M. (2009). Using Wiki technology to support student engagement: Lessons from the trenches. *Computers & Education*, *52*(1), 141–146.

Conole, G., 2008. The role of mediating artefacts in learning design.*Handbook of research on learning design and learning objects: Issues, applications and technologies*, pp.108-208.

Conole, G., Dyke, M., Oliver, M. and Seale, J., 2004. Mapping pedagogy and tools for effective learning design. *Computers & Education*, *43*(1), pp.17-33.

Cranefield, S., & Purvis, M. (2001). Generating Ontology-Specific Content Languages Stephen Cranefield Martin Purvis. In *In Proceedings of the Workshop on Ontologies in Agent Systems, 5th International Conference on Autonomous Agents* (pp. 29–35).

Curricula, C. (2001). Computer Science, Final Report, The Joint Task Force on Computing Curricula. *IEEE Computer Society and Association for Computing Machinery, IEEE Computer Society*.

Curtis, D. D., & Lawson, M. J. (2001). Exploring collaborative online learning. *Journal of Asynchronous Learning Networks*, *5*(1), 21–34.

Dabbagh, N., & Kitsantas, A. (2012). Personal Learning Environments, social media, and self-regulated learning: A natural formula for connecting formal and informal learning. *The Internet and Higher Education*, *15*(1), 3–8.

Dalton, J., & Smith, D. (1986). *Extending children ' s special abilities : strategies for primary classrooms*. Melbourne, Australia: Ministry of Education.

De Coi, J. L., Herder, E., Koesling, A., Lofi, C., Olmedilla, D., Papapetrou, O., & Siberski, W. (2007). A model for competence gap analysis. In *In Proceedings of 3rd International Conference in WEB Information Systems and technology* . Barcelona, Spain.

De Jarnett, L. (1996). Knowledge the latest thing. *Information Strategy The Executives Journal*, *12*(2), 3–5.

Dillenbourg, P. (1999). What do you mean by ' collaborative learning '? In *Collaborative learning Cognitive and computational approaches* (pp. 1–19). Oxford: Elsevier.

Engelbrecht, E. (2003). A look at e-learning models: investigating their value for developing an e-learning strategy. *Progressio*, *25*(2), 38–47.

Eraut, M. (1994). *developing professional knowledge and competence*. London: Falmer Press.

Facebook-Developer. (2016). Graph API version. Retrieved May 27, 2016, from https://developers.facebook.com/docs/graph-api/reference/v2.6/group

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–91.

Fayzrahmanov, R. R., Göbel, M. C., Holzinger, W., Krüpl, B., & Baumgartner, R. (2010). A unified ontology-based web page model for improving accessibility. In *In Proceedings of the 19th international conference on World wide web* (pp. 1087–1088).

Fischer, G., Ostwald, J., & Santayana, G. (2001). Knowledge Management : Problems , Promises , Realities , and challenges. *Intelligent Systems, IEEE*, *16*(1), 60–72.

Fisher, M., & Baird, D. E. (2005). Online learning design that fosters student support, self-regulation, and retention. *Campus-Wide Information Systems*, *22*(2), 88–107.

Friesen, N., & Anderson, T. (2004). Interaction for lifelong learning. *British Journal of Educational Technology*, *35*(6), 679–687.

Gagne, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2004). *Principle of Instructional Design* (5th Editio.). Belmont, CA: Thompson Wadsworth.

Gilbert, L., & Gale, V. (2007). *Principles of E-learning Systems Engineering.* Oxford: Chandos.

Gilbert, L., Sim, Y. W., & Wang, C. (2005). Modelling the learning transaction. *Proceedings - 5th IEEE International Conference on Advanced Learning Technologies, ICALT 2005, Kaohsiung, Taiwan*, 615–616.

Gómez-Pérez, A. (2004). *Ontology Evaluation*. *Handbook on Ontologies* (Vol. 16). doi:10.1007/978-3-540-92673-3

Govindasamy, T. (2002). Successful implementation of e-Learning Pedagogical considerations. *The Internet and Higher Education*, *4*(3), 287–299.

