A SCORM Compliant E-learning Content Prototype for the Training of OBE Mathematics educators in the context of developing countries

by

Xolisa Piyose

(20617913)

Supervisor: Prof. SD Eyono Obono

MSc; PhD (Computer Science, France)

A dissertation submitted to the Faculty of Accounting and Informatics at the Durban University of Technology in complete fulfilment of requirements for the Master's degree of Technology in Information Technology

April 2010

DECLARATION

I, Xolisa Philip Piyose, declare that this dissertation represents research work carried out by myself and that it has not been submitted in any form for another degree at any university, university of technology, or any higher learning institution. I also confirm that all information used from published or unpublished work of others has been acknowledged in the research.

---------- ----------

Xolisa Philip Piyose Date

Abstract

The main purpose of this study was to examine how e-learning can help resolve some of the most acute problems that are specific to the nature of the outcomes-based education (OBE) system in developing countries. This was accomplished by investigating the relevant literature on OBE and by designing an e-learning content prototype for the South African version of OBE, with the focus on the training of Mathematics and Mathematical Literacy educators.

OBE is an education system centred on the theory of mastery of learning introduced by Bloom in the 1950s. It has been implemented worldwide in primary and secondary schools and also in tertiary institutions. Some studies have shown that OBE is problematic, and that both educators and learners are opposed to this system of education. Existing research also reports that the quality of education in OBE is very poor as compared to that of the traditional education system. This study was an attempt to identify the most acute problems experienced by educators and learners in the OBE context and to design a prototype for e-learning content that can be used in courses in an attempt to solve these problems.

The research population of the perceptions survey consisted of Mathematics and Mathematical Literacy educators and learners from the 6 000 primary and secondary schools of the KwaZulu-Natal (KZN) province of South Africa. Eighteen schools formed part of the research sample, with an average of two schools per region (the KZN province is divided into nine regions). Both private and public schools were included in the study. Data for the study were collected from March 2007 to August 2007 in the form of a perceptions survey of 104 educators and 288 learners, yielding an average of six educators and sixteen learners for each randomly selected school.

Results from the perceptions survey show that educators and learners do not understand OBE terminology. In addition, educators claim that they are not sufficiently trained for OBE. Research

participants also report that schools' basic infrastructure is unsatisfactory, and that their classrooms are overcrowded. Mathematics is perceived as the most difficult subject by both educators and learners. The survey also reveals that most public schools do not have computers and that neither educators nor learners have access to computers in their public libraries.

A SCORM- (Sharable Content Object Reference Model) compliant e-learning course was developed in this study to address the most acute problems identified by the survey, based on the Software Engineering Unified Model. The designed e-course contains OBE terminology such as learning outcomes, OBE principles, assessment standards, assessment methods, national curriculum statement and learning fields. The e-learning course content also contains the Mathematics and Mathematical Literacy curriculum for grades 11 and 12. It was constructed using 16 documents extracted from the National Department of Education's website: 7 documents under Further Education and Training, 4 under Teacher Guide, and 5 under General Education and Training. The evaluation of the e-learning content prototype was conducted through a survey among 36 educators from different primary and secondary schools of the Mnquma Municipality of the Eastern Cape province of South Africa. They were trained in the SCORM-compliant e-learning course content at the Walter Sisulu University's Butterworth campus. The training took place from 10 to 13 November 2009. After the training, educators filled out a questionnaire on their perceptions of the effectiveness of the proposed e-learning content prototype with regard to the practice of OBE.

Results from the SCORM e-course evaluation survey showed that the proposed SCORM software artefacts allow educators to have a better understanding of OBE terminology. The proposed software artefact is user-friendly and educators recommended its use not only for Mathematics but for all subjects.

List of abbreviations

ADDIE	Analysis, Design, Development and Implementation Model
CEF	Central Energy Fund
CEF-WSU	Central Energy Fund for Walter Sisulu University Community
DoE	Department of Education
EMIS	Education Management Information System
FET	Further Education and Training
FIS	Financial Information Systems
HOD	Head of Department
HTML	Hypertext Mark-up Language
ICT	Information and Communication Technology
IT	Information Technology
MarlinaLS	Marlina Learning System
MS Excel	Microsoft Excel
NCS	National Curriculum Statement
NSC	National Senior Certificate
NQF	National Qualifications Framework
OBE	Outcomes-based Education
RELOAD	Reusable Learning Object Authoring and Delivery
SCORM	Sharable Content Object Reference Model
WSU	Walter Sisulu University

Acknowledgements

I would like to thank Jehovah God deeply for giving me the strength to conduct this research: You are really my stronghold in good and bad times.

To Professor Seraphin Eyono Obono, my supervisor, who with great enthusiasm provided me with endless valuable information: Your sharp mind and extensive knowledge not only introduced me to the OBE world, but also to electronic course design. I admire you and owe you so much! Thank you so very much.

To Professor Thiruthlall Nepal, my advisor: Thank you for believing in me, and for your inspiration and guidance. You helped me tremendously by proofreading my research report and by providing the necessary financial assistance and support for my thesis. Thank you.

To my mother, Florence No-eight Piyose: Thank you very much, old lady, for encouraging me during the times of distress and for providing me with the necessary support at all times. Thank you very much, Mas 3.

To Tandile Ngxekana, my friend: Thank you very much for your wonderful support at all times, including, to mention but a few, accommodation, research books, deep concerns, constructive comments and encouragement. To my other friends, Zandile Poyo and Sonwabo Patekile: Thank you for printing my questionnaires when I had nowhere else to go, and for the parties that cheered me up when I was down.

Last but not least, I want to thank Doctor Mthabela and Michelle from the KwaZulu-Natal Department of Education. To the late Mrs Mandy Nkosi: I thank you very much for your

encouragements. To all educators and learners that participated in this study: Thank you very much. Without you, this study would have been impossible.

Table of contents

List of figures

List of tables

Chapter 1
INTRODUCTION

The aim of this study was to identify problems that are experienced by educators and learners in the outcomes-based education (OBE) system, and to design and evaluate a SCORM- (Sharable Content Object Reference Model) compliant content prototype to solve the most acute of those problems. In this chapter, the background of the study, the objectives and the scope of the study are discussed. The problem statement, hypotheses and the research questions are clearly defined, and the rationale behind the research and the research methodology employed are also presented in this chapter.

1.1 Background

The science of education has moved through various movements and schools of thought. The decade between 1950 and 1960, however, is particularly interesting, with particular reference to the work of B.F. Skinner and Benjamin Bloom (Tucker, 2005). Bloom's work on educational objectives can indeed be regarded as the foundation of OBE (Zengele, 2004), while Skinner's work on the science of learning and the art of teaching can be seen as the foundation of e-learning (Were, Rubagiza, Denley & Sutherland, 2007).

OBE is defined as a system of education in which everything that is taught has a specific purpose. The proponents of OBE claim that the best way to learn is to first outline the needs to be achieved, and thereafter to determine strategies, processes and techniques to meet the identified needs. Several countries around the world have attempted to implement OBE, with more or rather less success (Naicker, 2000). South Africa, for example, implemented the OBE system after a political regime change in the country in 1994.

Since 1994, attempts to change the education system in South Africa have been both philosophical and structural. In 1996, the new South African government inaugurated a nation-wide process to transform the curriculum – particularly its aims, methodology and learning areas. They had to be seen to be delivering on their education promises, and thus needed a new curriculum to be published, and to be at least partially implemented before the 1999 elections (Sieborger, 1998).

Over the course of the years 1996 and 1997, various curriculum committees representing a range of stakeholders were charged with producing the new curriculum for South Africa. Its structure and framework were centrally pre-determined and non-negotiable: The model was to be outcomes-based, and the traditional subjects were to be abolished in favour of 'learning areas'. A major problem was the timescale: from the start participants were presented with deadlines which they knew were impossible to achieve and the process was always constrained by severe time pressures and overly optimistic planning. The aim of the education reform movement of 1994 onwards was to focus on outcomes that are knowledge-gained instead of on inputs. But, according to Thusi (2006), some of the confusion surrounding OBE is precisely the issue of semantics.

According to Stofells and Onwu (2005: 112), Curriculum 2005, which was implemented in South Africa in 2005, was neither "educator supportive" nor "educator friendly". Stoffels and Onwu (2001) assert that this is why OBE did not gain favour among educators: many schools did not receive enough learner support materials; teacher guides did not provide good examples of OBE lessons and learner assessment; class visits, monitoring and feedback by local, district and national Department of Education (DoE) officials were non-existent; and important concepts of the OBE curriculum were not included in teacher training sessions.

In principle, OBE sounds good. However, in practice, it is problematic. South African educators are confused by differences between the new system and the old system, and feel that OBE

undermines the traditional system and introduces new problems. As a result, most educators are finding it difficult to adapt to OBE (Thusi, 2006) and are resisting to the smooth implementation of OBE. This resistance could lead to poor-quality education. Resistance is a major challenge for OBE in South African schools. Moreover, the successful and effective implementation of OBE depends on a sound understanding of OBE policies; terminology by those involved in its implementation and those using the system i.e. educators and educators.

The education world has been taken to new heights by the introduction of e-learning, mainly in developed countries that have the necessary resources for its successful deployment (Dunmill & Arslanagic, 2006). E-learning, sometimes referred to as computer-based training or online distance education, refers to structured, computer-enabled learning, carried out by individuals or groups outside of a physical classroom, over the internet, or within an internal network (Parker, 2003). Today, computers have opened new opportunities and they provide more flexible ways to enhance teaching and learning processes. According to Ron (2004), e-learning, technology-enhanced learning and computer-mediated instructions are the leading trends of education in the 21st century. The number of e-learning conferences, seminars and training initiatives are increasing worldwide, as e-learning is increasingly used to facilitate the implementation of new modes of education both in schools and in businesses.

However, e-learning is still experimental in developing countries (Were *et al*., 2007). The introduction of e-learning in developing countries in the OBE context is therefore interesting with regard to two main aspects: the general technological infrastructural problems faced by developing countries and the specific problems inherent to the nature of the OBE system.

In South Africa, there is a high expectation by the DoE for primary and secondary schools to implement information and communication technology (ICT). This expectation necessitates the use of computers for teaching and learning. According to the DoE (2004), all South Africans learners will be ICT-capable by 2013, from Grade 1 up to Grade 12. This means that learners

will be able to use ICT with confidence in schools, and in society in general. The question therefore is: Are educators sufficiently trained in ICT in order to help the learners? Magi (2008) asserts that the use of ICTs can help to solve many of the challenges currently experienced in primary, secondary and tertiary education. Even though many researchers have investigated the adoption of e-learning in developing countries (Adam, 2005; Conole, De-Laat, Dillon & Darby, 2006; Dagada & Jakovljevic, 2004; Engelbretcht, 2003; Entanado & Diaz, 2001; Higgins, 2003; Parker, 2003; Ungerleider & Burns, 2002; Were *et al*., 2007) and other researchers have examined the practice of OBE in the developing world (Acharya, 2003; Brown, 2004; Butler, 2004; Fisher, 2005; Jackson, 2000; Jansen & Christie, 1999; Killen, 2005; Makgato & Mbanguta, 2002; Malan, 2000; Naicker, 2000; Ramolefe, 2003; Thusi, 2006; Zengele, 2004), very few studies have attempted to establish a link between the benefits of e-learning and the specific problems inherent to the nature of the OBE system.

The aim of this study was therefore to examine how e-learning can help resolve some of the most acute problems that are specific to the nature of the OBE system in the context of a developing country.

1.2 Problem statement

OBE in the South African context has been strongly criticised in a widely circulated paper written by Jansen (1997). He asserts that OBE in South African primary and secondary schools is doomed to fail. The first reason cited by Jansen as one of the causes for OBE failure is that "the language of OBE is too complex" (1997: 10). This OBE language problem seems to be amplified by the system's novelty, especially for educators trained in a different education system. In another publication, Jansen (1998) further asserts that OBE is based on flawed assumptions of what happens inside schools, classroom sizes and the kinds of educators that have to teach in an OBE system.

In all primary and secondary schools, the DoE expects educators to be responsible for the implementation of the OBE curriculum in their schools. Therefore, whether educators understand OBE policies and terminology or not, they have to implement OBE. Jansen (1998) also questions the extent to which educators were involved during the development of OBE policies and curriculum's. He asserts that only a small group of educators were included in the Learning Area Committees. According to Ramolefe (2003), educators' attitudes towards OBE suggest that they are not well trained for OBE and they do not understand the OBE system. This suggests that the implementation of OBE may be problematic in most schools in South Africa.

1.3 Research questions

The main research questions of this study were formulated as follows: How can e-learning enhance the implementation of OBE? What aspects of OBE must be prioritised for enhancement through e-learning?

That main research questions were divided into the following sub-questions.

Research sub-question one: *What are the challenges faced by OBE educators and learners in a typical primary or secondary school of a developing country?*
This sub-question addresses questions such as the following: Are those challenges only related to the specific nature of OBE? Do those challenges subsist across the board, irrespective of social, historical and geographical differences? What are the implications of these challenges for learners' and educators' performance?

Research sub-question two: *How can e-learning help OBE educators and learners in a typical primary or secondary school of a developing country?*
This sub-question addresses questions such as the following: What are the constraints to the deployment of e-learning applications in developing countries? What is the best e-learning

standard that is suitable in those conditions? What are the best long-term and short-term e-learning strategies and solutions for the resolution of the challenges mentioned above?

1.4 Hypotheses

In this study, the following untested assumptions were used as a starting point to further explore answers to the research questions.

Assumption one: OBE comes with its own specific challenges, but these challenges are worsened by infrastructural deficiencies present in developing countries. The severity of these challenges might vary depending on the social status of the learners, educators or schools (i.e. rich versus poor, private versus public, rural versus urban, etc). These challenges negatively impact on the overall quality of education.

Assumption two: While the internet is increasingly being used in developed countries, schools in developing countries to a large extent still do not have access to personal computers and the internet. In contrast, cell phone technology seems to be used to a large degree in developing countries. E-learning standards can therefore be deployed via the internet but also via cell phone technology. However, the real problem seems to be the unavailability of relevant content for the deployment of e-learning. The study is therefore directed towards the need for relevant e-learning content. However, at this stage, the nature and the choice of priority themes for such content is still to be explored.

1.5 Objectives

The main objective of this study was to examine how e-learning can help resolve some of the most acute problems specific to the nature of the OBE system in the context of a developing country. This purpose was achieved by identifying these problems and by providing an e-learning-based solution to some of the problems in the form of e-learning course content.

The main objective can be divided into the following sub-objectives:

a) Identify, clarify and prioritise obstacles and challenges to the effective use of OBE in primary and secondary schools in South Africa.
b) Design and evaluate e-learning course content that can help resolve the above-mentioned obstacles and challenges.

1.6 Rationale

Considerable intellectual effort has been put into the design and planning of OBE on the basis of the theory of mastery of learning developed by Bloom in the 1950s. As pointed out by scholars such as Jansen (1997; 1998), Killen (2005), Ramolefe (2006), Stoffels and Onwu (2001), Thusi (2006) and Zengele (2004), the principles of OBE are noble; however, its downfall lies in its implementation. The main rationale of this study was to contribute to a scientific effort in seeking ways to improve the implementation of OBE.

1.7 Scope of the study

This study focused on OBE in primary and secondary schools in the developing country South Africa, and did not deal with tertiary education. Instead, the focus was on general education, and special issues such as adult education or special needs education were not addressed. It was not concerned with education in developed countries. It ran across geographical boundaries ranging from rural schools to semi-urban and urban schools. It focused on the opinions of both public and private school educators and learners, and did not consider the opinions of school government authorities such as ministers and curriculum developers. In addition, the study was not limited to a specific gender group, as both male and female educators and learners were equally considered in the research. It also did not focus on a specific racial group; however, because of the demographics of its participants, the research mostly dealt with black educators and learners, with a few exceptions.

1.8 Research methodology

This study included a survey and a prototype design and evaluation. The purpose of the survey was to capture the challenges of OBE in primary and secondary schools in the context of developing countries. The purpose of the prototype was to construct a software artefact that can assist in resolving some of the challenges identified by the survey. The population and sampling, data-collection and data-analysis techniques used in the survey and in the prototype design and evaluation are briefly described in the next section, and are also discussed in Chapter 2, which deals with the perceptions survey, and in Chapter 4, which focuses on the evaluation of an e-learning content prototype. The prototype presented in Chapter 3 of this dissertation was designed based on research from documents such as policy and curriculum documents available from the website of the DoE of South Africa. Only documents addressing the challenges identified in the survey formed part of the research. The analysis of these documents was done manually. The description of the prototype as well as the documents used for the design of the prototype is given in Chapter 3. The development of the prototype was achieved based on the Unified Process Model, a well-known software engineering model proposed by Jacobson, Booch and Rumbaugh (1999). After the design and implementation of the prototype, a group of educators that participated in the Central Energy Fund (CEF) project at the Walter Sisulu University (WSU) was used to test its usability.

1.8.1 Population

The population of the initial perceptions survey consisted of primary and secondary school educators and learners using an OBE system. The study examined educators' and learners' perceptions of their daily challenges at school, as well as their description of the status of their schools' infrastructure.

The research population for the e-learning course content and evaluation consisted of all Mathematics and Mathematical Literacy policies and curriculum documents available on the website of the DoE of South Africa. Mathematics is taught in South Africa from the Foundation

Phase (grades R–3) up to the Senior Phase (grades 10–12) for primary and secondary education. Therefore, all Mathematics and Mathematical Literacy policies from the Foundation Phase up to the Senior Phase formed part of this research population.

The research population for the evaluation of the e-learning software consisted of educators teaching in primary and secondary schools in South Africa who participated in the CEF-WSU project.

1.8.2 Sampling

Educators and learners were selected from a sample of schools from the KwaZulu-Natal (KZN) province of South Africa. At the time of the study, there were around 6 000 schools in total in KZN. The province is divided into nine districts; districts are divided into circuits; and circuits are divided into wards. Therefore, schools belong to wards. Three schools were randomly selected from each district. One grade was randomly selected from each selected school among the grades offering Mathematics or Mathematical Literacy courses (using simple random sampling). Six male and six female learners were randomly selected from the selected grade. Two female and two male educators were randomly selected from the selected school, which gave a total sample size of 400 participants for this survey.

For the design of an e-learning content prototype, documents were classified into two categories: documents that helped to shape the structure of the e-learning course content, and documents that were used to populate this structure with the relevant content. Only documents written in English were considered. Subject-specific documents related to Mathematics or Mathematical Literacy were given priority. General documents were, however, also part of the sample, provided that they could also be used for Mathematics or Mathematical Literacy.

The evaluation panel of the e-learning prototype sample consisted of educators participating in the CEF-WSU project. All educators participating in the project took part in the survey,

irrespective of the subject they teach. A total research population of 37 participants took part in the survey.

1.8.3 Data collection

For the perceptions survey and the evaluation of the e-learning content prototype, data were collected using questionnaires personally distributed to participants by the researcher himself. For the perceptions survey, the researcher visited the selected schools and personally distributed the questionnaires to the research participants, assisting them by answering their queries while they filled out the questionnaire and collecting the completed questionnaires.

Documents used for the design of an e-learning content prototype were collected from the South African DoE's website. The researcher downloaded all Mathematics, Mathematical Literacy and policy documents that could be used for the design of the prototype.

For the evaluation survey, the researcher trained the participants on the SCORM software. The researcher distributed the questionnaires to the participants immediately after the training and assisted them by answering their queries. Most questions on the questionnaires were closed-ended questions.

1.8.4 Data analysis

For the perceptions survey, questionnaire answers were analysed as values under the following variables: respondents' perceptions of the practice and understanding of OBE curriculum design issues; respondents' perceptions of the practice and understanding of OBE curriculum implementation issues; respondents' perceptions of their own preferences with regard to assessment including subjects' level of difficulty; and respondents' assessment of their use of information and communication technology (ICT). Likert scale values were used to map out the

dominant perceptions and the correlation between respondents' backgrounds and their perceptions.

For the design of the prototype, the documents were analysed according to the requirements stipulated in Chapter 3 of this dissertation. These requirements are based on the curriculum for Mathematics and Mathematics Literacy as well as OBE terminology policies.

For the evaluation of the e-learning content prototype, questionnaire answers were analysed as values under the following variables: educators' assessment of past training experiences; educators' computer literacy background information; educators' computer competence; and the perceived usability of the proposed e-learning content prototype by educators.

1.9 Dissertation overview

Chapter 1 contains the introduction to the dissertation. The background of the study was highlighted in this chapter to allow the reader to understand the context in which this study was undertaken. In addition, the problem statement, research questions, hypotheses, rationale and research methodology were also presented in this chapter.

Chapter 2 is dedicated to the analysis of education practitioners' perceptions of the design and implementation of OBE, and the impact of the usage of ICT on OBE. A review of the literature and a discussion of the research methodology and the research results are also presented in this chapter. The literature review includes research on the implementation of OBE in South Africa and abroad.

Chapter 3 entails a presentation of the development of an e-learning content prototype for the training of OBE Mathematics and Mathematical Literacy. The requirements and design are

outlined in this chapter based on the Unified Process Software Engineering Model. The proposed e-learning teacher training software is also presented in this chapter.

Chapter 4 is a presentation of the evaluation of the perceived impact of the e-learning prototype on the understanding of OBE by educators. A literature review of the usage and effectiveness of SCORM is first presented, followed by the presentation of the methodology used for the evaluation. The findings of the survey are presented following the data analysis on the basis of the variables identified.

Finally, conclusions and recommendations are drawn for the study and presented in Chapter 5. Possible future directions of research in the field of e-learning for developing countries are also proposed.

1.10 Conclusion

The concept of learning is high on today's education agenda. This does not only hold true in South Africa as, ironically, the implementation of OBE is still criticised worldwide. This calls for new models to modernise the implementation of OBE in order to improve educational excellence. At the same time, the implementation of ICT in South African schools has been requested by many education stakeholders.

In this chapter, the problem statement and the rationale of this study were outlined, as well as its objectives, hypotheses and research questions. The methodology of this research study was also briefly outlined in this chapter and it will be further presented in chapters 2 and 4.

The next chapter is a detailed presentation of the first phase of the research on the perceptions of educators and learners with regard to the understanding of OBE and the use of ICT.

Chapter 2

AN ANALYSIS OF THE PERCEIVED IMPACT OF THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN THE IMPLEMENTATION OF OUTCOMES-BASED EDUCATION

2.1 Introduction

This chapter starts by presenting a review of the existing literature on OBE before an analysis of the perceived impact of the use of ICT is presented. Literature on the perceptions of educators, learners and course designers of OBE is reviewed first, followed by a literature review of the role of school basic infrastructure in education. Thereafter, the role of ICT on education in general is examined. The role of ICT in Mathematics is discussed in Chapter 4 of this study.

This chapter further presents the methodology used to gather and analyse data on learners' and educators' perceptions on the use of ICT and their understanding of OBE. The research method, the population as well as the sample size and sampling method are also defined in this chapter. The research variables are described together with the research instrument that has enabled the data collection.

Lastly, the research findings for the perceptions survey of learners and educators with regard to their working conditions are presented in this chapter.

2.2 Literature review

This section presents a review of the existing literature on OBE and the impact of IT usage by education practitioners (educators and learners). The literature review is guided by the following questions:

a) What does the existing literature reveal of the perceptions of educators and learners of the design and implementation of OBE?
b) What is the impact of the school environment on learning programmes?
c) What is the impact of ICT on education in general?

2.2.1 Outcomes-based education challenges

According to Daziell and Gourvenec (2003), the aim of OBE was to initiate new partnerships in learning, from primary and secondary education to universities, universities of technology and colleges. These authors conducted a study among 12 educators and 44 first-year students of the Curtin University of Technology in Australia. The study concluded that OBE really introduces new and diverse possibilities for educators, learners and partnerships, calling into question many of the premises underlining tertiary teaching and the institutional structures supporting it. For learning to be successful in OBE, active partnerships between educators and learners are crucial (Daziell & Gourvenec, 2003). However, OBE seems to be facing many challenges, as identified by several scholars (Jackson, 2000; Jansen, 1998; Malan, 2000; Naicker, 2000; Ramolefe, 2003; Thusi, 2006; Zengele, 2004).

2.2.1.1 The perceptions of outcomes-based education in South Africa

A negative criticism of OBE is reflected in Malan (2000): OBE is bureaucratic and time-wasting, and it erodes the professional autonomy of educators. This criticism is based on the results of a study conducted in the Western Cape province of South Africa for which 12 course designers from the provincial DoE and 19 educators from D. F. Malan High School located in Bellville central were selected to participate. The aim of the study was to investigate the effectiveness of

the implementation of OBE in secondary schools in the Western Cape. A questionnaire was administered to the educators participating in the study, which was based on the following two main research questions: What are the factors that show the effectiveness of OBE? Is OBE a good education system? Face-to-face interviews were also conducted to gather information from course designers based on the following main questions: Is OBE a good education system for a South African curriculum? Why OBE in South Africa? What are the critical pros and cons in the implementation of OBE in South Africa? The study indicated that there is an explicit connection between outcomes, learning and assessment. School principals indicated that 85% of educators' attitude towards OBE is negative, up to a point that they are not willing to implement OBE in their teaching methods. A total of 68% of the educators indicated that OBE is not a good education system to be used in South Africa. All course designers reflected that OBE is a good education system and that educators should change their negative attitude towards its use (Malan, 2000). The same proportion of course designers also reflected that there is a problem with the old education system, and that OBE was introduced to improve the education of the country so that matriculants could become employable.

Jackson (2000) is of the opinion that OBE is philosophically and epistemologically unsound due to the fact that it does not accommodate the structure of some subjects and disciplines such as Mathematics. According to Jackson (2000), OBE pays little attention to processes. He further comments that important education outcomes, such as values and attitudes, are difficult to transmit to learners, that curriculum content is trivialised in OBE, and that OBE emphasises skills attainment at the expense of knowledge. Jackson's (2000) findings are based on a case study of a school in the Gauteng province of South Africa in which interviews and questionnaires were used as the data-gathering technique. The aim of the study was to investigate possible factors that could contribute to the failure of OBE, and the study took place prior to the implementation of OBE in South Africa. The research was conducted with a sample size of 14 to 18 educators selected from a high school located in the northern part of Gauteng in South Africa. A questionnaire was administered to educators based on the following main research question:

Do you think OBE will have a positive impact on the South African curriculum? The findings of the study indicate that approximately 85% of the educators thought that OBE was not a good education system for South Africa, based on the fact that South African schools have large numbers of learners, that there is a general shortage of textbooks in schools and that there is a great number of disadvantaged institutions (Jackson, 2000).

2.2.1.1.1 The perceived role of management in outcomes-based education

Educators' perceptions of OBE were studied by Ramolefe (2003) with the aim of determining how educators perceive the role of national and local departments of Education, and how they perceive the role of principals in providing leadership in the context of OBE in South Africa. Ramolefe (2003) conducted a case study of Grade 8 and 9 educators from two schools in the Limpopo province of South Africa. Six to twelve educators were selected in each school. A questionnaire was administered to the educators in order to capture their opinions on the following questions: Do principals understand OBE? Do principals discuss OBE issues with educators? Do the national and local offices of the DoE provide support for educators on OBE matters? Are principals well trained for OBE management? The results of Ramolefe's (2003) study indicate that according to the perceptions of educators, principals do not understand OBE (reported by 75% of the educators), they do not plan meetings to discuss OBE with educators (reported by 70% of the educators), and there is not enough support from the national and local departments of Education with regard to the implementation of OBE (indicated by 70% of the educators).

Zengele (2004) also conducted a study on the extent to which education managers are equipped with professional skills and knowledge for the successful implementation of OBE. Zengele (2004) conducted a survey and gathered data from focus-group interviews and questionnaires with the purpose of determining existing conditions in schools during OBE implementation, the value of stakeholders' involvement in OBE management and the imperatives for education managers during the implementation of OBE. The purpose of the questionnaire used by Zengele

(2004) was furthermore to investigate respondents' views of OBE implementation, respondents' knowledge of OBE and their feelings about its implementation, existing school management styles and how respondents viewed the management of OBE in schools. The research population for both the interviews and the questionnaires in this study consisted of eight to ten educators from schools in the Gauteng Western District of South Africa. A purposive sampling method was used in the study. The results of Zengele's (2004) study indicate that both managers (80%) and educators (100%) complained about the training provided by the DoE: they thought it was too brief and presented haphazardly, with trainers having little knowledge of OBE. They also complained that there were no facilities to support OBE implementation. Zengele (2004) clearly highlights the criticisms that educators, learners and school principals have on the implementation of OBE in South Africa.

2.2.1.1.2 Resources

Naicker (2000) concludes that OBE is problematic due to resource unavailability, the concept itself, and educators', learners' and parents' perspectives of its implementation. Naicker (2000) further concludes that OBE has been poorly implemented in South Africa due to the contribution of numerous factors, such as limited resources regarding placements from special facilities to regular education, training, and so on. Naicker (2004) conducted a survey using a questionnaire with a sample size of 108 primary schools, which constitutes 10% of the primary schools in the Western Cape Province, to establish the impact of OBE on grades 1 and 2 of the Foundation Phase. The sample covered rural, urban, public and private schools. The research analysis was based on, but not limited to, the following main research questions: How successful have specific outcomes been implemented in grades 1 and 2? What has been the level of success of the implementation of different learning outcomes? Has there been sufficient human resource development to assist educators and to ensure that they are adequately trained in dealing with diversity? The results of Naicker's study (2004) were positive for urban schools as compared to rural schools. The results reflected that classes in rural schools are overcrowded compared to those in private schools, which have an average size of 30 to 35 students. Regarding specific

learning outcomes, 67% of the respondents indicated that specific outcomes have not been successful implemented, and almost the same number of respondents indicated that there were no resources to assist the educators to handle diversity in schools.

According to Thusi (2006), who conducted a study on the effective implementation of OBE in the primary schools of the Eastern Cape province of South Africa, OBE is an important cornerstone for a democratic society. Thusi (2006) also articulated factors that might hamper the smooth implementation of OBE: inadequate training of school principals and educators, poor school infrastructure and a lack of resources and of commitment of both educators and the DoE. The aim of the study was to determine the perceptions of participants of the implementation of OBE at district, school and classroom levels. Individual and focus-group interviews were used to gather information. Individual interviews were conducted with a number of district officials, principals and educators, totalling 37 people from 9 districts in the Eastern Cape. Focus-group interviews were conducted at three training sites in the Eastern Cape with a total of 40 participants. The main aim of all the interviews was to determine the perceptions of participants of the implementation of OBE. The research findings reflected that the attitude of many principals and educators towards OBE emanated from the manner in which information was disseminated during their training. Participants articulated that the amount of training they received for such a complex change was totally insufficient. Some educators lacked motivation, and others were openly sceptical of the credibility of the OBE curriculum (Thusi, 2000). The study also showed that since educators from rural and farm schools suffered in the traditional system (before OBE), they welcomed any change that would relieve their situation, including OBE (Thusi, 2006).

2.2.1.2 School infrastructure

The impact of the state of schools' infrastructure on educators' absenteeism and retention was analysed by Schneider (2003). According to Schneider (2003), educators in poorer-quality facilities are more likely to be absent and to leave the teaching profession. This assertion is based

on the results of a survey of educators in Chicago and Washington DC in the United States of America (Schneider, 2003). The aim of Schneider's (2003) study was to investigate the impact of school infrastructure on education outcomes. The principal, eight staff members and twelve learners of a school in city were interviewed to analyse their assessment of the local infrastructure-management capacity, school infrastructure plans and the impact of the school infrastructure on both educators and learners. In addition, a questionnaire was used to gather data from a sample of 1 796 educators selected randomly out of 23 930 educators in the Chicago and Washington DC districts. The results of the interviews and questionnaires indicated that poor school infrastructure does not motivate educators and learners to be effective in their teaching and learning respectively. Schneider (2003) concluded that the impact of school infrastructure on education outcomes could be broken down into the quality of the facilities, the overall design of facilities and facilities' effect on actual teaching and learning time. Schneider (2003) also concluded that the quality of educator–learner relationships is based on the availability of basic resources (desks, playgrounds, electricity, classrooms, water, laboratories, and so on) in schools. Almost all the educators (96%) indicated that their school facilities are inadequate. Seventy-two per cent of the learners, 86% of the educators and the principal found many problems with the design of their school, including issues such as inadequacy of science laboratories, schools infrastructure being too large, inadequacy of professional space and classes being smaller. The results also reflect that even when schools are well designed, they are often not well maintained (Schneider, 2003).

The issue of poor school infrastructure is also addressed in Fisher's work on the interplay of quality facilities, school climate and learner achievements (Fisher, 2005). Fisher (2005) used a questionnaire to gather data from participants from 82 middle schools in Virginia in United States of America, which was completed during a regularly scheduled faculty meeting. About one-third of the faculty members present were randomly selected to participate in a survey concerning the quality of education facilities. Research variables captured by the survey included participants' satisfaction with regard to the following: the quality of facilities; the maintenance of

facilities; support resources such as learning materials and tools for laboratories; and Grade 8 learners' achievement in the subjects English and Mathematics. Fisher's (2005) findings indicate that support resources, quality facilities and student achievements are related to one another. Fisher (2005) further shows that despite increases in construction at schools, the buildings of one in eight schools are still in a poor condition. Sixty-nine per cent of the participants indicated that they were not satisfied with the quality of the received resources and support, and 72% indicated that the above-mentioned issues impact greatly on learners' achievement.

a) Library infrastructure in outcomes-based education

According to Johanson (2007:18), factors that contribute to the failure or vast criticism of the OBE system in schools in the Western Cape province of South Africa are a lack of resources, especially in township schools (e.g. a shortage of adequate learning resources which is specifically the case for the indigenous languages); the dependence on external support in the form of voluntary workers and donations; infrastructural problems; the absence of possible co-operating public libraries; and inadequate library opening hours due to security problems. Johanson (2007) conducted an observational study in order to assess the practices in a Cape Town public library. She also conducted a field survey in the Western Cape, Northern Cape and Free State provinces. The survey sample consisted of six employees from each library. Participants filled out a questionnaire on the following issues: the lack of explicit emphasis on school libraries in the curriculum, educators' focus on textbooks, the lack of understanding of the educational role of school libraries in OBE, the lack of support from principals, and contact problems between schools and public libraries. Johanson concluded that problems with basic infrastructure contribute greatly to the failure of OBE. Eighty-three per cent of the participants indicated that there is no emphasis on library usage in the curriculum and that educators focus excessively on textbooks for their lessons. All the participants indicated that there is no link at all between school principals and public libraries. The study also revealed that officials from the DoE and course designers do not create a direct link between public libraries in their curriculum, which could possibly be done in the form of assignments or projects (Johanson 2007).

Brown (2004) reflects on the need for education practitioners to use libraries. Brown (2004) conducted a study on the impact of public libraries on surrounding schools. The study was conducted in Cape Town in the Western Cape province of South Africa. A questionnaire was administered to 19 employees of the Cape Town Library based on the following two main issues: the impact that the shift from apartheid to democracy has had on education practitioners, and the library needs of disadvantaged schools. Data analysis revealed that over 80% of the population was not satisfied with the change of curriculum after the apartheid era. Participants indicated that the only thing to be of importance is the availability of resources to the so-called disadvantaged schools. The study also revealed that those who did have access to the library were English speaking (70%), white (82%) and well educated (68%) employees. The study also reflects that almost 85% of learners from township and rural schools are not encouraged by their educators to use the public library. Based on a lack of resources in rural and township schools, all the research participants indicated a great need for community libraries in townships and rural areas (Brown, 2004).

2.2.2 The role of information and communication technology in education

The positive impact of the use of ICT is shown in a study conducted by Mutmaz (2000) on the factors affecting educators' use of ICT. Mutmaz (2000) concluded that educators' perception of their own teaching is central in influencing educators to use ICT in their teaching. Mutmaz (2000) further articulated that educators who successfully use technology in the classroom have positive attitudes to ICT and focus on learner choice and individual study rather than on the direction imposed by the educator. A questionnaire was designed to gather information on educators about their experiences in ICT, their attitudes to the value of ICT for teaching and learning, and their training experience in the use of ICT in education. The sample of the study consisted of 44 male and 28 female educators who use computers in their teaching. The study shows that educators who are regular users of ICT have confidence in using it, and those they

also perceive it to be useful for teaching, lesson planning and their personal work. Eighty-two per cent of the participants in Mutmaz's study (2000) further indicated that ICT makes lessons more interesting, easy and fun for educators and their learners; it makes lessons more diverse, more motivating and more enjoyable for learners; it helps to improve the presentation of learning materials; and it gives more power to the educator.

Naledi Pandor, in her capacity of Minister of Education of South Africa, at a World Ministerial Seminar on Technology in Education, stated that the introduction of ICT's in education symbolises an essential part of government's strategy to enhance the quality of teaching and learning in the South African education system, and that the key to reaching this objective is the integration of educators into the process (Department of Education, 2005). This means that society expects a lot from ICT, as it can in turn contribute towards the improvement of quality of life, and the building of a peaceful, successful and democratic society.

2.2.2.1 The use of information and communication technology in disadvantaged schools

Were *et al*. (2007) conducted a study on the use of ICT to support basic education in disadvantaged schools and communities. According to these authors, modern ICT has a definite place in the education system and especially in attempts to improve the quality of education (Were *et al*., 2007). This was the conclusion of the study conducted in one disadvantaged school located in the northern region of Rwanda with a sample of 45 learners and 12 educators. The aim of the study was to outline the use of ICT in disadvantaged schools. Before the participants started to fill out the questionnaire, they were required to use a computer to learn trigonometry and graphs for Mathematics and science. All the learners and educators who participated in the study indicated that ICT supports the learning of basic terms in education and that it makes learning more enjoyable.

2.2.2.2 Information technology usage at tertiary level

Ungerleider and Burns (2002) suggest that ICT can help both educators and learners in their teaching and learning. According to them, the use of computers can help learners to be better problem solvers and autonomous learners, by encouraging the development of independent thinking skills, starting as early as in pre-schools (Ungerleider & Burns, 2002). This is the result of a questionnaire-based survey conducted among 12 instructors and 131 students of the University of British Columbia studying in their second year of the Bachelor of Science degree in Applied Mathematics. The aim of the survey was to determine students' attitudes towards the use of computers in their curriculum. The main questions that were to be addressed were: What are the students' attitudes towards ICT? What is the impact of ICT on the Mathematics curriculum? In total, 100% of the students and 64% of the instructors reflected that students' attitudes towards computers and computer-related technologies improve as a consequence of exposure to it. Based on the above findings, Ungerleider and Burns (2002) concluded that the use of ICT for group work can be beneficial if educators take into account the complex interplay between the age of the learners, the kind of task and the amount of independence allowed. Eighty-eight per cent of the instructors indicated that the use of ICT for mathematics instruction has a significantly positive effect on teaching high-level concepts to learners in Grade 8 or higher (Ungerleider & Burns, 2002).

Similarly, Dunmill and Arslanagic (2006) provide evidence that ICT positively impacts on learners' achievement in core subjects. Their study provides evidence that the use of music and visual arts enhances learning processes and outcomes. A questionnaire was administered to 14 educators and 65 students of the University of New Zealand under the following main research questions: What teaching practices using ICT make a positive difference for students in arts? What evidence is there of improved outcomes (educational, cultural, social and economic) through the effective use of ICT in arts education? Dunmill and Arslanagic (2006) assert that the learning environment, curriculum pedagogy and content are central to the effective use of ICT. However, educators need to be confident in their subject knowledge as well as in basic ICT

literacy so that they can effectively integrate ICT into teaching. Ninety per cent of the educators in this study indicated that the software that they use for music and for arts in general makes it easy for them to clarify basic terms to students and add a little bit of innovation to learning. They articulated that students have more fun using software. All students in the study indicated that the use of ICT helps them to learn fast and to enjoy learning (Dunmill and Arslanagic, 2006).

2.3 Perceptions survey on the impact of information and technology on the understanding of outcomes-based education

The purpose of this section is to present the methodology used to gather and analyse data, and present the results on learners' and educators' perceptions gleaned by means of a survey. This section starts by presenting the objective of the survey, the research design and data-collection and data-analysis processes. Thereafter, the survey findings are presented in detail according to the characteristics of the research population. The educators' and learners' perceptions are then presented. Lastly, the summary of the findings are presented. Perceptions in this case are related to the state of ICT infrastructure and general challenges that educators and learners face in their schools.

2.3.1 Objective of the survey

The primary objective of the survey was to seek difficulties/problems experienced by educators and learners with issues relating to curriculum design and the implementation of OBE in their schools. The survey also sought to determine which is the most difficult subject as perceived by both educators and learners out of the fields of mathematics or mathematical literacy, science, languages, arts and culture, and business and management.

2.3.2 Research design

This section presents the research method, the research population and the sampling method, as well as the research instrument used for the survey.

2.3.2.1 Research method

Data on educators' and learners' perceptions were gathered during a survey of primary and secondary schools in the KZN province of South Africa. A database of all the schools in the province was collected from the officials of the provincial DoE. The database contains a record of each school with the following information: the district, circuit, ward, Education Management Information System (EMIS) number, as well as the name of the school, its level, and its registration status, details on the ownership of the school, its address and its telephone number.

2.3.2.2 Research population

Even though schools were surveyed, it is important to note that educators and learners are the ones that participated in the research. The research population consisted of learners and educators in primary and secondary schools in the KZN province of South Africa. The province has 6 200 schools in total, consisting of 400 private schools and 5 600 public schools. The province is mostly rural, but does have a few cities and small towns. It has 4 000 rural schools, 400 urban schools and 1 800 semi-urban schools. The education system in South Africa is divided into the following categories: pre-school, primary, junior secondary, senior secondary and tertiary. This study was only concerned with primary and secondary schools. It included educators and learners from grades 4 to 11 eleven. In the South African education system, schools offer a variety of subjects, such as Mathematics, English, Geography, and so on. Learners can choose the courses that they want to study. The population of learners and educators in this province mainly consists of black people, with a few white and Indian individuals. Zulu is the first language for most of the black people, and either English or Afrikaans is the first language for white and Indian people. English is the medium of instruction

in most schools, with possible exceptions in rural schools that may use Zulu, and in some urban or semi-urban schools that may use Afrikaans. Gender is almost equally distributed among learners and educators, with a slight majority of females. Learners' ages in the study population vary from 10 to 18 years. The ages of educators vary from 25 to 60 years, with a majority of educators aged around 40. Most educators have gone through a formal teacher or subject-specific initial training programme, with few exceptions in some private schools.

2.3.2.3 Research sampling

The number of schools in the research population is estimated at 6 000 and the official regulation from the DoE of South Africa recommend a maximum class size of 20 students. This means the total population of learners and educators is in the order of a million. This large population size motivated the choosing of a representative sample for this study.