Grace, T. P. L. (2009). Wikis as a knowledge management tool. *Journal of Knowledge Management*, *13*(4), 64–74.

Gruber, T. R. (1993). A Translation Approach to Portable Ontology Specifications. *Knowledge Acquisition-Special Issue: Current Issue in Knowledge Modelling*, *5*(2), 199–220.

Gunawardena, C., Hermans, M. B., Sanchez, D., Richmond, C., Bohley, M., & Tuttle, R. (2009). A theoretical framework for building online communities of practice with social networking tools. *Educational Media International*, *46*(1), 3–16.

Gupta, B., Iyer, L. S., & Aronson, J. E. (2000). Knowledge management: practices and challenges. *Industrial Management & Data Systems, 100*(1), 17–21.

Halpin, H., Hawke, S., Herman, I., Prudhommeaux, E., Raggett, D., & Swick, R. (2009). W3C semantic web Activity. In *W3C Sematic Web, http://www. w3. org/2001/sw*.

Healey, P. (1992). Planning through debate: the communicative turn in planning theory. *Town Planning Review*, *63*(2), 143.

Hemmi, a., Bayne, S., & Land, R. (2009). The appropriation and repurposing of social technologies in higher education. *Journal of Computer Assisted Learning*, *25*(1), 19–30.

Hoffman, E. S. (2009). Evaluating Social Networking Tools for Distance Learning. In *In Technology, Colleges and Community (TCC) Worldwide Online Conference* (pp. 92–100).

Horridge, M., Knublauch, H., Rector, A., Stevens, R., & Wroe, C. (2004). A Practical Guide To Building OWL Ontologies Using The Protégé-OWL Plugin and CO-ODE Tools Edition 1.0. *The University Of Manchester*.

Horridge, M., Knublauch, H., Rector, A., Stevens, R., Wroe, C., Jupp, S., … Drummond, N. (2009). Chapter 1.

IEEE. (2012). Creating Learning Technology Standard. *IEEE Learning Technology Standards Committee*. Retrieved May 16, 2016, from http://grouper.ieee.org/groups/ltsc/wg12/

Ioannides, D. (2000). XML and electronic publishing XML schema languages : beyond DTD. *Library Hi Tech*, *18*(1), 9–15.

Isotani, S., Inaba, A., Ikeda, M., & Mizoguchi, R. (2009). An ontology engineering approach to the realization of theory-driven group formation. *International Journal of Computer-Supported Collaborative Learning*, *4*(4), 445–478.

Jameson, J., Ferrell, G., Kelly, J., Walker, S., & Ryan, M. (2006). Building trust and shared knowledge in communities of e-learning practice: collaborative leadership in the JISC eLISA and CAMEL lifelong learning projects. *British Journal of Educational Technology*, *37*(6), 949–967.

Johnson, D. W., & Johnson, R. T. (1990). Social Skills for Successful Group Work. *Educational Leadership*, *47*(4), 29–34.

Johnson, D. W., & Johnson, R. T. (1996). *Cooperation and the use of technology*. *Handbook of* *research for educational communications and technology: A project of the Association for Educational Communications and Technology, (pp. 1017-1044)*. New York.

Johnson, G. M. (2004). constructive remediation: Correction in Context. *International Journal of Special Education*, *19*(1), 72–88.

Johnson, G. M. (2009). Instructionism and Constructivism: Reconciling Two Very Good Ideas. *International Journal of Special Education*, *24*(3), 90–98.

Jonassen, D. H., Tessmer, M., & Hannum, W. H. (1998). *Task analysis methods for instructional design*. Mahwah, New Jersey, Lawrence Erlbaum Associates, Inc., Publishers.

Kabilan, M. K., Ahmad, N., & Abidin, M. J. Z. (2010). Facebook: An online environment for learning of English in institutions of higher education? *Internet and Higher Education*, *13*(4), 179–187.

Kahiigi, E. K., Ekenberg, L., Hansson, H., & Tusubira, F. F. (2007). Exploring the e-Learning State of Art. In *In Conference on E-learning, Academic Conferences Limited* (Vol. 6, pp. 349–368).