2.3.2.3.1 Sampling method

The KZN province is divided into nine districts; districts are divided into circuits; and circuits are divided into wards. Therefore, schools belong to wards. For the purpose of this study, three schools were randomly selected from each district and one grade was randomly selected from each selected school among the grades offering Mathematics or Mathematical Literacy. The random selection of schools in a given district was obtained by applying the random MS Excel function to the range of schools in each district. An example of the random selection is given in Figure 2.1. The same randomisation method was used for the choice of a grade in a given school. In addition, the school principal from the selected grade selected four bright male and four bright female learners. The principal from the selected school also selected two female and two male educators, giving a total sample size of 394 participants for the research, as shown in Table 2.1.

```
Function random selection (school: string)
        Begin
                If school = "primary", then
                   School = Rand (E3:E6256)*0.025*5
                 Else
                    If school = "Junior secondary", then
                      School = Rand (E3:E6256)*0.025*9
                    Else if school = "Senior secondary" or "High school", then
                              School = Rand (E3:E6256)*0.025*12
                          Endif
                      Endif
                  Endif
        End
```

Figure 2.1: Algorithm for choosing research participants

Table 2.1: Gender distribution of the research participants

Participants	Gender		Total
	Male	Female	
Educators	46	60	106
Learners	144	144	288
Total	190	204	394

In South Africa, districts are a geographical organisation of the province. All the districts were represented in this study, including rural districts, urban districts and semi-urban districts. Therefore, the chosen sample is representative of the population in a geographical sense. Only one grade was randomly chosen from each selected school, implicating that there is a risk that some grades might be under-represented in the study. There was parity between male and female research participants; therefore, the sample is representative of the population as far as gender is concerned. Learners and educators involved with Mathematics or Mathematical Literacy were

given preference in the study. The representatively of the sample with regard to other population characteristics, such as the age group of the participants and the private versus public status of the schools, was not examined in this study.

2.3.2.3.2 Sample size

The research population consisted of 300 learners and 100 educators (see Table 2.1). It represents 0.025% of the entire research population.

2.3.2.3.3 Research variables

The research variables identified for the perceptions survey can be grouped into four main categories: respondents' perceptions of the practice and understanding of OBE curriculum design issues; respondents' perceptions of the practice and understanding of OBE curriculum implementation issues; respondents' perceptions of their own preferences with regard to assessment including subjects' level of difficulty; and respondents' assessment of their use of IT. These variables are classified below either as dependent or as independent variables.

a) Dependent variables

The variable "use of ICT" was the dependent variable for this study.

b) Independent variables

The following are the independent variables used in the perceptions survey.

- Perceptions of curriculum design issues: This included data on the perceptions of educators of their participation in the design of learning outcomes. This relates to the first two OBE principles: clarity of focus and design down.
- Perceptions of curriculum implementation issues: This included data on respondents' perceptions of OBE practice and the perceptions of learners and educators with regard to

the way OBE is understood and practiced in the school. It also includes data on respondents' perceptions of the school environment, the assessment methods that they practice and the availability of study guides in their schools.

- Data on individual preferences represent the perceptions of learners and educators of their academic difficulties, and their preferred assessment and communication methods.

2.3.2.3.4 Research instrument

A questionnaire was designed in order to gather data on the different research variables mentioned above. The questionnaires were personally delivered to all participants at their schools. The researcher travelled to all corners of the province of KZN to administer and collect the questionnaires. The researcher organised sessions in each school to allow the participants to fill out the questionnaires and query aspects of the questionnaires that were not clear to them – the researcher was therefore present at all times. These sessions usually took place in a classroom specially organised for this purpose by the school principal. Each school visit was preceded by a telephonic conversation with the school principal for the purpose of explaining the study and making an appointment for the visit.

There was one type of questionnaire for learners and another type of questionnaire for educators. Both types of questionnaires initially enquired about the background of the participants, with reference to race, location, gender, age and whether the participants have a computer, a cell phone, and so on. The questionnaires then addressed matters concerning the school environment and learning conditions, the practice and understanding of OBE, and the identification of learners' and educators' academic difficulties. The questionnaire consisted of the following types of questions:

- Scaled response questions: Participants were asked to answer the question by selecting one of the "strongly disagree", "do not agree", "not sure", "agree", or "strongly agree" alternatives given to them.

- Rank response questions: Participants were required to answer to the questions by ranking their answers in order of preference from the given alternatives.
- Open-ended questions: Participants were required to discuss or explain their own views according to the questions asked.

Questions on the school environment and learning conditions dealt with issues such as the availability of computer and the internet, textbooks, laboratories and library resources and the suitability of class sizes.

Questions on the understanding and practice of OBE dealt with issues such as OBE principles, the clarity of outcomes, the design of the curriculum, high expectations and expanded opportunities.

Questions on academic difficulties dealt with issues such as the availability of OBE literature and textbooks, and ranking of the most difficult subject for both learners and educators.

Copies of the learners' and educators' questionnaires are presented in appendices A and B respectively.

2.3.3 Data collection

The gathering of data for this phase of the study took place from February 2007 to April 2007 on a full-time basis. The researcher physically distributed and collected the questionnaire to the participants of the schools under investigation.

2.3.4 Data analysis

The answers to the questionnaires were tabulated in a spreadsheet with the rows representing the research participants (learners or educators) and the columns representing the answers of these

participants. The spreadsheet reached a dimension of around 300 rows and 80 columns. It means there were potentially 80 variables to analyse. There was a need to select or group variables that were to be studied. The process for the variable selection and grouping is explained in the following section.

2.3.4.1 Data aggregation

Because the purpose of the study was to identify the most pressing challenges faced by schools with regard to the OBE curriculum design and implementation, variables related to curriculum design issues were grouped together and variables related to curriculum implementation issues were also grouped together. Background data was also identified as a variable, representing the characteristics of the population of the perceptions survey. To simplify the results, schools in small towns and large urban schools were grouped together to form the group non-rural schools. This resulted in having two possible values for location: rural and non-rural. With regard to racial groups, white people, coloured people and Indians were grouped together to form non-Africans. This was done merely in order to simplify data analysis, as technically, all these groups can be classified as Africans.

For each variable, a single value representing the collection of all columns under that variable was calculated using aggregation formulas. To clarify the combination of each variable, it was necessary to present the answers of the first two participants of this study as tabulated from the MS Excel spreadsheet.

a) Variable 1: Respondents' perceptions of curriculum design issues

The variable *respondents' perceptions of curriculum design issues* are the combination of the first two OBE principles: clarity of focus and design down of outcomes. These variables are based on a Likert-scale of questions. The questions are presented as Section I, Part 1 and 2 of appendices A and B. For the purpose of the calculations, an answer of "strongly disagree" was

assigned a value of “1”; “do not agree” was assigned a value of “2”; “not sure” was assigned a value of “3”; “agree” was assigned a value of “4”; and “strongly agree” was assigned a value of “5”. Table 2.2 presents all the variables that fall under the variable of OBE curriculum design issues. The sum of all the variables was calculated using MS Excel’s aggregation function SUM (range). The sum of all variables was therefore the value that indicates respondents’ perceptions of the curriculum design issues (Table 2.2).

Table 2.2: Curriculum design variable

Variables	Respondent 1	Value	Respondent 2	Value
1) Most outcomes are clearly stated.	Agree	4	Do not agree	2
2) Most outcomes are clearly broken down by DoE.	Do not agree	2	Do not agree	2
3) Most outcomes are clearly broken down by an educator.	Do not agree	2	Do not agree	2
4) The timeframe is clear in terms of the definition of outcomes.	Agree	4	Not sure	3
5) DoE is available for clarifications of outcomes.	Agree	4	Not sure	3
6) Assessment criteria for outcomes are clear.	Not sure	3	Not sure	3
7) The use of computers in the assessment process is satisfactory.	Not sure	3	Do not agree	2
8) Subject guidelines have a clear usable table of content.	Agree	4	Agree	4
9) Subject guidelines have a clear index.	Agree	4	Agree	4
10) Subject guidelines have clear identifiable sections.	Not sure	3	Do not agree	2
11) I can differentiate between levels of outcomes.	Do not agree	2	Do not agree	2
12) I understand the vertical integration of outcomes.	Do not agree	2	Do not agree	2
13) I understand the horizontal integration of outcomes.	Agree	4	Not sure	3
14) The combination of outcomes makes sense.	Not sure	3	Not sure	3
14) I have contributed to the design of outcomes.	Agree	4	Not sure	3
15) Learning building blocks are identifiable.	Agree	4	Not sure	3
16) Learning building blocks are clarified.	Not sure	3	Not sure	3
17) Timeframe is included in the definition of learning blocks.	Agree	4	Agree	4
Sum (variables)		**59**		**48**
Total		**85**		**85**

b) Variable 2: Respondents' perceptions of curriculum implementation issues

The variable *respondents' perceptions of curriculum implementation issues* are the combination of two OBE principles: expanded opportunities and high expectations. This variable deals with issues such as the school environment, the effectiveness of the outcome to help learners in choosing careers, learners' performance, educators' competence, assessment of teaching and learning standards and many more. These variables are also based on a Likert-scale of questions (see Appendix A). For the purpose of the calculations, an answer of "strongly disagree" was assigned a value of "1"; "do not agree" was assigned a value of "2"; "not sure" was assigned a value of "3"; "agree" was assigned a value of "4"; and "strongly agree" was assigned a value of "5". Table 2.3 presents all variables on OBE curriculum implementation issues. The sum of all the variables was calculated using MS Excel's aggregation function SUM (range). The sum of all variables was therefore the value that indicates respondents' perceptions of the curriculum implementation issues (Table 2.3).

c) Individual preferences

The variable *respondents' perceptions of individual preferences* is based on the assessment methods, communication modes used for teaching and learning, the perceived most difficult subject and the availability of textbooks according to learning areas. These are the ranking response variables outlined as Part II of Section I of appendices A and B. For assessment methods and communication modes preference it was necessary to select the first choice for all participants. Then, for assessment types, the score was distributed as follows: "Theory and Practice" was "3"; "Theory only" was "2"; and "Practice only" was given a value of "1". For the ranking of the most used communication mode, the scores were distributed as follows: "Mixed communication" was "3"; "Written communication" was "2"; and "Oral communication mode" was assigned a value of "1". For the ranking of the most used learning approach and assessment method, it was necessary to group Individual home assessment", "Individual class assessment and "Home self-study" together. The selection of one of them as the most used learning approach and/or assessment method was assigned a value of "3". Any learning approach that deals with

assessment method for learners working in groups was assigned a value of “2”. The classical and play learning approaches were assigned a value of “1”. The highest score of each variable represent a normal learner. For the purpose of the calculations, it was also necessary to group subjects according to the perceived level of difficulties. Mathematics was considered the most difficult subject area followed by science. However, for the most difficult subject, all six choices were taken into consideration. The scores were distributed as follows from “1” up to “6” respectively: “Other subjects”, “Business and Management”, “Arts and Culture”, “Languages”, “Science” and “Mathematics”, where “6” represents the most difficult subject. In case where participants ranked “Languages” or any other subject instead of Mathematics as the most difficult, the minimum score for the subject was recorded. For instance, if the user answered as follows (from the most difficult to the least difficult subject): Languages, Mathematics, Science, Arts and Culture, Business and Management, Other subjects, then “Languages” will not be assigned a score of 6 although it is indicated as the most difficult subject but it will receive a score of 4. Therefore, the score will not be (6+5+4+3+2+1) but (4+5+4+3+2+1), taking into consideration the minimum value when the subject is not in a perceived score position. Table 2.4 presents all the variables that fall under the variable of individual preferences.

d) The use of ICT

For the dependent variable use of ICT on the background information includes: availability of computers at home, school and tele-centres; the use of computers, the use of cell phones; the availability of televisions; and the indication of the most watched programmes. All variables that fall under the variable use of ICT are grouped together. These variables are based on Section 0 of appendices A and B and are closed-ended questions. It was necessary to assign “1” to “Yes” and “0” to “No” responses (Table 2.5) so that the total for all variables under this category can be clarified.

Table 2.3: Curriculum implementation issues

Variables	Respondent 1	Value	Respondent 2	Value
1) Education standards set for learning and teaching are usually high.	Agree	4	Agree	4
2) Most educators are competent enough.	Agree	4	Do not agree	2
3) Learners' performance is mostly high.	Agree	4	Agree	4
4) My own performance is mostly high.	Agree	4	Not sure	3
5) Most educators are well trained to perform their duties.	Agree	4	Agree	4
6) Classrooms are overcrowded.	Do not agree	2	Do not agree	2
7) Learners' attitude towards studying is adequate.	Do not agree	2	Not sure	3
8) Educators' attitude towards teaching is adequate.	Not sure	3	Not sure	3
9) OBE is a good education system.	Not sure	3	Agree	4
10) The timeframe for extra-curricular activities is adequate.	Agree	4	Do not agree	2
11) The archiving of subject records is satisfactory.	Not sure	3	Agree	4
12) The usage of computers for academic administration is satisfactory.	Not sure	3	Not sure	3
13) My school management support me in using OBE and its approaches.	Do not agree	2	Not sure	3
14) Learning techniques are easily identified.	Do not agree	2	Do not agree	2
15) Working in groups helps to improve learners' performance.	Agree	4	Agree	4
16) The use of computers in the learning process is satisfactory.	Do not agree	2	Not sure	3
17) Different learning methodologies promote laziness to learners.	Agree	4	Agree	4
18) The school's basic infrastructure (water, electricity, classrooms, playgrounds) is adequate.	Agree	4	Agree	4
19) Laboratories' infrastructure (excluding computer laboratories) is adequate.	Not sure	3	Not sure	3
20) The library's infrastructure (books, staff, space, time) is adequate.	Agree	4	Not sure	3
21) Learning activities lay foundations for basic knowledge.	Agree	4	Not sure	3
22) Learning activities lay foundations for basic career needs.	Agree	4	Not sure	3
23) Learning activities lay foundations for hands-on-oriented careers.	Agree	4	Not sure	3
24) Learning activities lay foundations for futuristic career needs.	Do not agree	2	Do not agree	2
25) Educators and school management organise experts to solve learners' problems and classroom matters.	Do not agree	2	Do not agree	2
28) My school is taking the first step to contact other schools to assist in matters concerning OBE.	Not sure	3	Do not agree	2
Sum		**89**		**83**
Total		**180**		**180**

Table 2.4: Individual preferences

Variables	Respondent 1	Value	Respondent 2	Value
1) Preferable type of assessment	Theory and practice	3	No answer	0
2) Preferable communication mode	Written	2	No answer	0
3) Rank the most used assessment method	Individual home assessment	2	Individual home assessment	2
4) Rank the most used learning approach	Individual home assessment	3	Individual home assessment	3
5) Rank the most difficult subject				
a) Difficult subject 1	Mathematics	6	Science	5
b) Difficult subject 2	Science	5	Mathematics	5
c) Difficult subject 3	Languages	4	Business and Management	2
d) Difficult subject 4	Arts and Culture	3	Arts and Culture	3
e) Difficult subject 5	Business and Management	2	Other	1
f) Difficult subject 6	Other	1	Languages	1
6) Rank the availability of textbooks				
a) Subject 1	Languages	1	Other	0
b) Subject 2	Mathematics	2	Arts and Culture	1
c) Subject 3	Science	3	Business and Management	2
d) Subject 4	Arts and culture	1	Languages	3
e) Subject 5	Business and Management	2	Science	4
f) Subject 6	Other	0	Mathematics	5
7) Rank the timeously arrival of textbooks				
a) Subject 1	Languages	1	Other	0
b) Subject 2	Mathematics	2	Arts and Culture	1
c) Subject 3	Science	3	Business and Management	2
d) Subject 4	Arts and culture	1	Languages	3
8) Rank the availability of library books				
a) Subject 1	Languages	1	Other	0
b) Subject 2	Mathematics	2	Arts and Culture	1
c) Subject 3	Science	3	Business and Management	2
SUM (variables)		58		67
TOTAL		180		180

Table 2.5: The use of ICT

Variables	Respondent 1	Value	Respondent 2	Value
1) Have a computer at				
a) Home	No	0	Yes	1
b) School	Yes	1	Yes	1
c) Telecentre	No	0	No	0
2) Does your PC have internet access?	No	0	No	0
3) How much did the computer cost?	N/A	0	Don't know	0
4) What do you use the computer for?				
a) Playing games	No	0	Yes	1
b) Watching TV	No	0	No	0
c) Typing	Yes	3	Yes	3
d) Studying	Yes	3	Yes	3
e) Surfing the net	No	0	Yes	1
f) Work	No	0	No	0
g) Watching DVDs	No	0	No	0
h) E-mail	No	0	Yes	1
5) Do you have a television at home?	Yes	1	Yes	1
6) How often do you watch television?	Less than 2 hours	1	2 to 3 hours	2
7) Programmes you watch the most				
a) News	No	0	Yes	2
b) Educational programmes	Yes	3	Yes	3
c) Talk shows	Yes	2	Yes	2
d) Drama	Yes	1	Yes	1
e) Soapies	Yes	1	No	0
f) Movies	Yes	1	Yes	1
g) Magazine programmes	No	0	Yes	1
h) Sport	Yes	1	No	0
i) Music	Yes	1	No	0
Sum (variables)		**20**		**24**
Total		**55**		**55**

2.3.5 Survey findings

This section presents the research findings of the survey with regard to the impact of the use of ICT and the understanding of OBE on the perceptions of learners and educators of their working conditions. The profile of the research participants is first presented, followed by the analysis of research results.

2.3.5.1 Characteristics of the research population

The background of the research phase one participants is presented in this section and is divided into demographics and ICT adoption. Background data includes issues of: race, gender, age, social status (rural versus urban, private versus public) and ICT adoption. Results with regard to demographics and ICT adoption are presented below.

a) Demographics

There were 104 educators and 304 learners in the research sample. These educators and learners come from five primary schools, seven junior secondary schools, and seven senior secondary schools, classified between four private and fifteen public schools, with nine schools located in rural areas, seven in small towns and three in major cities. Fifty-four per cent of the educators were female and 46% were male, and 50% of the learners were female, and the other 50% were male. Seventy-two per cent of the educators and 84% of the learners were Africans.

b) Information and communication technology adoption

The survey reveals that cell phones and televisions are widely adopted by educators. Indeed, 100% of the educators reported that they own both cell phones and a television. This figure is however significantly lower for the learners. Only 45% of the learners own a cell phone, and only 70% of the learners have access to a personal television.

Forty per cent of the educators reported that they do not have access to a computer at all, neither at home, at schools, nor at tele-centres. Twenty-seven per cent of the educators reported that they only have access to computers at school. The rest of educator population (almost 30%) does have access to computers either at home, at school or at a tele-centre.

With regard to the learners, 60% that do not have access to computers at all. In addition, the percentage of learners that rely on schools for access to computers is 15%, which is small compared to the 25% reported by the educators.

2.3.5.2 Respondents' perceptions

This section reports on the perceptions of respondents based on the research variables: assessment of curriculum design issues, assessment of curriculum implementation issues and individual preferences. Table 2.6 presents the correlation analysis of the results according to occupation, gender, location, ownership and racial group.

2.3.5.2.1 Assessment of curriculum design issues

The participants of this research scored 50% average on curriculum design issues. This means that the participants are satisfied are satisfied and not satisfied with some of the curriculum design issues. There is a positive correlation expressed by African male learners (0.90) of private schools and there is a negative correlation expressed by non-African male learners (-0.60) of private schools. There is also a positive correlation expressed by African male learners (0.52) of public schools. Therefore, for both private and public schools, only African males are of the opinion that ICT is used for curriculum design issues. Interestingly, though, there is no correlation whatsoever shown by female learners of both private schools and public schools. This therefore depicts that male learners either assess things positively or negatively (Table 2.6).

With regard to educators, Table 2.6 reflects that only African females (0.50) teaching in private schools showed a positive correlation between curriculum design issues and the use of ICT. There is also a negative correlation for non-African male educators that teach in rural schools (-0.97) and non-rural schools (-0.56).

On average, therefore, both educators and learners indicated that there is no impact of ICT usage when dealing with curriculum design issues.

2.3.5.2.2 Assessment of curriculum implementation issues

Table 2.6 reflects that there is a positive correlation expressed by learners from private schools, irrespective of gender and racial group. This might be because their schools are well equipped with computers and they themselves own IT devices such as cell phones. The same is unfortunately not true for their peers in public schools.

Table 2.6 also reflects a correlation expressed by female educators of private schools irrespective of the racial group they belong to. However, public school educators reflect a negative correlation between curriculum implementation issues and the use of IT.

2.3.5.2.3 Individual preferences

There is a negative correlation expressed by African male learners (-0.99) and non-African female learners (-0.54) studying in private schools between individual preferences and the use of IT. There is a positive correlation (0.87) expressed by non-African female learners studying in public schools (Table 2.6).

When it comes to educators, there is a negative correlation expressed by female African educators (-0.50) and there is a positive correlation expressed by female non-African educators (0.87) working in private schools (Table 2.6).

Table 2.6: Correlation analysis between variables

BACKGROUND					VARIABLES			
					INDEPENDENT			DEPENDENT
OCCUPA-TION	OWNER-SHIP	LOCA-TION	RACIAL GROUP	GENDER	PREFERENCE	DESIGN ISSUES	IMPLEMENTATION ISSUES	
Learner	Private	Non-rural	African	Female	0.025	0.20	**0.83**	
				Male	**-0.99**	**0.92**	**0.61**	
			Non-African	Female	**-0.54**	0.45	**0.58**	
				Male	-0.19	**-0.60**	**0.61**	
	Public	Non-rural	African	Female	0.28	0.23	-0.56	
				Male	0.21	**0.52**	0.26	**IT**
			Non-African	Female	**0.57**	-0.17	0.17	
				Male	0.50	-0.30	0.32	
		Rural	African	Female	-0.01	0.35	-0.13	
				Male	0.02	0.22	0.02	
Educator	Private	Non-rural	African	Female	**-0.50**	**0.50**	**0.50**	
				Male	0.01	0.02	0.40	
			Non-African	Female	**0.87**	-0.21	**0.50**	
				Male	-0.33	**-0.97**	-0.03	
	Public	Non-rural	African	Female	-0.48	-0.38	**-0.82**	
				Male	0.01	0.03	**-0.90**	
			Non-African	Female	-0.44	0	**0.64**	
				Male	-0.46	-0.06	-0.63	
		Rural	African	Female	-0.04	-0.04	-0.18	
				Male	-0.13	0.19	-0.22	
			Non-African	Female	-0.32	0.21	0.27	
				Male	-0.13	**-0.56**	0.24	

2.3.6 Summary of the findings

The survey's findings can be divided into five categories: demographics, ICT adoption, assessment of curriculum design issues, assessment of curriculum implementation issues and individual preferences. The demographics of the population studied revealed that most learners and educators were black, Zulu speaking and female. The age range for most of the educators is

30 to 50 years. These demographics are in line with the characteristics of the general population in KZN province of South Africa.

The survey reveals that all educators have their own cell phone and television set, but that is far from being the case for learners, where it is reported that only one-third of learners own a cell phone, and almost half of the learners do not have access to a personal television. Access to computers is also low for educators, with 40% of the educators reporting no access at all, with a higher figure of 60% for learners. Schools do not seem to give support regarding access to computers, especially for learners, as only 15% of the learners reported that they do have access to computers at school. This figure is slightly higher for educators, namely 25%.

The results reflect that approximately 90% of the participants do not use IT for educational purposes, and do not even have access to ICT's. These results show that even those who own devices such as cell phones and televisions do not use them for educational purposes, especially the learners studying at public schools in rural areas.

2.4 Conclusion

This chapter presented the literature on the use of OBE in the South African curriculum, the perceptions of educators and learners of their understanding of OBE, and the impact of ICT on education.

Although OBE is regarded as a good educational system, this chapter shows that many learners have a negative regard for this educational system. Some criticisms concern the understanding and terminology of OBE, the training of educators in the OBE system, the lack of support from school principals, the exclusion of educators from OBE planning, and the lack of support from departmental officials during the implementation of OBE. The use of ICT in the learning and teaching of Mathematics is reported in this chapter as a good way for educators and learners to

solve mathematical problems, as evidenced by research mainly conducted in developed countries.

The research design that was followed was also described in this chapter, with a detailed explanation of why the chosen research methods were used. The researcher also outlined the scope of the research, and research variables and the research instruments used for this study were discussed. The data-gathering techniques used in this study were also outlined in this chapter.

Lastly, this chapter presented the survey findings between a dependent variable and independent variables.

Chapter 3

THE DESIGN OF AN E-LEARNING CONTENT PROTOTYPE

3.1 Introduction

The purpose of this chapter is to present the requirements, analysis and design of an e-learning content prototype for the training of Mathematics educators to effect understanding of OBE. This chapter starts by presenting the system requirements. The Unified Process Model was used to analyse the requirements and to create the design artefacts of the system. These design artefacts were converted into a SCORM-compliant course content prototype with the help of the Reload Editor software. Lastly, the system itself is presented in this chapter.

3.2 Requirements

The purpose of the SCORM-based course content prototype is to train educators on the main OBE concepts and to provide some assistance for Mathematics and Mathematical Literacy courses.

The main requirements of the system is that it must be based on the content of the most important official documents relating to the South African OBE system, including policy documents as well as curriculum documents, with an emphasis on the mathematics subject area.

3.2.1 Subject statements

A subject statement describes the outcomes of the subject, the associated assessment standards and the competence descriptions for different grades. These subject statement documents are

located on the DoE website (Department of Education, 2007d) under the title “NCS Subject Statements”. There is one document for Mathematics for grades R to 12 and another subject statement document for Mathematical Literacy for grades 10 to 12. It is required of the system to present to users subject statements for Mathematics and Mathematical Literacy only. The system is also required to present the definition of the term ‘subject statement’.

3.2.2 Subject teaching activities guidelines

The guidelines on how to plan teaching activities for the subject are located on the DOE website (Department of Education, 2007b) under the heading “NCS Learning Programme Guidelines”. There is one learning programme document for Mathematics and one for Mathematical Literacy. In addition, there is one Mathematics document under the title “Teacher Guide: Mathematical Literacy Teacher Guides”; one under the title “NCS Development of Learning Programmes”; and one under the title “Teaching Reading in the Early Grades: A Teacher’s Manual 09 January 2008” for grades R to 9. The guidelines on how to plan teaching activities for the subject in a vocational programme are classified according to their National Qualifications Framework (NQF) levels (from Level 2 to Level 4). These guidelines have been placed on the DoE website (Department of Education, 2007b). There are three Mathematics documents and three Mathematical Literacy documents under the title “NC (Vocational) Subject Guidelines”. The guidelines on how to plan teaching activities in a training college for the various topics of the subject are located on the DoE website under the title “Further Education and Training Colleges Training Manuals”. These guidelines consist of five Mathematics documents and three Mathematical Literacy documents. It is required of the system to present the Grade 11 and/or Grade 12 subject guidelines for Mathematics and Mathematical Literacy subjects only. General information on the clarity of guidelines is also required to be presented on the system.

3.2.3 Assessment guidelines

The assessment guidelines are located on the DoE website (Department of Education, 2007a) under the title “NCS Subject Assessment Guidelines”. There is one assessment guideline document for Mathematics and one for Mathematical Literacy for grades 10 to 12. There is one assessment guideline document for Mathematics under the title “NCS Assessment guidelines” for the Intermediate Phase. There is also one assessment guideline document for Mathematics under the title “NCS Foundation Phase Assessment Guidelines Grade R–3” for the Foundation Phase. The assessment guidelines for subjects in a vocational programme are classified according to their NQF levels (from Level 2 to Level 4). These guidelines have been placed on the DoE website (Department of Education, 2007a) under the title “NCS (Vocational) Assessment Guidelines”. There are three assessment guidelines documents for Mathematics and three for Mathematical Literacy for vocational studies. There are also guidelines on how to assess subjects that are based on foreign languages such as French, Portuguese, Spanish, and so on. Such guidelines, however, did not fall within the scope of this study. The guidelines for practical assessment tasks if the subject involves any practical aspects such as laboratories, etc. Because Mathematics does not involve any practical activities, there are no documents under this section on the DoE website (Department of Education, 2007a). The system is required to present assessment guidelines for grades 11 and or 12 for Mathematics and Mathematical Literacy only. The types of assessments, methods of assessment and assessment standards are required to be presented by the system.

3.2.4 Examination guidelines

The guidelines for the March, June, September and November examinations are presented. There is one Mathematical Literacy document under the title “Examination Guidelines for Grade 12 NCS 2008” on the DoE website (Department of Education, 2007c). There is one Mathematics document under the title “NCS Assessment Guidelines” for the Intermediate Phase. There is also one Mathematics document under the title “NCS Foundation Phase Assessment Guidelines

Grade R–3" for the Foundation Phase. The system is required to present Grade 11 examination guidelines for Mathematics and Mathematical Literacy.

The examination exemplars and papers for the subject for different years with their marking memorandums for Mathematics are presented. These documents have been placed on the DoE website (Department of Education, 2007c) under the title "NCS Grade 12 Exemplar 2008". There are six Grade 12 examination exemplars for Mathematics and four Grade 12 examination exemplars for Mathematical Literacy. One document is a teacher guide to examinations under the title "Teacher Guide: Mathematics and Mathematical Literacy Exemplar Examination Papers and Memorandums for Grades 10–12 (NCS)". There are six Grade 11 Mathematics examination documents and four Grade 11 Mathematical Literacy examination documents under the title "NCS Grade 11 Examination 2007". There are also six Grade 10 Mathematics documents and two Grade 10 Mathematical Literacy documents under the title "Scholar Information Grade 10 November 2006 Question Papers". It is required of the system to present exam exemplars for grades 10 and 11 final examination papers as well as their memorandums for 2006 and 2007.

3.2.5 Teacher training manual

The teacher training manual for the subject for a five-day training course. These documents have been placed on the DoE website (Department of Education, 2007e) under the title "NCS Teacher Training Manual" (one document for Mathematics and another one for Mathematical Literacy) for grades 10 to 12. The system is created based on these documents. It is therefore required for the system to present the training programme session by session.

3.2.5 Vocational training

These are general documentation on vocational training on the DoE website. These documents are located under the title "Further Education and Training Colleges" (Department of Education, 2007f). As mentioned before, these documents do not fall within the scope of this study.

3.2.6 Scenario for the design of the system

An educator must be able to perform that tasks are required by the DoE. An educator must be able to use a teacher guide for the subject that he or she is teaching. In the teacher guide, the necessary subject topics, syllabus, lesson durations and the timeframe for assessment are clearly defined. However, educators are allowed to use their own timeframes, provided that they do not fall behind the DoE's timeframe. Educator must therefore prepare for the learners' classes, tests and assignments, and all of these must be captured correctly. These assessment tasks must be in harmony with the outcomes of the subject as outlined in the teacher guide. All assessments must be moderated by the subject leader in a school or someone that will be selected by the school principal to do so in order to ensure that the outcomes of the subjects are met. The educator as well as the subject leader should familiarise themselves with the subject statements and the assessment methods that can be used for that subject. The subject files have to be ready for auditing at any time that the departmental official wishes to access them (Figure 3.1).

Since this study was only concerned with the training of educators, the focus was not on all the activities that an educator can perform, but on the activities that relate to the design of the curriculum. In summary, therefore, the system is required to

- train Mathematics and/or Mathematical Literacy educators in the OBE curriculum;
- allow educators that do not teach Mathematics or Mathematical Literacy to also use the system to effect understanding of OBE; and
- provide curriculum documentations related to the training to the users.

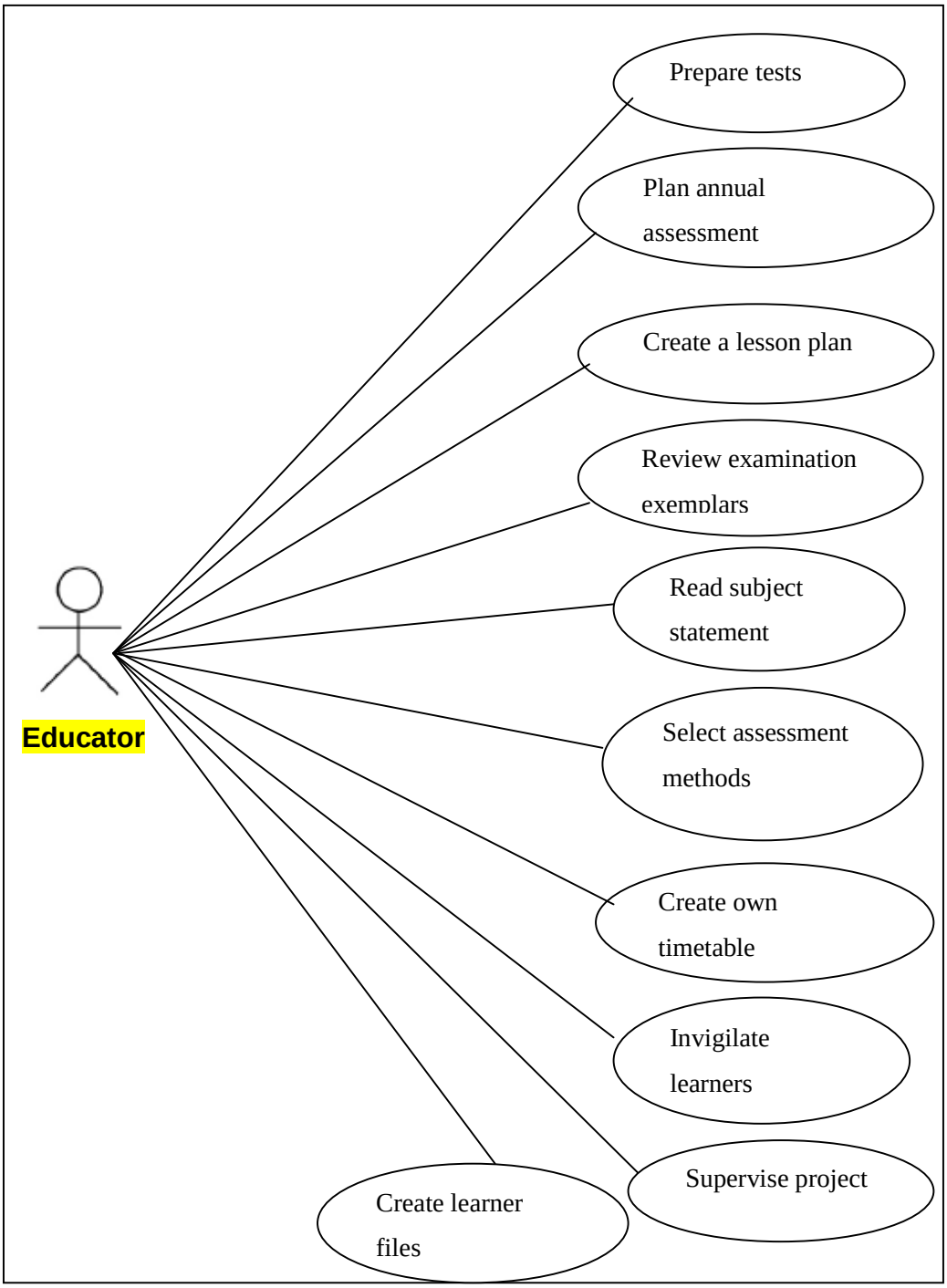

Figure 3.1: Use case for educators

3.3 Research design

This section presents the research sampling, research variables and the research instrument used to analyse the curriculum documents used for the study.

3.3.1 Research sampling

The number of documents in the research population is estimated to be 70 documents and each document is at least 50 pages or more. It is important, however, to note that not all the information in each document was used, but only the information that related to the design of the e-learning content prototype.

3.3.2 Sampling method

The documents were classified into two categories: documents that help to shape the structure of the e-learning course content, and documents that could be used to populate this structure with the relevant content. In general, documents chosen in the sample had to be related to the challenges identified in the first phase of this research. Only English documents were considered. Subject-specific documents related to Mathematics or to Mathematical Literacy were given priority. General documents also formed part of the sample, provided that they can also be used for Mathematics or for Mathematical Literacy.

3.3.2.1 Sample size

The research sample of the prototype design was seven documents under Further Education and Training (FET) (grades 10–12), four documents under Teacher Guide, and five documents under General Education and Training (GET) (grades R–9). The numbers represent the number of documents under the specified categories. It represents 0.05% of the entire research population.

3.3.3 Research variables

The research variables of this research phase were classified into research variables for the prototype design and research variables for the prototype evaluation.

The research variables were further grouped into six main categories which are independent variables: language of the document, the nature of the document, the subject-specific content of the document, the grade level of the document, the nature of the challenges addressed by the document and the role of the document in the construction of the e-learning content prototype.

a) Independent variables

The research documents were described according to the following independent variables:

- The language of the document. It is a language in which the document is written. It can be English, Sotho, Afrikaans, Zulu, and so on.
- The general nature of the document. It describes the classification according to the OBE terminology. It can either be statement documents, teaching guidelines, assessment guidelines, examination exemplar papers or memorandums, and teacher training manuals.
- The subject-specific content of the document. The subjects were either Mathematics or Mathematical Literacy.
- The grade level of the document. The documents ranged from Grade R to Grade 12.
- The description of the document. It provides a brief summary of the content of the document.
- The nature of the challenges addressed by the document. These challenges were identified in the first phase of the research.

b) Dependent variable

The dependent variable of the prototype design was the following:

- The role of the document in the construction of the e-learning content prototype. This role could either be a structural role or a content role.

3.3.4 Research instrument

The internet was the main instrument used for the collection of the documents for the study. More specifically, the website of the DoE of South Africa was the main source of information for the second phase of this study. The second research instrument used was an open-source e-learning content editor called Reload Editor. This tool was used by the research to create the SCORM-compliant e-learning content prototype.

3.4 The prototype

To develop the e-learning content prototype, Hypertext Mark-up Language (HTML) was used to develop webpages for e-learning teacher training course content prototype. The webpages were then uploaded to SCORM's Reusable Learning Object Authoring and Delivery (Reload) Editor for e-learning prototype. The Reload Editor was selected because it allows the course designer to create, import, edit and export content pages. The prototype is based on the teacher training manual provided by the DoE. There are two different training content in the e-learning content prototype: one for Mathematics and another for Mathematical Literacy. Both trainings were divided into four sessions: introduction to the National Curriculum Statement (NCS) and the National Senior Certificate (NSC); introduction to Mathematics or Mathematical Literacy subject statements; planning for teaching Mathematics or Mathematical Literacy; and the annual assessment plan.

3.4.1 Structure of the e-learning content

The e-learning content for Mathematics and Mathematical Literacy is similar for sessions 1, 3 and 4. They only differ in Session 2 (Figure 3.2).

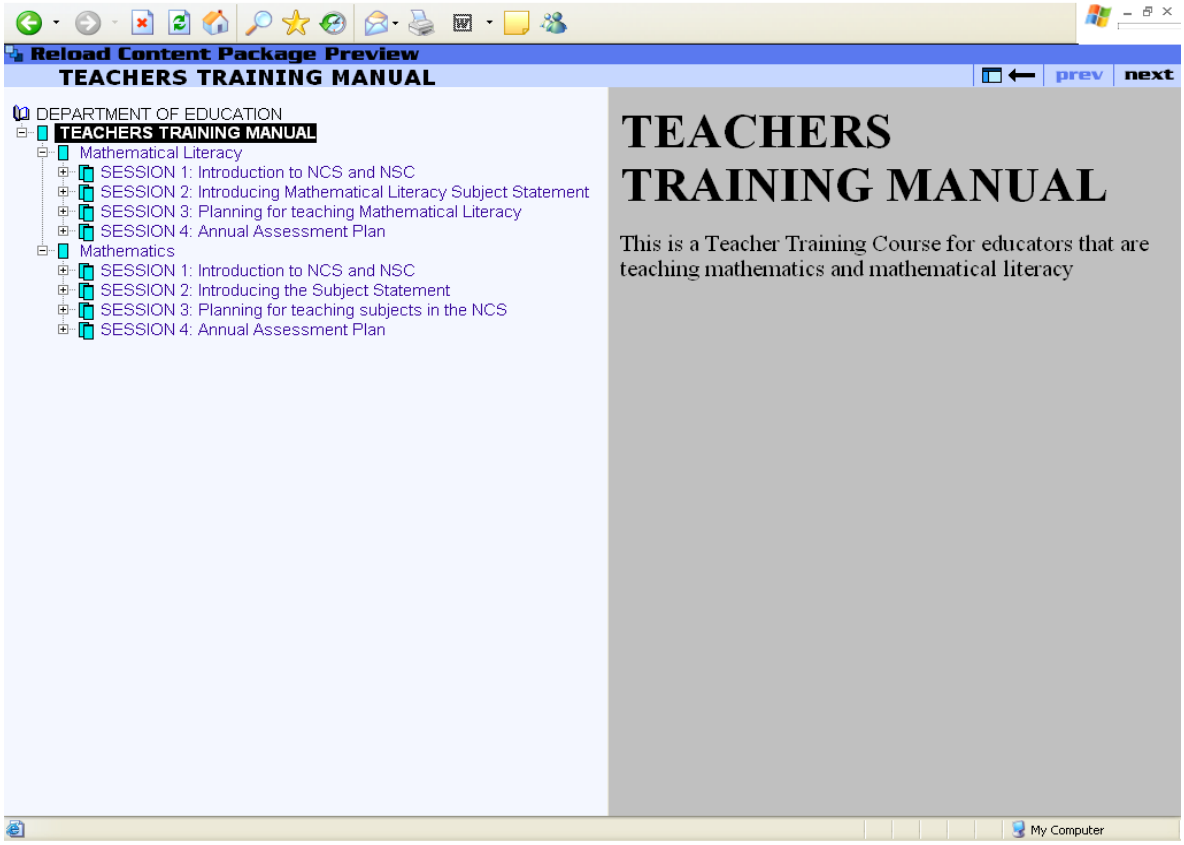

Figure 3.2: Teacher training manual: E-learning content for Session 1

The first session, namely the introduction to the NCS and the NSC, is divided into two activities, which are an overview of the documents provided in the e-learning content and the clarification of the NCS and the NSC in this e-learning teacher course training (see Figure 3.3).