Kane, K., Robinson-Combre, J., & Berge, Z. L. (2010). Tapping into social networking:: Collaborating enhances both knowledge management and e-learning. *Vine*, *40*(1), 62–70.

Kaplan, A. M., & Haenlein, M. (2010). Users of the world, unite! The challenges and opportunities of Social Media. *Business Horizons*, *53*(1), 59–68.

Kohlhase, M. (2000). OMDOC: Towards an Internet Standard for the Administration, Distribution, and Teaching of Mathematical Knowledge. In *In Artificial Intelligence and Symbolic Computation* (pp. 32–52). Springer Berlin Heidelberg.

Krathwohl, D. R. (1964). *taxonomy of educational objectives*. *Book 2, Affective domain.* London: Longman.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: A review of the research. *Computers in Human Behavior*, *19*(3), 335–353.

Lau, A., & Tsui, E. (2009). Knowledge management perspective on e-learning effectiveness. *Knowledge-Based Systems*, *22*(4), 324–325.

Laurillard, D. (1993). Rethinking university teaching: A framework for the effective use of educational technologies. *Routledge*.

Lee, M. J. W., & McLoughlin, C. (2011). *Web 2.0-Based E-learning :Applying Social Informatics for Tertiary Teaching*. Hershey. New York: Information Science Reference.

Levesque, H. J. (1986). Knowledge Representation and Reasoning. *Annual Review of Computer Science*, *1*(1), 255–287.

Levy, M. (2009). WEB 2.0 implications on knowledge management. *Journal of Knowledge Management*, *13*(1), 120–134.

Lytras, M. D., Naeve, A., & Pouloudi, A. (2005). A Knowledge Management Roadmap for E-Learning: The Way Ahead. *International Journal of Distance Education Technologies*, *3*(2), 68–75.

Macdonald, R. (1999). Specifying aims and learning outcomes. Open University Press.

Mager, R. F. (1997). Preparing Instructional Objectives. *A Critical Tool in the Development of Effective Instruction (3rd Ed.). Atlanta, GA: The Center for Effective Performance.*

Manca, S., & Ranieri, M. (2013). Is it a tool suitable for learning? A critical review of the literature on Facebook as a technology-enhanced learning environment. *Journal of Computer Assisted Learning*, *29*(6), 487–504.

Marshall, B., Zhang, Y., Chen, H., Lally, A., Shen, R., Fox, E., & Cassel, L. N. (2003). Convergence of Knowledge Management and E-Learning: the GetSmart Experience. In *Proceedings of the ACM/IEEE Joint Conference on Digital Libraries* (Vol. 2003-Janua, pp. 135–146). Houston.

Martensson, M. (2000). A critical review of knowledge management as a management tool. *Journal of Knowledge Management*, *4*(3), 204–216.

McAndrew, P., Goodyear, P. and Dalziel, J., 2006. Patterns, designs and activities: unifying descriptions of learning structures. *International Journal of Learning Technology*, *2*(2-3), pp.216-242.

McAdam, R., & McCreedy, S. (1999). A critical review of knowledge management models. *The Learning Organization*, *6*(3), 91–101.

McClelland, D. C. (1973). Testing for competence rather than for “intelligence”. *The American Psychologist*, *28*(1), 1–14.

McGuinness, D. L., & Van Harmelen, F. (2004). OWL Web Ontology Language Overview.

W3C Recommendation. Retrieved May 19, 2015, from http://www.w3.org/TR/2004/REC-owl-features-20040210/

Mehanna, W. N. (2004). e-Pedagogy: the pedagogies of e-learning. *Research in Learning Technology*, *12*(3), 279–293.

Melis, E., Andres, J. B. E., Frischauf, A., Goguadze, G., Libbrecht, P., Pollet, M., & Ullrich, C. (2003). Knowledge representation and management in ACTIVEMATH. *International Journal on Artificial Intelligence and Mathematics, Special Issue on Management of Mathematical Knowledge*, *38*(1--3), 47–64.