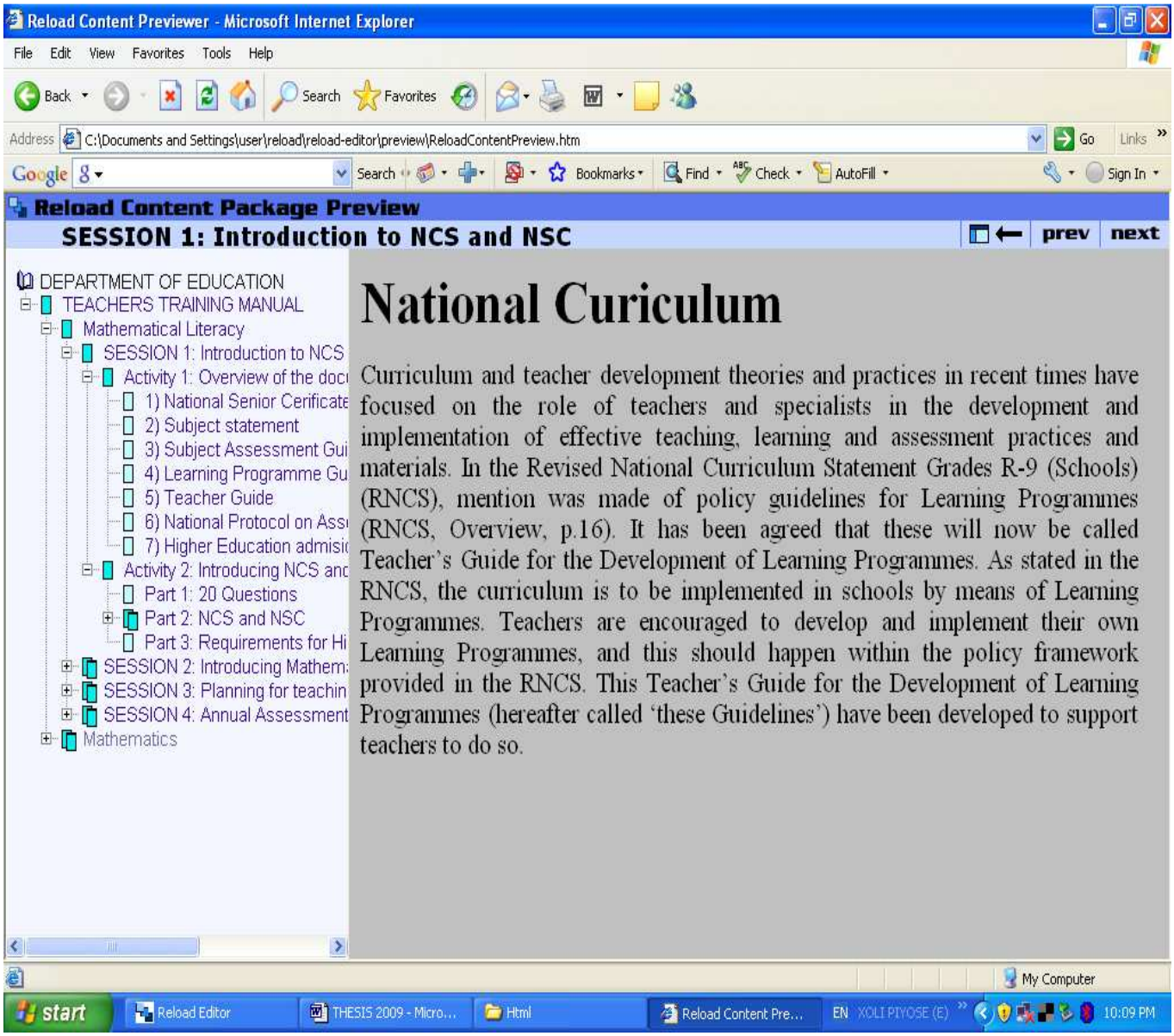

Figure 3.3: Session 1: Introduction to the NCS and the NSC

(i) Activity 1: Overview of the documents

There are seven documents provided in the e-learning content prototype under Activity 1, namely the National Senior Certificate Policy, subject statement, subject assessment guidelines, learning programme guidelines, teacher guide, national protocol on assessment, and higher education admission requirements. When the user clicks on each document, the PDF file will be displayed on the screen with the explanation with regard to that link. For instance, when the user clicks on National Senior Certificate Policy, the document explaining this policy will be displayed (see Figure 3.4).

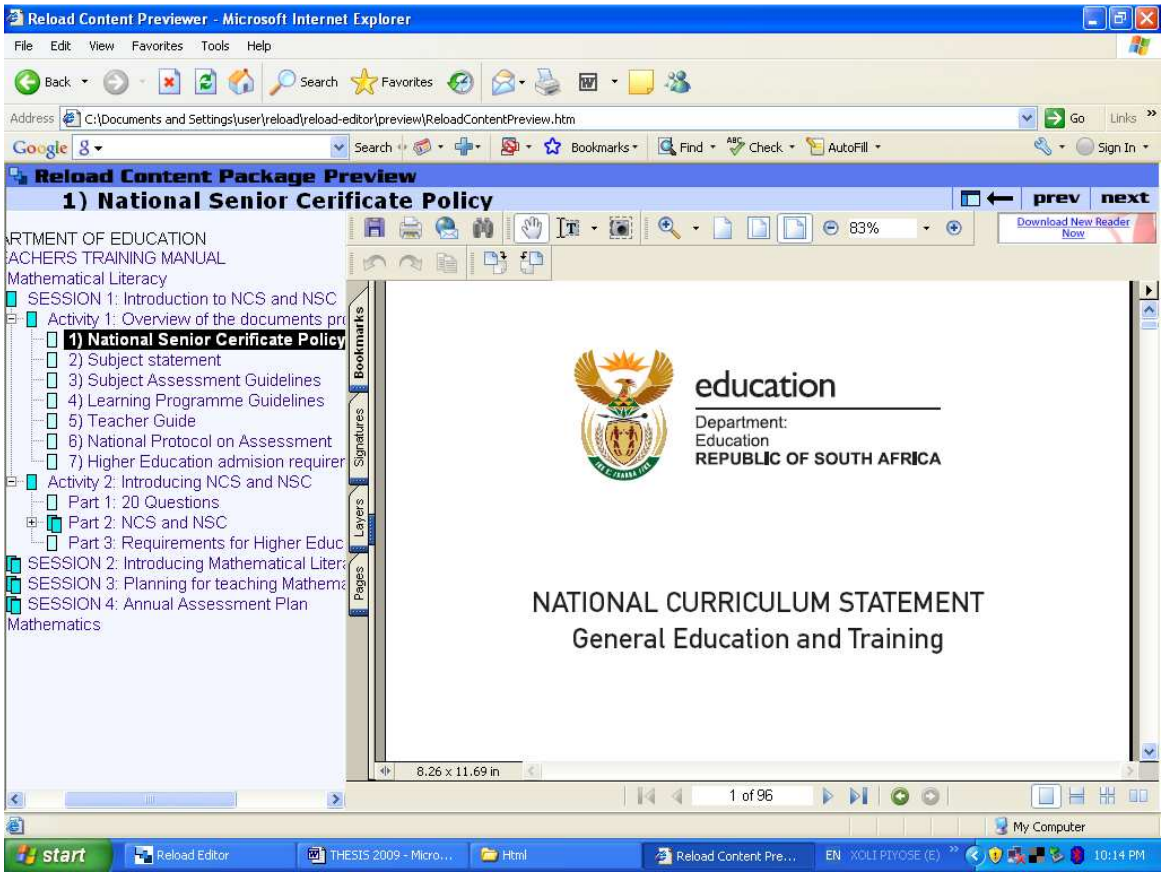

Figure 3.4: Session 1, Activity 1: National Senior Certificate Policy

(ii) Activity 2: Clarification of the NCS and the NSC

Under clarification of the NCS and the NSC, there are three documents, namely 20 Questions, where educators are provided with 20 questions to test their knowledge of the NCS; NCS and NSC, which clarifies the curriculum statement and eight curriculum principles, namely social transportation; OBE; high knowledge and high skills; integration and applied competence; progression, articulation and portability; human rights and inclusivity; valuing indigenous knowledge systems; and credibility and quality (see Figure 3.5). OBE has rich content as compared to other curriculum principles.

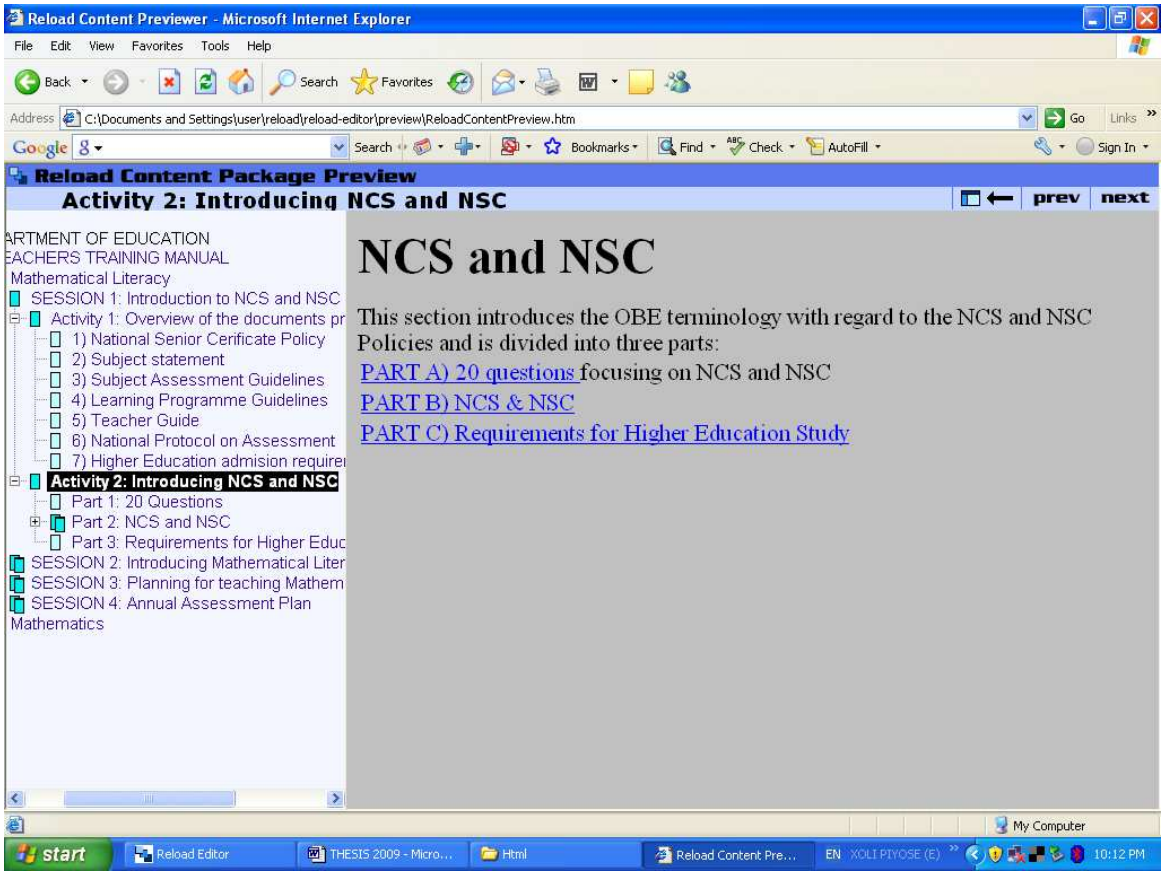

Figure 3.5: Session 1, Activity 2: Clarification of the NCS and the NCR

OBE has two links, namely OBE principles, with its four main principles, and the OBE learning field, with learning programme guidelines and definitions that include the clarification of some OBE terminology with regard to subject, definition, scope, purpose, learning field and learning programme guidelines; and learning programme types. The learning programme types are divided into GET for grades R to 9, FET for grades 10 to 12, and Higher Education and Training (HET) for higher certificates, diplomas and degrees. However, it is very important to note that GET and HET did not form part of this study, as it was limited to an e-learning content prototype for FET educators. There are eight learning areas presented under FET, which are languages; arts and culture; business and management services; technology and engineering; human and social sciences; and mathematical, computer and agricultural sciences.

b) E-learning content for Session 2: Mathematics

The second session, Introduction to Mathematics and Introduction to Mathematics Literacy, is different, as it is structured according to the subject needs or curriculum. For Mathematics teacher e-learning content prototype, the second session was divided into four activities, namely introduction to Mathematics; Mathematics learning outcomes and assessment standards; content and context for the attainment of assessment standards; and recommendations and closure (see Figure 3.6).

(i) Activity 1: Introduction to Mathematics

Under this link, there is a PDF document that defines mathematics, the purpose of studying mathematics, the scope of the subject and educational and career links for mathematics learners (see Figure 3.6).

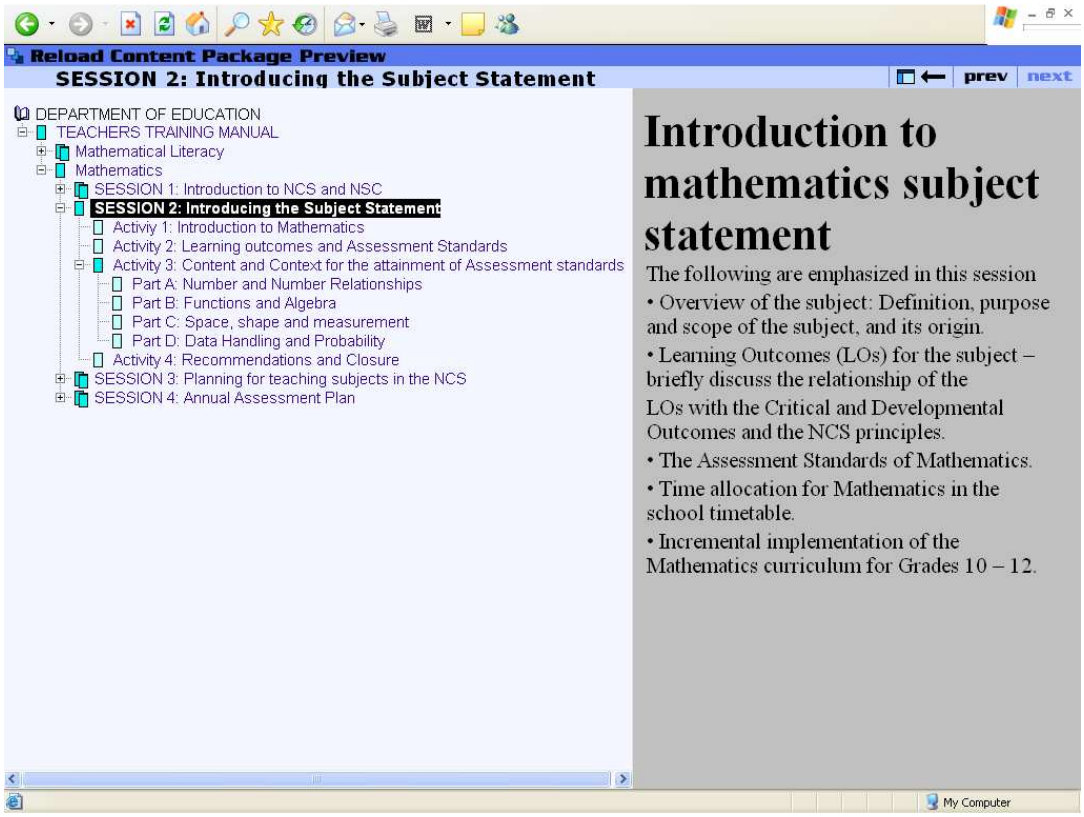

Figure 3.6: Session 2 and its activities for Mathematics educators only

(ii) Mathematics learning outcomes and assessment standards

There are four learning outcomes displayed under this activity, namely functions and algebra, number relationships, shape measurement and data handling. When the user clicks on each learning outcome, the information with regard to that link clarifying the outcome and assessment standards is displayed on the screen (see Figure 3.8).

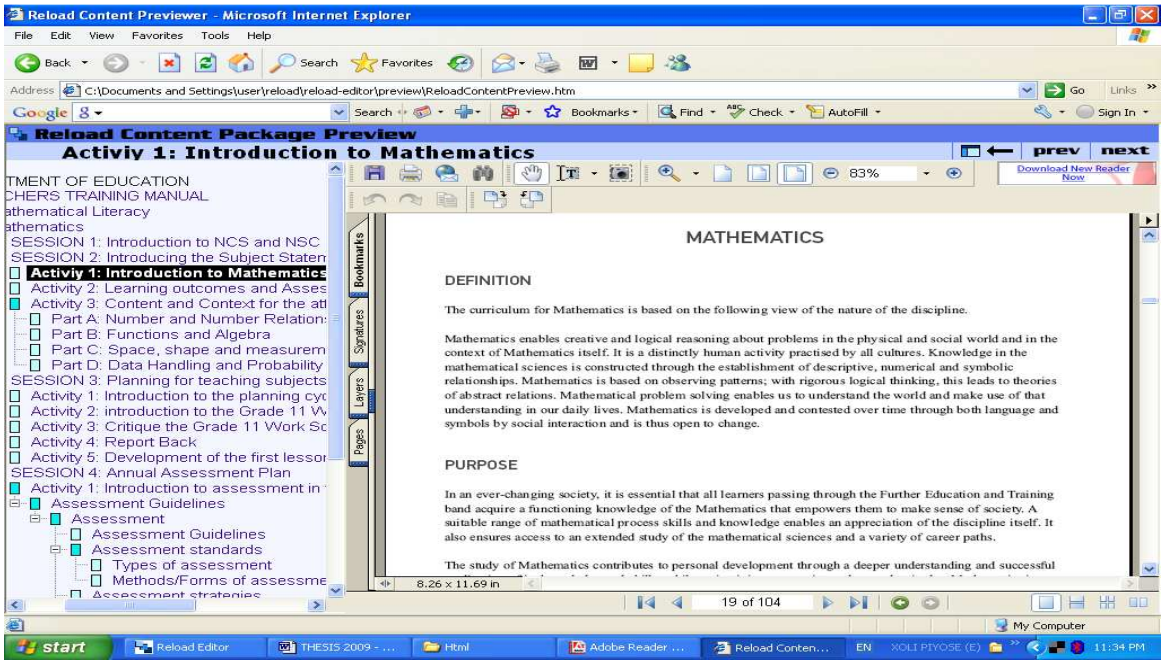

Figure 3.7: Introduction to mathematics

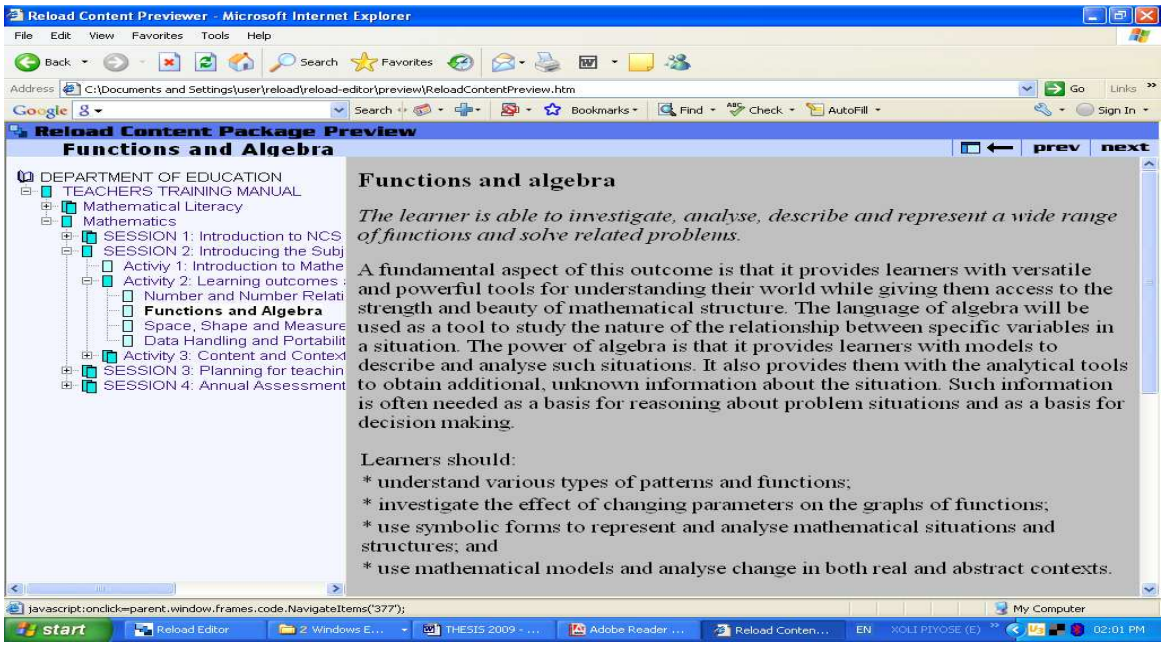

Figure 3.8: Learning outcomes

(iii) Content and context for the attainment of assessment standards

Content and the actual context for the attainment of assessment standards of learning outcomes are presented in this section. There are four parts under the attainment of assessment standards, namely number and number relationships; functions and algebra; space, shape and measurement; and data handling and probability. When the user clicks on the link, the information specific to that link will be displayed on the screen. For instance, when the user clicks on the space, shape and measurement link, the information explaining the attainment of assessment standards for space, shape and measurement will be displayed (see Figure 3.9).

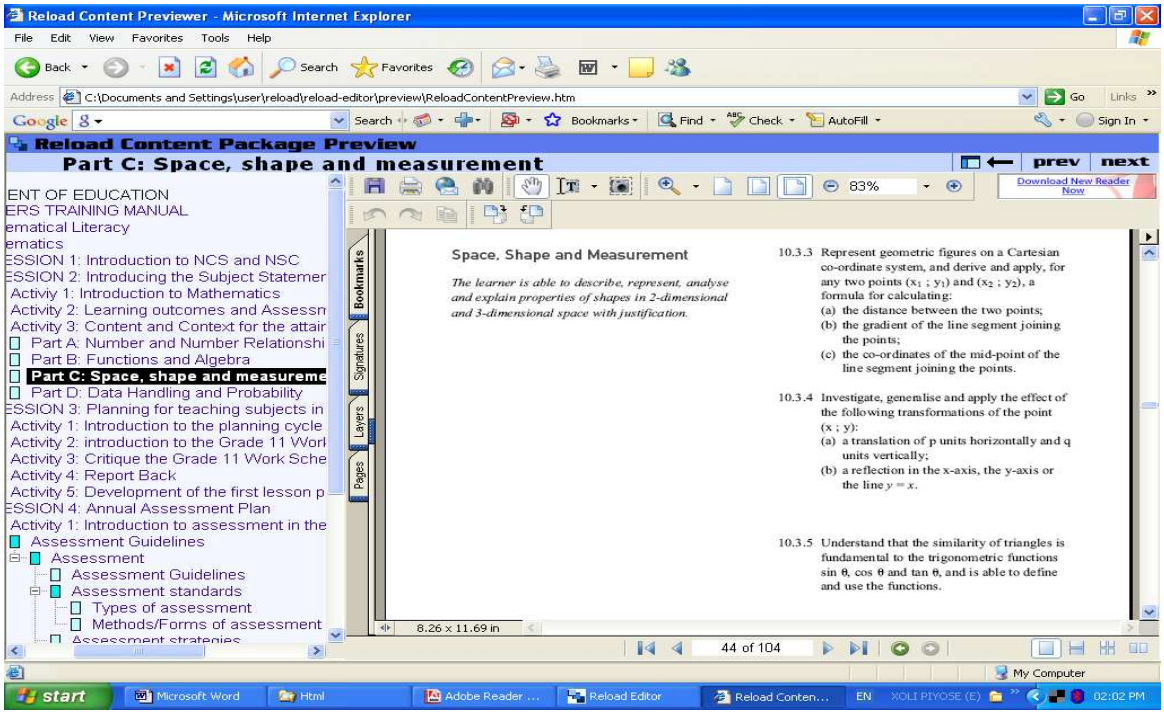

Figure 3.9: Space, shape and measurement

c) E-learning content for Session 2: Mathematical Literacy

For Mathematical Literacy, the second session is divided into eight learning outcomes, namely subject statement; income and expenditure; space and shape; calculating costs; measuring and

calculating; data handling; introduction to Mathematical Literacy; and teaching Mathematical Literacy (see Figure 3.10).

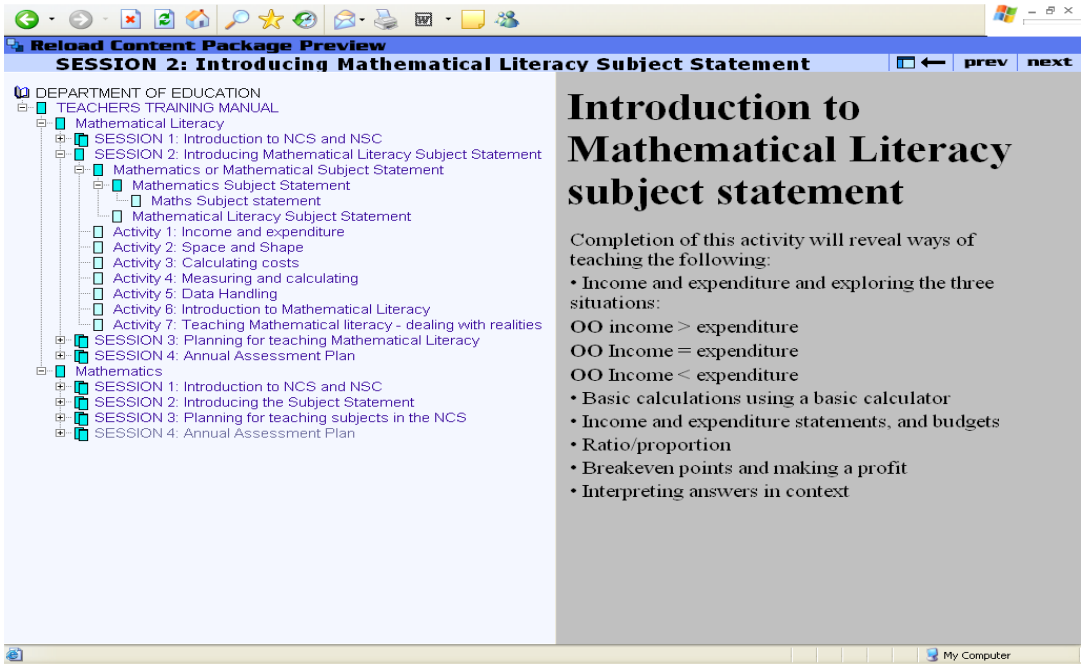

Figure 3.10: Session 4 and its activities for Mathematical Literacy educators only

When the user clicks on each link, the information with regard to that link will be displayed on the screen. For instance, when the user clicks on “Introduction to Mathematical Literacy”, a PDF file clarifying the definition of Mathematical Literacy, the purpose of the subjects and educational and career links will be displayed on the screen (see Figure 3.11).

d) E-learning content for Session 3

The third session, planning for teaching subjects in the NCS, is divided into four activities, namely introduction to the planning cycle; developing a subject frame; developing a working schedule; and developing a lesson plan (see Figure 3.12).

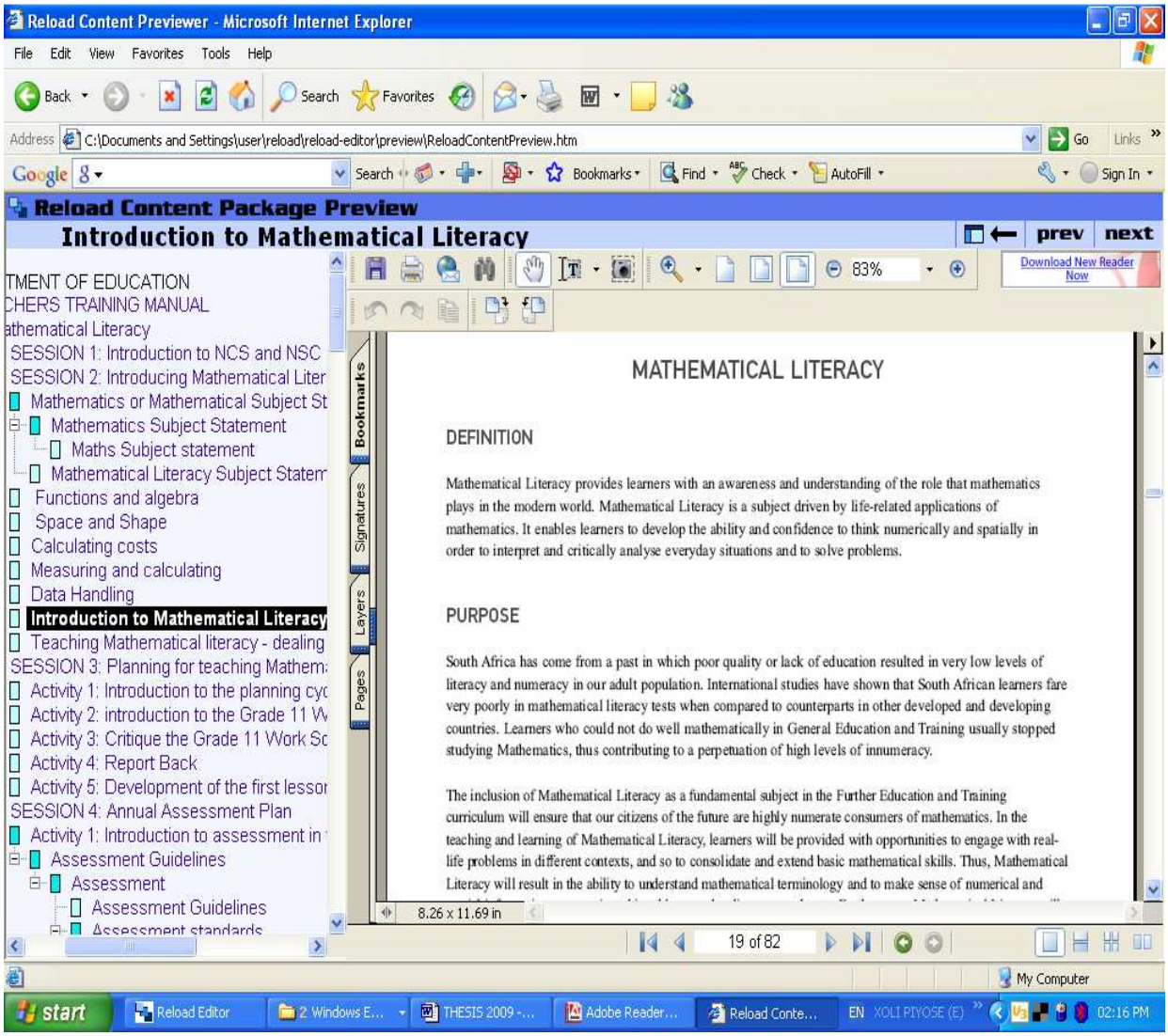

Figure 3.11: Introduction to Mathematical Literacy

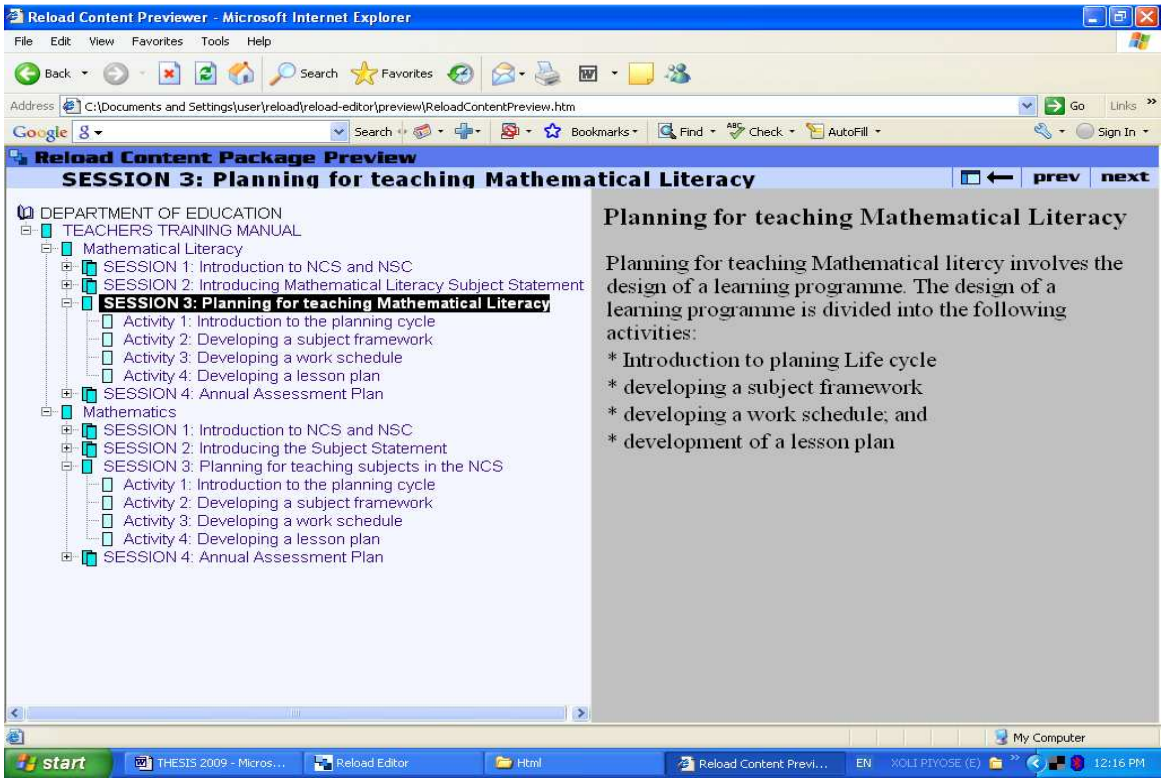

Figure 3.12: Session 3 and its activities for Mathematical Literacy educators only

The planning for teaching Mathematics and Mathematical Literacy in this study is identical.

(i) Introduction to the planning cycle

When the user clicks on this link, a PDF file will appear that introduces three phases of developing and planning the teaching of Mathematical Literacy (see Figure 3.13). The phases for each grade are developing a subject framework; developing a work schedule; and developing a lesson plan.

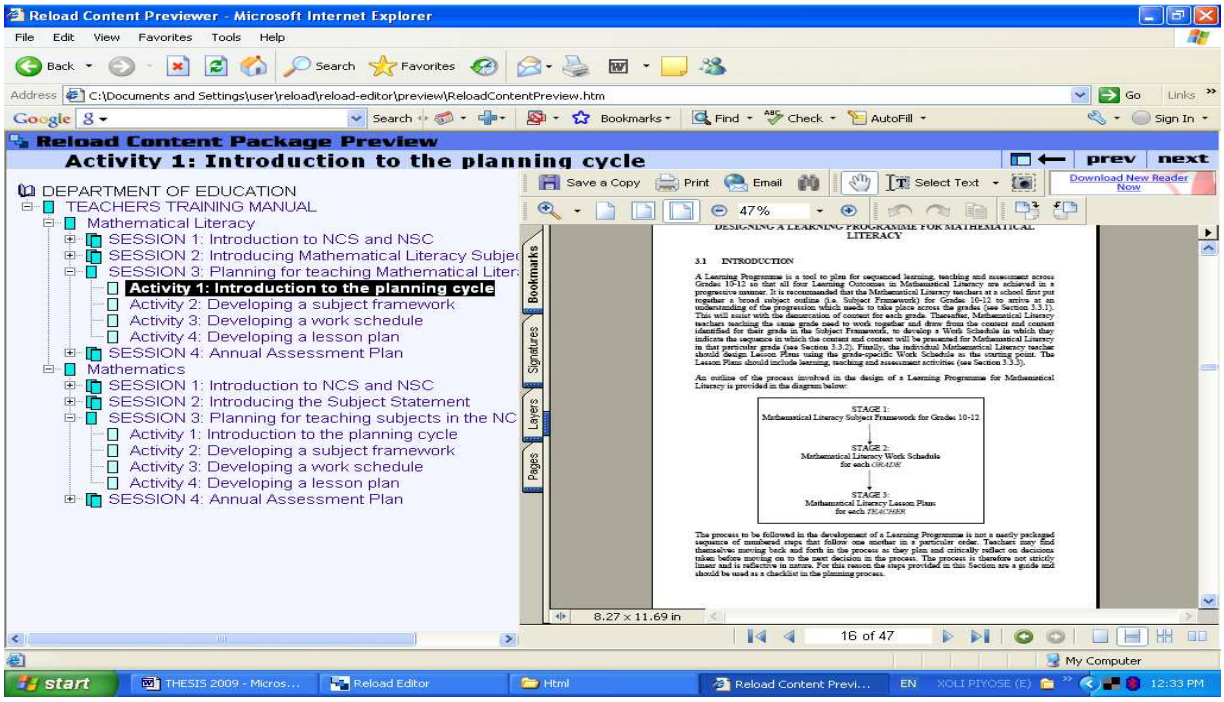

Figure 3.13: Introduction to the planning cycle

(ii) Developing a subject framework

This section is a PDF document that presents guidelines for developing a subject framework for all OBE subject areas. The PDF document also contains an exemplar of a Grade 12 subject framework (see Figure 3.14).

(iii) Developing a work schedule

When the user clicks on developing a work schedule link, a PDF document containing guidelines on how to develop a work schedule will be displayed on the screen. In the appendix of the guideline, an exemplar of developing a work schedule for Grade 12 is displayed (see Figure 3.15).

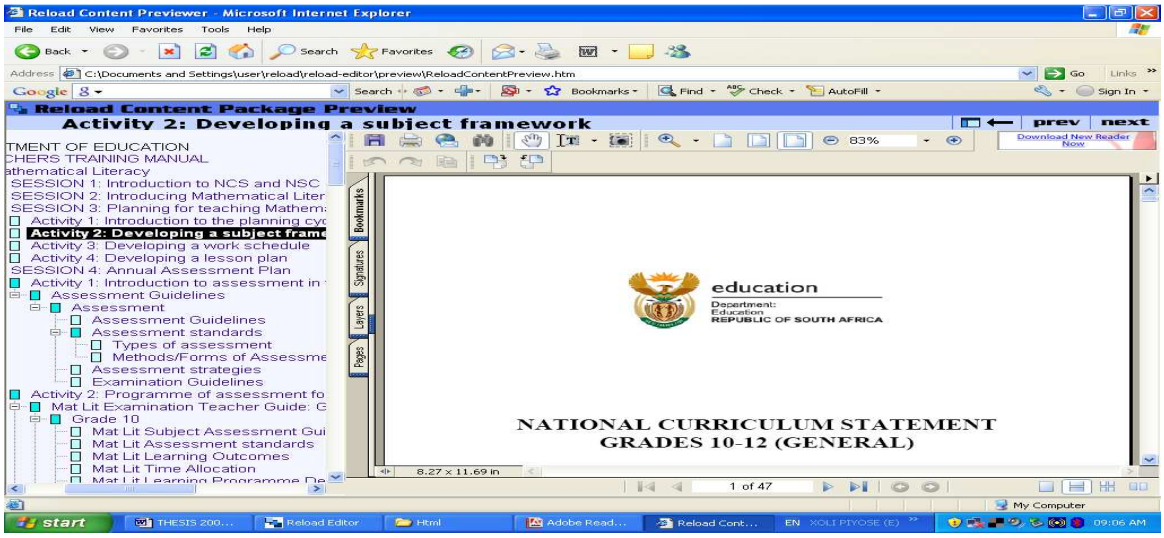

Figure 3.14: Developing a subject framework

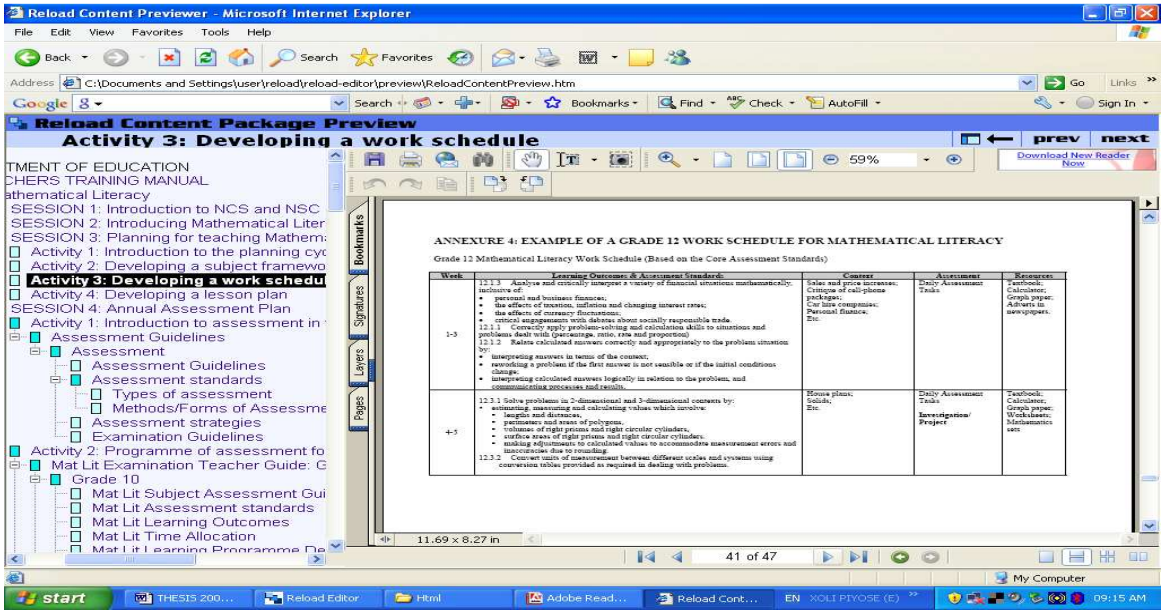

Figure 3.15: Developing a work schedule for Mathematical Literacy Grade 12

(iv) Developing a lesson plan

When the user clicks on the developing a lesson plan link, a PDF document containing guidelines on how to develop a lesson plan will be displayed on the screen (see Figure 3.15).

e) E-learning content for Session 4

The fourth session, annual assessment plan, is divided into three categories, namely introduction to assessment in the NCS; programme of assessment for grades 10 and 11; and development of a Grade 11 annual assessment plan (see Figure 3.16).

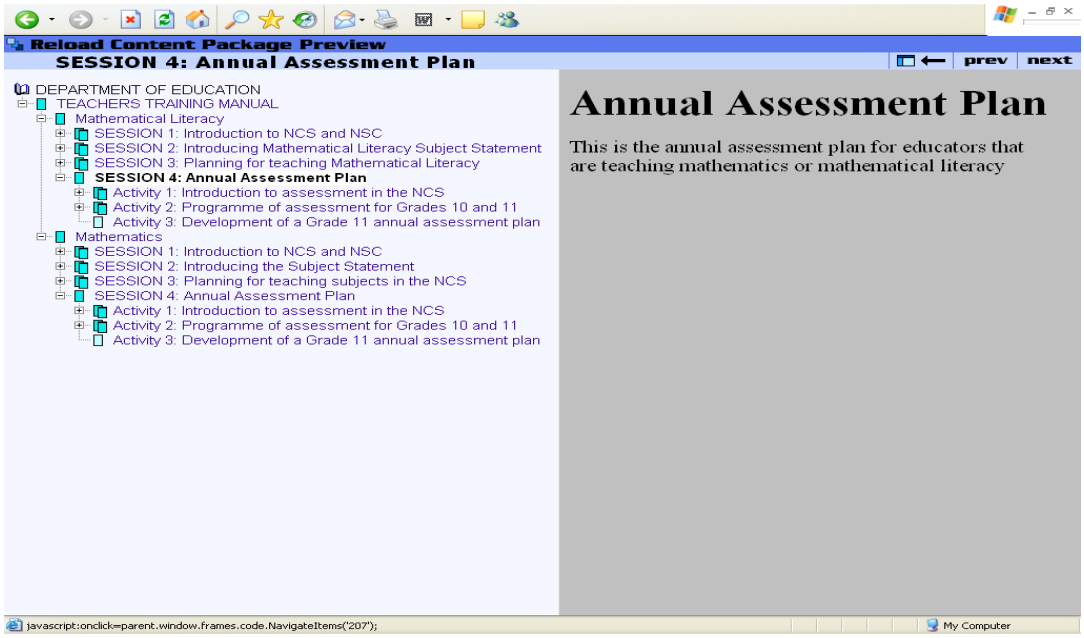

Figure 3.16: Session 4 and its activities

(i) Activity 1: Introduction to assessment in the NCS

Introduction to assessment in the NCS presents the general terminology to be understood by educators when dealing with assessment. Assessment is divided into four categories, namely assessment guidelines; assessment standards, which are further divided into types and methods of assessments; assessment strategies; and examination guidelines (see Figure 3.17).