Mendes, M. E. S., Martinez, E., & Sacks, L. (2002). Knowledge-based Content Navigation in e -Learning Applications. In *In Proc. of the 2002 London Communications Symposium, LCS*. London.

Meredith, S., & Newton, B. (2003). Models of eLearning: Technology Promise vs Learner Needs Literature Review. *International Journal of Management Education*, *3*(3), 43–56.

Merrill, D. (1994). *Instructional Design Theory*. New Jersey: Education Technology.

Noy, N. F., & Mcguinness, D. L. (1993). Ontology Development 101 : A Guide to Creating Your First Ontology, 1–25.

Paquette, G. (2007). An Ontology and a Software Framework for Competency Modeling and Management. *Educational Technology & Society*, *10*(3), 1–21.

Pettenati, M. C., & Ranieri, M. (2006). Informal learning theories and tools to support knowledge management in distributed CoPs. In *In Innovative Approaches for Learning and Knowledge Sharing, EC-TEL. Workshop Proceeding* (pp. 345–355).

Phosaard, S., & Wiriyapinit, M. (2011). Knowledge Management via Facebook: Building a framework for Knowledge Management on a social network by aligning business, IT and Knowledge Management. *Proceedings of the World Congress on Engineering 2011, WCE 2011*, *3*, 1855–1860.

Piaget, J. (1955). *The Child's Construction of Reality*, London: Routledge & Kegan Paul.

Popper, K. R. (2014). Conjectures and Refutations: The Growth of Scientific Knowledge. *Routledge*.

Prins, F. J., Nadolski, R., Berlanga, A. J., Drachsler, H., Hummel, H. G., & Koper, R. (2008). Competence Description for Personal Recommendations: The Importance of Identifying the Complexity of Learning and Performance Situations. *Educational Technology & Society*, *11*(3), 141–152.

Prud'hommeaux, E., & Seaborne, A. (2008). SPARQL Query Language for RDF. *W3C Recommendation*. Retrieved May 19, 2016, from https://www.w3.org/TR/rdf-sparql-query/

Ramsden, P., 2003. *Learning to teach in higher education*. Routledge.

Reigeluth, C. M. (1999). *Instructional Design Theories and Models: A new paradigm of instructional theory*. *Mahwah, NJ: Lawrence Erlbaum* (Vol. 2).

Reigeluth, C. M., Merrill, M. D., Wilson, B. G., & Spiller, R. T. (1980). The elaboration theory of instruction: A model for sequencing and synthesizing instruction. *Instructional Science*, *9*(3), 195–219. Retrieved from http://mdavidmerrill.com/Papers/ElaborationTheory.pdf

Rouse, M. (2005). WhatIs.com "Tomcat." *TechTarget*.

Sammour, G., Schreurs, J., Al-Zoubi, A. ., & Vanhoof, K. (2008). The role of knowledge management and e-learning in professional development. *International Journal of Knowledge and Learning*, *4*(5), 465–477.

Shawar, B. A. (2009). Learning Management System and its Relationship with Knowledge Management. In *Forth International Conference on Intelligent Computing and Information systems* (pp. 738–742).

Simpson, E. J. (1972). *The Classification of Educational Objectives in the Psychomotor Domain*. *The psychomotor domain* (Vol. 3). Washington, DC: Gryphon House. Retrieved from http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED010368

Sitthisak, O., & Gilbert, L. (2014). *Competence Modelling and Technology - Enhanced Learning*. Scholar Press.

Sitthisak, O., Gilbert, L., & Davis, H. C. (2008). Transforming a competency model to assessment items. *In The 4th International Conference on Web Information Systems and Technologies (WEBIST), Funchal, Madeira*.

Sitthisak, O., Gilbert, L., & Soonklang, T. (2013). Integrating Competence Models with Knowledge Space Theory for Assessment. In *CAA conference* (pp. 1–8). Retrieved from http://caaconference.co.uk/wp-content/uploads/Sitthisak_caa2013_submission.pdf

Smith, M. K. (1996). Competence and Competency: What is competence? How has it been reduced to competency?What is the impacton education and training? Retrieved May 18, 2016, from http://infed.org/mobi/what-iscompetence-and-competency/

Sowa, J. F. (2000). *Knowledge Representation: Logical, Philosophical, and Computational Foundations*. *Pacific Grove*. CA: Brooks/Cole.