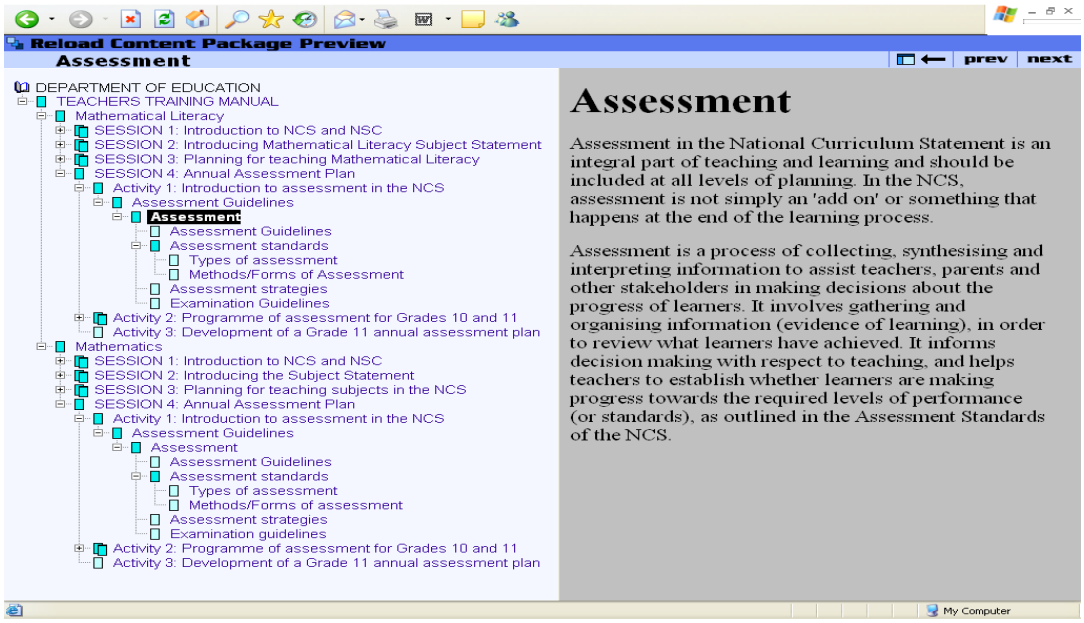

Figure 3.17: Assessment guidelines

Assessment guidelines guide the educator with regard to the forms and methods of assessment to be used based on the learning outcomes of the subject (see Figure 3.18).

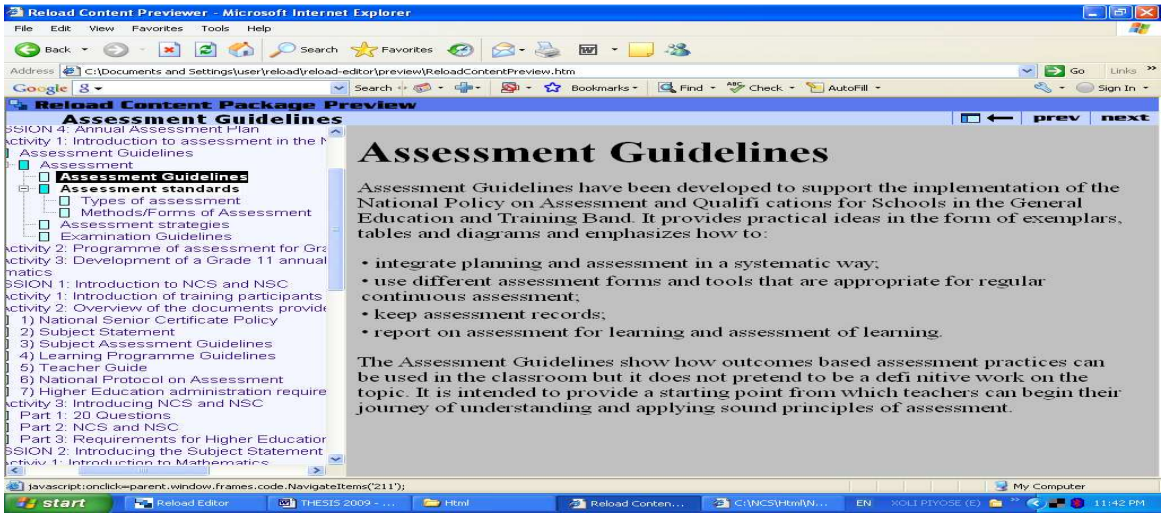

Figure 3.18: Assessment guidelines

When the user clicks on the assessment standards, types of assessment and methods of assessment links, links will be displayed on the screen for the user to specify the exact link he or she is interested in. For instance, when the user clicks on methods/forms of assessment, the information describing the methods and forms of assessment to be used for Mathematics and/or Mathematical Literacy will be displayed (see Figure 3.19).

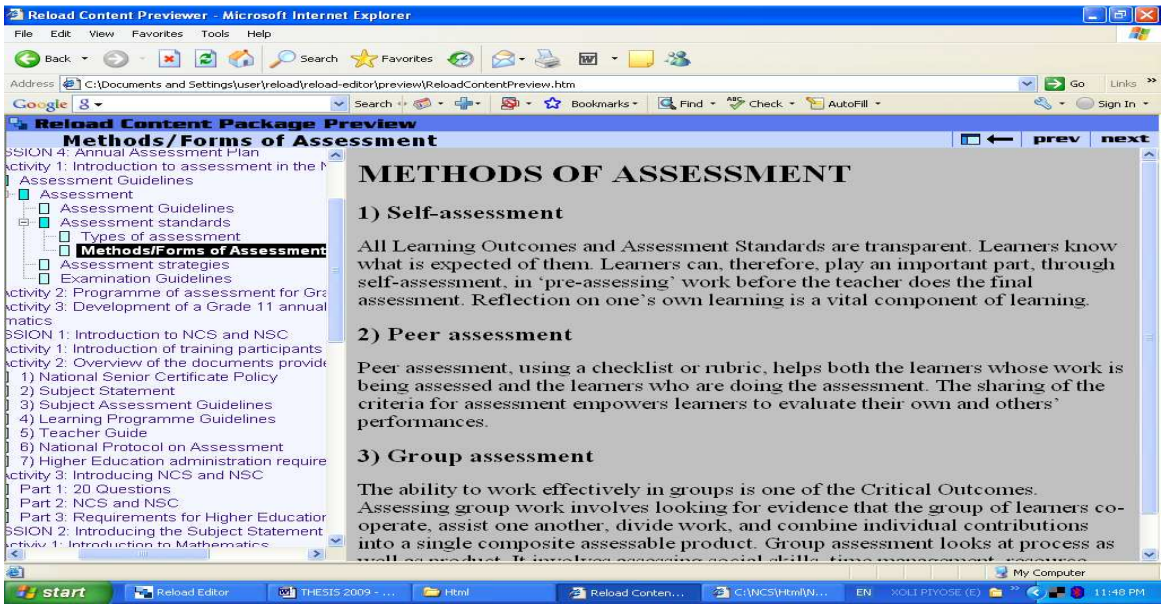

Figure 3.19: Methods of assessment

(ii) Activity 2: Programme of assessment for grades 10 and 11

Programme of assessment is divided into teacher examination guide and examination exemplars for grades 10 to 12. Under each grade in the teacher guide, there are six links, namely subject assessment guidelines; assessment standards; learning outcomes; time allocation; learning programme design; and programme guidelines for Mathematics and Mathematical Literacy. For each grade under examination exemplars there are question papers and their memorandums as well as the year and month of the examination (see Figure 3.20).

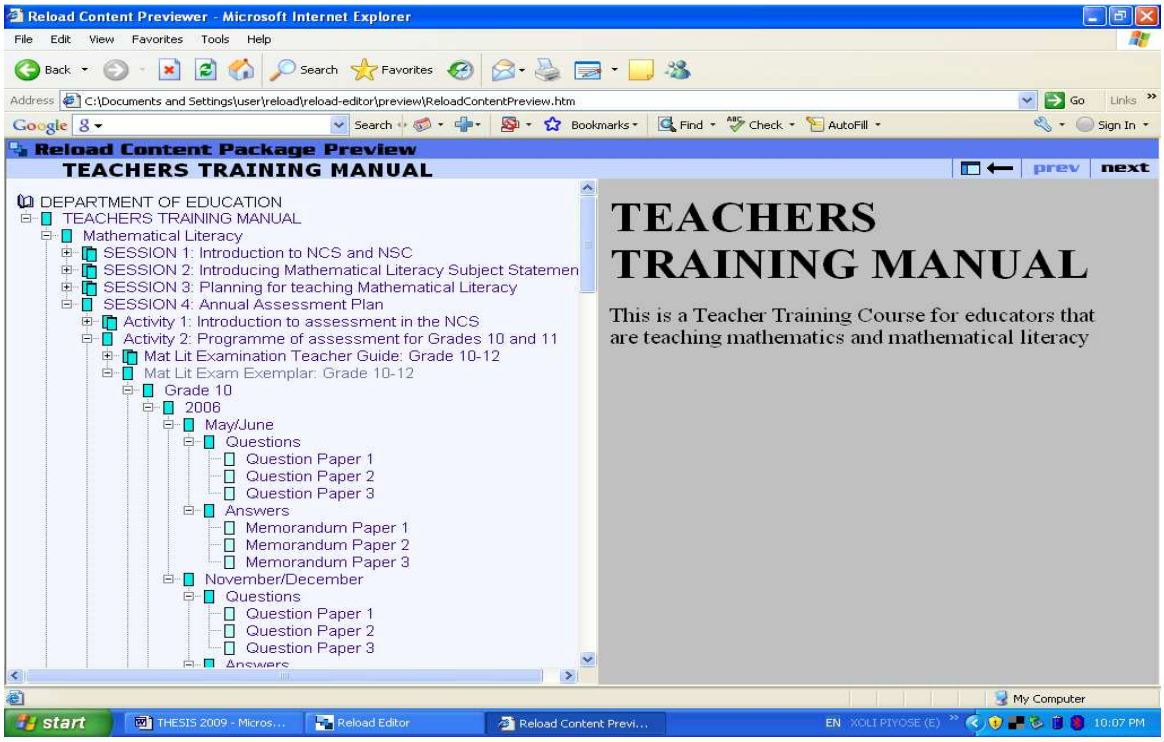

Figure 3.20: Programme of assessment

3.5 Conclusion

This chapter presented the e-learning content prototype for Mathematics and Mathematical Literacy educators. The system requirements, the design of the system and the actual prototype were presented. The research methodology for the selection of the documents used to design an e-learning content prototype was clearly outlined. The research variables and the data-analysis technique used in this study were also clearly defined in this chapter.

Chapter 4

EVALUATION OF THE PERCEIVED IMPACT OF E-LEARNING ON EDUCATORS' UNDERSTANDING OF OBE

4.1 Introduction

This chapter starts by presenting a review of the existing literature on the impact of e-learning on education in general with special reference to SCORM. The literature on the perceptions of both learners and educators is reviewed first, followed by the literature on educators' training in e-learning and on the impact of SCORM on education.

This chapter further presents the methodology used to gather and analyse data on educators' perceptions of the impact of the SCORM software proposed for the training of educators in OBE. The research method, the population, as well as the sample size and sampling method are presented in this chapter. The research variables are then described together with the research instrument that enabled the data collection.

Lastly, the research findings of the survey on the perceptions of educators of the impact of e-learning on their understanding of OBE are presented, together with the statistical analysis.

4.2 Perceptions of educators and learners of e-learning

Conole *et al.* (2006) conducted a study on learner's experiences of e-learning. According to these authors, despite the fact that learners are now literate, they are not academically e-literate and still lack necessary skills to make appropriate critical use of information (Conole *et al.*, 2006).

This study's aim was to describe the learners' personal background and learning context in which they integrate technology into their learning. An online survey was used to gain a wider understanding of learners' experiences with regard to particular artefacts, whereas case studies of individual learners (via audio-logs and interviews) included describing the nature of the e-learning activities carried out by the learners and exploring the e-learner context and background. The research population for the study by Conole *et al*. (2006) consisted of 85 students in economics, languages, medicine and computing. Their findings show that students are evidently comfortable with using technology and see it as integral to their learning. They are generally sophisticated users, using technologies in a variety of different ways to support different aspects of their learning. Eighty per cent of the students indicated that technology is a vital and fun tool for learning, and that they feel the part of a wider network. All the students proved to be comfortable with the use of technology for learning because they had access to a rich variety of free material. In addition, they expected high quality with regard to different forms of interactivity with one another when learning. Ninety per cent of the students regarded technology as an integral part to all aspects of their lives (Conole *et al*., 2006).

Parker (2003) also indicates educators' and learners' positive perceptions of the use of e-learning. Parker (2003) conducted a study among first-year IT and financial information systems (FIS) students of the Cape Technikon in South Africa. A questionnaire was distributed to a total of 165 IT and FIS students. All students participating in this study were using computers for almost 70% of their study time and were registered for an online Information Systems course. The findings of the study reflect the familiarity of education practitioners (educators and learners) with the use of computers for learning. More than 90% of the respondents agreed or strongly agreed that it is enjoyable to use a personal computer and approximately 60% reflected that online lectures allow them to search for required information more conveniently. The findings also reflected that although e-learning contributes to the increase of their workload, students still perceive e-learning as fun and of better quality compared to traditional teaching and learning practices (Parker 2003).

4.2.1 E-learning as a training tool

Wilson *et al*. (2006) of the University of Birmingham in the United Kingdom developed an interactive tool for teaching rheumatology. Essential skills were targeted during the development of the teaching tool, such as problem solving and decision analysis. A total of 131 students and practitioners using the tools expressed themselves as follows:

> "We were able to share ideas on the discussion page and learn from each other. The information flowed and comments were precise and to the point. Power, hierarchy and professional boundaries were broken down enabling us to work as a unit." (Wilson *et al.*, 2006: 8)

Wilson *et al.* (2006) further report on an e-learning programme developed for learners and problem solvers to stimulate real-world patient scenarios. Students could question patients and examine their x-rays and other laboratory tests. The study concluded that both students (78%) and practitioners (90%) agreed that e-learning is a worthwhile supplement to traditional and modern teaching methods (Wilson *et al*., 2006).

4.2.2 Information and communication technology and Mathematics

According to Rahman, Ghazali and Ismail (2003), although there is abundant literature on the potential of technology to change the way in which mathematics is taught, there does not seem to be enough literature on how the use of technology changes leaners' perceptions of mathematical problem solving. A sample of 131 student teachers attending a second-year Mathematics Teaching Methods Course at the School of Educational Studies, University Sains, Malaysia, were participants in this study. These student teachers had different basic mathematics qualifications and teaching experiences. The majority (93%) of the sample were female and 7% were male (Rahman *et al*., 2003). Several students from different mathematical backgrounds were required to take the course in mathematics using the MS Excel spreadsheet package. The

course was based on graphs and calculations. The research findings revealed that student teachers' perceptions of problem solving in mathematics actually changes with the use of ICT. Although students were quite apprehensive at first, they enjoyed the course and, most importantly, they experienced a new perspective of mathematical problem solving. Ninety per cent of the participants displayed satisfaction with learning mathematics using ICT. The researchers concluded that the role of ICT is regarded as supporting and enhancing of the ability of students' to solve mathematics problems. Most importantly, it changed the way the student teachers approached these problems. The study also reported that the so-called weaker students were also able to succeed with the help of technology, which helped them to realise that mathematics is not just for so-called excellent achievers (Rahman *et al*., 2003).

According to Ungerleider and Burns (2002), mathematics instruction has the longest history of using technology for instructional purposes and boasts several impressive systems and programs for the instruction of mathematics and mathematical concepts. Ungerleider and Burns (2002) conducted a study to determine whether the use of computers can help students be better problem solvers when learning mathematics and science. A questionnaire-based survey was conducted among 12 instructors and 131 students of the University of British Columbia studying in their second year of the Bachelor of Science degree in Applied Mathematics. All learners expressed the joy and freedom of learning mathematics using computers and concluded that computers help them to grasp the terms easily and quickly. The study concluded that the use of ICTs for mathematics instruction has a significantly positive effect on teaching high-level concepts to students in Grade 8 or higher (Ungerleider & Burns, 2002).

Lujara, Kissaka, Trojer and Mvungi (2007) emphasise the high need for the integration of the learning of mathematics with ICT. Lujara *et al*. (2007) conducted a study on e-learning environments and resources for secondary schools in Tanzania. Lujara *et al.*'s study was motivated by the 2005 failure rate for Mathematics as compared to other subjects in Tanzanian secondary schools, as presented in Table 4.1.

Table 4.1: Learners' performance in Tanzanian schools in 2005

Subject	% average failure rate
Chemistry	42
Civics	44
Commerce	62
Geography	54
History	51
Mathematics	**70**
Physics	46

Lujara *et al.* (2007) conducted a survey among six schools in the Arusha, Mbeya, Dodoma and Ruvuma regions of Tanzania to determine the problems experienced by educators and learners in the education system and to determine the factors that contribute to the high failure rate in Mathematics. Their research findings reflect that 60 to 80% of schools in all the regions had a shortage of adequate and qualified educators in Mathematics and Science, but specifically so in rural areas. The findings also reflect that 75 to 90% of the schools had a shortage of textbooks, and libraries. The researchers therefore recommended self-learning in an e-learning environment as a solution to the problems faced in Tanzanian schools. They recommended the use of SCORM e-learning content delivery to avail learning resources to both educators and learners (Lujara *et al*., 2007).

The use of ICT for teaching Mathematics was also studied by Sutherland (2006). Through the use of *Digital Tools for Learning Mathematics*, Sutherland (2006) became convinced that computers enable young learners to experience mathematics, and to use them in peculiar ways. Sutherland (2006) concluded that interest in using computers as tools for learning should be carried forward to all levels of the secondary school so that learners do not despair and later lose the motivation to discover and experiment with mathematical ideas. Sutherland (2006) used the Victor-Space digital tool to investigate the experience of 17 learners at Manville Primary School

in the USA. The study revealed that all learners were able to perform the calculations provided that they knew how to write the number.

4.2.3 Content prototype

It is widely recognised that internet and multimedia content can drastically change the education processes. The effectiveness of multimedia learning software strongly depends on the ability of the system's designer to encourage learners to use the system and interact with it throughout the learning tasks. Education is concerned with transmitting information in a way that allows learners to construct a mental model of the information (Tortora, 2004). This was the conclusion of a study in which an online questionnaire was distributed to 24 learners who used multimedia software as learning tool. The study revealed that all the learners were satisfied with the visualisation of the information and that internet and multimedia content helped them to think practically and be good problem solvers.

According to Bokhove (2003, existing mathematical tools become even more powerful and useful when learners' performance can be tracked online. The use of a common standard, in this case SCORM, enables the sharing of content, but also the storing of data on learners' performance. Learners know that they can be and are monitored by their educator. Together with other features of virtual learning environments, especially for communication, learners are stimulated to do their homework, and to do even more than what is required of them. According to Bokhove 2003), learners do not seem to mind the 'big brother is watching you' concept. Computer-aided learning is also seen as a more 'fun' way of studying otherwise boring subjects. Bokhove (2004) further comments that one of the success factors of the use of ICT is that all educators in an institution probably agree on the vision they have on mathematics education. Ideally, less experienced educators would be supported by experienced ones and experiences are shared alike to evaluate and improve the use of ICT in the classroom. From a technological point

of view, SCORM contributes to the realisation of a meaningful ICT-rich education (Bokhove, 2004).

4.2.3.1 E-learning content prototype

Potter *et al*. (2005) developed the MarlinaLS_ system with the primary objectives of enhancing the engagement and interaction of learners within a specific setting and enhancing learning outcomes. The system was tested on 27 students of the Odana region in Canada. The results indicated that the more students used the MarlinaLS_ system, the more, on average, their learning outcomes improved. Greater usage of the MarlinaLS_ system was systematically related to improved student performance in both calculative and non-calculative examination questions, and also in assignments completed during the semester (Potter *et al*., 2005).

4.2.3.2 The impact of the SCORM e-learning standard

Milliken and Barnes (2002) conducted a study on students' perspectives of technology-based teaching in higher education. According to these authors, it is often rewarding and indeed necessary to move out of the so-called established comfort zones of beliefs and practices of teaching and to try something different (Milliken & Barnes, 2002). They further articulate that the educator must constantly recreate the process of instruction and be prepared, and equipped, to impart knowledge in a variety of ways, so that individual learners' needs can be met. Milliken and Barnes developed a SCORM e-learning platform used by students at the Curtin University of Technology in United States of America. A questionnaire was administered to 68 students based on the following main research question: How successful was the module in improving the quality of student learning? Students were also asked to rate their satisfaction with the module from very good to poor under the following main statements: clarity of the module, structure of the lectures, content of the lectures, and presentation of materials. The majority of the participants (85%) indicated that the structure and organisation of the material was good.

Seventy-eight per cent of the participants indicated that the clarity of modules and the content of the lectures were very good (Mikillen & Barnes, 2002).

The positive results of SCORM-compliant e-learning courses are further indicated by a study conducted by Nicholas (2006). He conducted a study on the best practices for the development of SCORM courses. Nicholas (2006) recommends that organisations utilising the SCORM benefit from extensive instructional designer training in SCORM-based practices. The ADDIE model of instruction design was the method used to gather information in Nicholas's study. This model consists of four sequentially arranged phases: analysis, design, development and implementation. The sample in the study consisted of six students of three different institutions in the USA. The students were asked to use the system after it was developed and thereafter were invited to a roundtable discussion to share their experiences with using the system. The study revealed that 82% of the participants felt that SCORM-based instruction is important, 64% of the participants had an improved attitude towards SCORM, and 91% felt comfortable with the standard. The study therefore indicated that educational content should always trump SCORM when designing distributed learning (Nicholas, 2006).