Stoof, A., Martens, R. L., & Van Merriënboer, J. J. G. (2007). Web-based support for constructing competence maps: Design and formative evaluation. *Educational Technology Research and Development*, *55*(4), 347–368.

Supnithi, T., Inaba, A., Ikeda, M., Toyoda, J., & Mizoguchi, R. (1999). Learning goal ontology supported by learning theories for opportunistic group formation. *Artificial Intelligence in Education: Open Learning Environments: New Computational Technologies To Support Learning, Exploration and Collaboration*, *50*(1), 67–74.

Sure, Y., Staab, S., & Studer, R. (2002). Methodology for development and employment of ontology based knowledge management applications. *ACM SIGMOD Record*, *31*(4), 18.

Svinicki, M. D. (1998). A theoretical foundation for discovery learning. *Advances in Physiology Education*, *20*(4), 4–7.

Tiwana, A. (2000). *The knowledge management toolkit: practical techniques for building a knowledge management system*. Prentice Hall PTR.

Toothaker, L. E. (1993). Multiple comparison procedures.

Trochim, W. M. (2006). Likert Scaling. Retrieved April 25, 2016, from http://www.socialresearchmethods.net/kb/scallik.php

Tudorache, T., Noy, N. F., Tu, S. W., & Musen, M. A. (2008). Supporting Collaborative Ontology Development in Protege. *International Semantic Web Conference*, 17–32.

Vermont-University. (2014). Collaborative Skills. *SUPPORTIVE CLASSROOM CURRICULUM*.

Vrasidas, C. (2004). Issues of pedagogy and design in e-learning systems. *Proceedings of the 2004 ACM Symposium on Applied Computing*, 911–915.

Vygotsky, L. S. (1978). *Mind in Society*, Cambridge, MA: Harvard University Press.

Wagner, C. (2004). Wiki : A Technology for Conversational Knowledge Management and Group Collaboration COLLABORATION. *Communications of the Association for Information Systems*, *13*(19), 265–289.

Wagner, R. (2011). *Building Facebook applications for dummies*. Hoboken: John Wiley & Sons.

Walsham, G. (2001). Knowledge Management : The Benefits and Limitations of Computer Systems. *European Management Journal*, *19*(6), 599–608.

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications* (Vol. 8). Cambridge university press.

Watanabe, K. (2005). A Study on needs for e-learning-Through the analysis of national survey and case studies. *Progress in Informatics*, (2), 77–86.

Wessner, M., & Pfister, H.-R. (2001). Group formation in computer-supported collaborative learning. *Proceedings of the 2001 International ACM SIGGROUP Conference on Supporting Group Work - GROUP '01*, 24.

WhatIs.com. (2014). Facebook. *Facebook*. Retrieved May 23, 2016, from http://whatis.techtarget.com/definition/Facebook

Whitelock, D., Gilbert, L., & Gale, V. (2011). Technology Enhanced Assessment and Feedback : How is evidence-based literature informing practice ? *2011 International Computer Assisted Assessment (CAA) Conference, Research into E-Assessment*, 1–12.

Yates, D., & Paquette, S. (2011). Emergency knowledge management and social media technologies: A case study of the 2010 Haitian earthquake. *International Journal of Information Management*, *31*(1), 6–13.

Zhang, D., Zhao, J. L., Zhou, L., & Nunamaker Jr, J. F. (2004). CLASSROOM. *Communications of the ACM*, *47*(5), 74–79.

Zhou, L. (2007). Ontology learning: State of the art and open issues. *Information Technology and Management*, *8*(3), 241–252.

Zhuge, H. (2002). A Knowledge flow model for peer-to-peer team knowledge sharing and management. *Expert Systems with Applications*, *23*(1), 23–30.