Josceanu, Isopescu, Plesu and Zelch (2003) recommend the use of SCORM-based content in a study on learning object metadata. In order to recommend metadata for adapting SCORM software at the University of Bucharest, city, lecturers' and students' perceptions had to be reviewed. A large survey of students and academic staff (more than 200 participants) at the Politehnica University in Bucharest revealed an increasing interest of the young generation in using new teaching and learning approaches, with ICT as the first choice. All students participating in the study indicated that it is fun and enjoyable to learn to use a SCORM-based e-learning platform, as it links students directly to the exact relevant information. All the lecturers expressed comfort with and confidence in using SCORM for their classes. The researchers therefore concluded that the integrated SCORM-based e-learning platform creates a friendly

teaching and learning environment and leads to efficient educational management (Josceanu *et al*., 2003).

4.3 Research methodology

The purpose of this section is to describe the methodology used to construct and evaluate an e-learning content prototype in an attempt to resolve some of the challenges faced by education with the implementation of OBE. The section starts by defining the research method, the research population, as well as the sample size and sampling method. The research variables are then described together with the research instrument that has enabled data collection.

4.3.1 Research method

This part of the study took place at the Department of Information Technology at Walter Sisulu University, South Africa, as part of the CEF project undertaken there. The CEF project is the project initiated by the Central Energy Fund together with the DoE to train educators, particularly in the rural areas of the Eastern Cape province of South Africa, on computers. The training is based on the International Computer Driving License syllabus. All (37) educators participating in the CEF-WSU project participated in this phase of the study. It is important to note that not all educators of the CEF-WSU project were Mathematics educators. It was, however, important to enrol all of them in the study as all of them were teaching under OBE.

4.3.2 Research population and sampling

The research population for the prototype evaluation consisted of all educators that participated in the CEF-WSU project, giving a research sample size of 37.

4.3.3 Research variables

The research variables for this phase of the study were classified into five categories: four independent variables and one dependent variable. The independent variables were educators'

assessment of past training experiences; educators' computer literacy background information; educators' computer competence; and the perceived usability of the proposed e-learning content prototype by educators. The dependent variable was the effect of the SCORM software course on educators' understanding of OBE.

4.3.4 Research instrument

A questionnaire was designed in order to evaluate the effectiveness of the proposed SCORM-compliant e-learning content prototype. Questionnaires were handed to all participants immediately after training. The researcher, assisted by a laboratory technician, trained the participants.

The questionnaire initially addressed the participants' backgrounds, including aspects such as race, gender, age and home language. The questionnaire then investigated their professional backgrounds, i.e. type of school at which they teach, teaching subject(s) and grade(s), highest qualification, and an indication of whether the educator has attended any prior training in teaching, learning and curriculum. Thereafter, the questionnaire addressed the usability of the proposed software in matters concerning the understanding of OBE, the presentation of the training and other quality issues such as the quality of the SCORM training. The questionnaire consisted of the following types of questions:

- Scaled response questions: Participants were asked to answer the question by selecting one of the "strongly disagree", "do not agree", "not sure", "agree", or "strongly agree" alternatives given to them.
- Closed-ended questions: Participants were required to select "yes" or "no" to answer the question asked.
- Open-ended questions: Participants were required to discuss or explain their own views according to the questions asked.

The details of the phrasing of the questions are available in Appendix C of this thesis.

4.3.5 Data analysis

The answers to the questionnaire were tabulated in a spreadsheet, with the rows representing the research participants (educators participating in the CEF-WSU project) and the columns representing the participants' answers. The spreadsheet reached a dimension of 40 rows and 40 columns.

4.3.5.1 Variable selection

For each variable, one value representing a collection of answers to all related questions was calculated. Variable on the background data representing participants' social status (rural versus urban, private versus public, etc,) and gender was selected. However, since the CEF-WSU project is for public school educators in rural areas in particular, there was no need for correlation classifications.

a) Educators' prior training experiences

The variable *educators' assessment of past training experiences* was drawn from the background data of a questionnaire of this phase (Appendix C). There were only two questions that related to the past training courses attended by educators participating in the study. The questions were closed ended, hence the researcher assigned a value of "1" to "yes" responses and the value of "0" to "no" responses. On the question whether the educators were satisfied with their past trainings on curriculum or not, three possible answers, namely not satisfied at all, satisfied and very satisfied, were provided. The researcher assigned "0" to "not satisfied at all" responses, "1" to "satisfied" and "2" to "very satisfied" responses (Table 4.2).

Table 4.2: Educators' past training experiences

Variables	Respondent 1	Value	Respondent 2	Value
1) Attended training before	Yes	1	No	0
2) Rate your satisfaction	Not satisfied at all	0	N/A	0
Sum		1		0
Total		3		3

b) Educators' computer competence

The variable *educators' computer competence* also includes the variable *educators' computer literacy background information*. Background information included issues such as the attendance of computer training prior to the CEF-WSU project, the ability to operate a computer after participating in the CEF-WSU project, the use of e-learning prior to using the SCORM software artefacts of this study, and perceptions of the use of computers for teaching and learning in primary and secondary schools in South Africa. All variables were based on closed-ended questions, with "yes" or" "no", and "better feeling" or "no change at all" as answers. The researcher assigned "1" to positive answers such as "yes" and "0" to negative answers such as "no". The sum of all these variables represents one single value on educators' computer skills.

c) Perceived usability of the proposed e-learning content prototype

The variable *perceived usability of the proposed e-learning content prototype* dealt with issues such as the user-friendliness of the software session by session and the usability of the information provided. These variables were based on Likert-scale questions. An answer of "strongly disagree" was assigned a value of "1", "do not agree" was assigned a value of "2", "not sure" was assigned a value of "3", "agree" was assigned a value of "4", and "strongly agree" was assigned a value of "5". The sum of all variables is the value that indicates respondents' perceptions of the usability of the proposed SCORM software artefact (Table 4.4).

Table 4.3: Educators' computer competence

Variables	Respondent 1	Value	Respondent 2	Value
1) Attended computer training before	No	0	No	0
2) If yes, rate the effectiveness	N/A	0	N/A	0
3) After CEF computer training, what is your attitude to using a computer for teaching and learning?	I feel that computers must be used for teaching and learning	1	I feel that computers must be used for teaching and learning	1
4) Can you use a computer?	Yes	1	Yes	1
5) Have you used an e-learning standard prior to the e-learning content prototype of this research?	No	0	No	0
6) If yes, for how long?	N/A	0	N/A	0
Sum		**2**		**2**
Total		**10**		**10**

d) Understanding of OBE

The variable *the effect of the SCORM software course on educators' understanding of OBE* assessed whether educators have a better understanding of OBE after attending the SCORM software course. These variables were also based on Likert-scale questions.An answer of "strongly disagree" was assigned a value of "1", "do not agree" was assigned a value of "2", "not sure" was assigned a value of "3", "agree" was assigned a value of "4" and "strongly agree" was assigned a value of "5". The sum of all the variables was calculated using MS Excel's aggregation function SUM (range). The sum of all variables was therefore the value that indicates respondents' perceptions of their understanding of OBE after the use of e-learning content prototype (Table 4.5).

There was no need to classify the results according to ownership, racial group and location, because all educators come from public schools, are Africans and teach in rural areas.

The results of the data analysis simply indicate the perceptions of the participants according to gender with respect to the four selected research variables of this phase of the study.

Table 4.4: The perceived usability of the proposed e-learning content prototype

Variables	Respondent 1	Value	Respondent 2	Value
1) Sessions are well presented.	Agree	4	Agree	4
2) Sub-sessions are also well presented.	Agree	4	Agree	4
3) The aim of each session is easily identified.	Agree	4	Agree	4
4) The structure of the training is adequate.	Agree	4	Agree	4
5) The introduction to the NCS and the NSC in Session 1 is satisfactory.	Agree	4	Agree	4
6) The introduction to Mathematics and Mathematical Literacy in Session 2 is satisfactory.	Agree	4	Strongly agree	5
7) The explanation with regard to planning for teaching and learning in Session 3 is satisfactory.	Agree	4	Agree	4
8) The annual assessment plan is satisfactory.	Agree	4	Agree	5
Sum (variables)		28		30
Total				

Table 4.5: Understanding of OBE

Variable(s)	Respondent 1	Value	Respondent 2	Value
1. Basic terms are clearly defined.	Agree	4	Agree	4
2. Assessment types are easily understandable.	Agree	4	Agree	4
3. The NCS is clarified.	Do not agree	2	Agree	4
4) I understand OBE terminology.	Agree	4	Agree	4
5) An improvement on training methods.	Agree	4	Agree	4
6) The training manual is easy to follow.	Agree	4	Agree	4
7) A broad understanding of the subject.	Agree	4	Agree	4
8) I am satisfied with SCORM e-learning training as compared to the traditional way of training.	Agree	4	Agree	4
9) I recommend this type of training for Mathematics.	Agree	4	Agree	4
10) Since taking this course, what is your attitude towards the understanding of OBE?	I feel better about my understanding of OBE	3	I feel better about my understanding of OBE	3
11) Should SCORM-based training be used for other subjects?	Yes	1	Yes	1
Sum (variables)		38		40
Total		52		52

4.4 Findings

This section presents the findings of the study regarding the impact of the proposed e-learning content prototype on educators' understanding of OBE. E-learning content prototype is for mathematics and mathematical literacy, in grade 10 to grade 12 of secondary education.

4.4.1 Characteristics of the research population

The background information on the research participants is presented in this section in the form of the participants' demographics and ICT background. The demographics information includes race, gender, age and social status (rural versus urban, private versus public, etc.).

4.4.1.1 Demographics

Thirty-seven educators who participated in the CEF-WSU project participated in this phase of the study. All of them come from public schools and are Africans. Ninety per cent of the participants are Xhosa speaking, 8% are Zulu speaking and 2% are Sotho speaking. Thirty-two per cent of the educators were male and 68% were female. All educators came from secondary schools, 74% from junior secondary and 26% from senior secondary schools. The age of the participants in this research is distributed as follows: 3% were between the ages of 20 and 24 years, 5% between 25 and 29 years, 16% between 30 and 34 years, 20% between 35 and 39 years, 24% between 40 and 44 years, 20% between 45 and 49 years, and 12% are 50 years and older. Thirty-six per cent of the educators teach Mathematics and/or Mathematical Literacy and science, 26% teaching human and social science subjects, 16% teach accounting subjects, 11% teaching business-related subjects and another 11% teach all Foundation Phase subjects.

4.4.1.2 Information and communication technology background

All the educators participating in this phase of the study indicated that they have never used an e-learning standard or content prototype before. The survey also revealed that 88% of these educators have never used a computer before the CEF-WSU training. However, all the educators were of the opinion that computers should be used for teaching and learning.

4.4.2 Respondents' perceptions

This section reports on the respondents' perceptions based on their assessment of past training experiences, their perceived computer competence and their assessment of the usability of e-learning software. The results are based on an analysis of averages, entailing the mark scored by participants, as shown in Table 4.6. Note that Table 4.6 represents marks scored by participants per gender.

Table 4.6: Mean analysis of research variables

Independent variable	**Average scores**		**Marks scored out of 100**
Assessment of past training	Female	0.76	**25**
	Male	1	**30**
	Total	3	100
Computer competence	Female	2.76	**28**
	Male	2.3	**23**
	Total	10	100
Usability of e-learning software	Female	**28.16**	**81**
	Male	**27.25**	**78**
	Total	35	100
Understanding of OBE	Female	**39.32**	**76**
	Male	39.16	**75**
	Total	52	100

a) Assessment of past training experiences

The educators indicated a relatively low level of curriculum and policy-making training experiences. As Table 4.6 shows, all participants, irrespective of gender, scored approximately 30%. This therefore indicates only one-third of the educators had attended training prior to the

introduction of OBE. Training in this case refers to skills- and curriculum-based training attended by participants other than their formal educational qualifications.

b) Computer competence

As presented in Table 4.6, these educators were generally computer illiterate before attending the CEF-WSU training. This therefore means that these educators are not ready to implement ICT in their schools, as they themselves are not proficient in operating computers. The DoE should therefore provide considerable training in the manner of the CEF-WSU project to train educators in the use of computers.

c) Usability of e-learning software

The educators felt that the proposed SCORM software artefact is usable, as they all scored above 75% for both the usability of the software and the understanding of OBE (Table 4.6). Thee educators are of the opinion that the SCORM-compliant e-learning content prototype helped them to understand OBE basic terms and that the prototype makes it easy for them to understand assessment types. E-learning-based software therefore does not only help educators understand OBE terminology, but also introduces or promotes the use of ICT.

4.5 Summary of survey findings

The survey's findings can be summarised into four categories: demographics, computer literacy background, assessment of prior training experiences, and the usability of the proposed SCORM-compliant e-learning content prototype based, and on the understanding of OBE. The demographics reveal that all the educators participating in this phase of the study were African and Xhosa and Zulu speaking, with a female majority. The age group for most of the educators was 30 to 50 years.

The research also revealed that the understanding of OBE of most educators participating in the CEF-WSU project was improved through the use of the proposed SCORM-compliant e-learning training.

The educators recommended the proposed SCORM-compliant software artefact as the most user-friendly and easy to understand training tool that can help educators to better understand whatever subject they were trained in. They remarked that the way in which the material is structured in the software promotes interest in learning OBE.

4.6 Conclusion

This chapter presented a review of the existing literature on educators' and learners' perceptions of the impact of e-learning on education in general, and offered a discussion of the effectiveness of teacher training in an e-learning environment and the impact of the e-learning content prototype on the understanding of OBE.

This chapter also presented the research method used during the evaluation of an e-learning content prototype. The population, sample size, research instrument and research variables were discussed. Lastly, this chapter presented the survey findings based on three independent variables and one dependent variable.

Chapter 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The purpose of this chapter is to assess the scientific contribution of this study by comparing the results and methodology of the study with similar research from the literature. Answers to the research questions that were posed in the first chapter of this dissertation are presented in this chapter. Each research result is also discussed and relevant recommendations are formulated.

5.2 Presentation of results

Only the first phase's research results are discussed in this section. The results of the evaluation of the SCORM-compliant training software are presented in the next section.

5.2.1 Information and communication technology adoption

This study reveals that cell phones and televisions are widely adopted by educators. Indeed, 100% of the educators reported that they own both a cell phone and a television. This figure is however significantly lower for learners. Only 45% of the learners own a cell phone and only 70% of them have access to a personal television. This study further reveals that 40% of the educators do not have access to a computer at all, whether at home, at school or at the local tele-centre. Twenty-seven per cent of the educators reported that they only have access to computers at school. The rest of educator population (75%) do not have access to computers, whether at home, at school or at a tele-centre.

The study conducted by Were *et al*. (2007) on the use of ICT to support basic education in disadvantaged schools and communities also relates to the results of this study, although the methodologies used in these two studies differ. Were *et al*.'s study was conducted only among two disadvantaged schools, whereas the current study was conducted among 27 private and public schools from rural, urban and semi-urban areas, representing advantaged and disadvantaged schools. Both these studies were conducted in developing countries. Were *et al*. (2007) also reported that there are challenges in the efforts to build a viable ICT infrastructure in South Africa, which might explain why approximately 65% of the participants of this study indicated that there are no computers in their schools.

Dunmill and Arslanagic (2006:4) provide evidence that ICT positively impacts on learner achievement in core subjects, including evidence that specifically relates to the use of music and visual arts to enhance learning processes and outcomes. Therefore, the use of ICT in teacher training will have a positive impact not only on educators' achievement but also on educators' grasp of knowledge necessary.

5.2.2 Outcomes-based education curriculum design and implementation issues

This study clearly shows that there is consensus among educators and learners that OBE is not understood in schools. However, learners from private schools indicated that there is a positive correlation between OBE curriculum implementation issues and the impact of IT usage.

These results complement the result obtained by Ramolefe (2004), who found that according to educators' perceptions; principals do not understand OBE (according to 88% of the educators participating in this study). The difference between the results of this study and that of Ramolefe's study is based on the fact that the current study gives the perception of both educators and learners of their own understanding of OBE, while Ramolefe's study gives the

perceptions of educators' view of principals' understanding of OBE. The two studies also differ with regard to their methodology: the current study entails as survey of almost 27 schools with 4 educators and 12 learners per school, while Ramolefe's study is a case study of two schools with 6 to 12 educators per school.

Malan (2000:35), who concluded that making the explicit connection between outcomes and the learning and assessment procedures is bureaucratic, time-wasting and erodes the professional autonomy of educators – making them even more accountable to students and peers smoothens the results of this study on perceptions of educators and learners on learning outcomes. The difference between these two studies relates to the methodology. Malan's (2000) study was conducted with a research population of 12 course designers and 19 educators using face-to-face interviews, whereas the current study was conducted with a research population of 304 learners and 104 educators using questionnaires to collect data.

5.2.3 Support and capacity building

Johanson (2007) suggests that factors that contribute to the failure or vast criticism of the OBE system in schools are a lack of resources, especially in township schools (e.g. shortage of adequate learning resources); the dependence on external support in the form of voluntary workers and donations; infrastructural problems; the absence of possible co-operating public libraries; and inadequate library opening hours due to security problems.

The research findings reflect that school buildings and basic infrastructure (i.e. water, electricity, playgrounds, laboratories, and so on) are inadequate in South African schools, especially in public schools. Moreover, the findings further reflect that there is no support from school principals or from local, regional and district DoE experts; there are no textbooks for Mathematics in schools or these textbooks arrive late at schools; and there is no support from neighbouring schools on matters that deal with OBE.

Johanson (2007) concludes that the DoE should not turn its attention to the implementation of the curriculum only, but to the inadequacy of the basic school infrastructure, as this might affect the quality of education and learners' achievements. Water, electricity, laboratories, libraries or community study centres needs to be taken into consideration in all schools for OBE to be successful in South Africa, keeping in mind that OBE was initially implemented in developed countries, where infrastructure is well established. The researcher further suggests that the process of integration to neighbouring schools has to be implemented, which will allow educators and learners of different schools to meet to discuss matters concerning OBE. The DoE must arrange workshops for educators of different schools and their school principals to assist one another in matters concerning OBE. The researcher also suggests that DoE officials and OBE curriculum experts must visit schools to assess the success and the failures of OBE in schools in order to improve the situation. The use of e-learning will help educators and the DoE to have direct communication on a daily basis. The researcher concluded that OBE is a good education system and that it can be of positive value to South Africans only if schools' infrastructure is adequate and educators are trained properly in the OBE system.

5.2.4 E-learning content design

In this study, a SCORM-compliant e-learning content prototype was developed to solve the most acute problems that were identified during the survey of this study. Based on the evaluation of the proposed software, the finding is that SCORM-compliant e-learning content prototype helps with familiarising educators with OBE terminology and that it can be a better training tool that could actually replace normal face-to-face training. The fact that the content prototype is better than face-to-face training is supported by Potter *et al.* (2005) who developed the MarlinaLS_ system with the objective of enhancing learners' engagement and interaction within the specific setting and to stimulate enhanced learning outcomes. The participants in Potter *et al.*'s (2005) study indicated that the system helped them to improve their learning outcomes in all disciplines

(mainly the field of mathematics) that there MarlinaLS_system was tested for. The difference between these two studies is that the system developed by Potter *et al.* (2005) was tested on 27 students, while the SCORM e-learning content prototype was tested on 37 educators who were attending a computer skills training course.

This study reveals that educators understand OBE better when they use the SCORM-compliant software. The study further reveals that the SCORM-compliant e-learning content prototype improves educators' current training methods, presents an easy-to-follow training manual, and helps educators to have a broad understanding of the subject they are being trained in. These research results are supported by Nicholas (2006), who conducted a study on best practices of SCORM. The students were asked to use the system after it was developed and thereafter were invited to a roundtable discussion of their experiences with the use of the system. The study revealed that 82% of the participants found that SCORM-based instruction is important, 64% of the participants had a better attitude towards SCORM after the training, and 91% felt comfortable with the standard (Nicholas, 2006). The difference between Nicholas's (2006) and this study is that Nicholas's study was conducted among learners, while the current study was conducted among educators.

5.3 Synthesis of significant findings and recommendations

This study initially investigated the challenges experienced by educators and learners with the use of OBE.

5.3.1 Understanding of outcomes-based education terminology

The findings of this study suggest that both educators and learners do not understand some of the basic terminology used in OBE. The basic terminology includes the vertical and horizontal integration of OBE, assessment terminology and strategies, and the NCS. Educators attended

training courses on OBE terminology, but indicated that the training was not enough, and that educators did not contribute to the design of OBE curriculum.

The researcher therefore suggests that educators need to undergo OBE training, after which their knowledge has to be tested to assess their understanding of OBE. When there is a change in education, educators, curriculum experts, industry experts, subject experts and possible even learners must all be included during the design of the new curriculum. The SCORM-compliant e-learning tool can be used in educators' OBE training. The SCORM e-learning course content can be very effective, as educators will be able to share information with one another and ask direct questions to the trainer, who will be the instructor of the SCORM e-learning course content.

5.3.2 The impact of SCORM e-learning content design

Research conducted by Milliken and Barnes (2002) suggests that a SCORM e-learning course presents learners with well-presented and easily understandable material. Seventy-eight per cent of the participants in their study indicated that the clarity of modules and the content of the lectures were very good (Miliken & Barnes, 2002). Nicholas (2006) recommend that organisations that utilise the SCORM standard would benefit from extensive instructional designer training in SCORM-based practices. The study reflected that students were satisfied with SCORM and that it made them confident of their course content (Nicholas, 2006).

In this study, a SCORM e-learning content prototype for the training of educators in Mathematics and Mathematical Literacy in the OBE system for grades 10 and 11 was developed. This SCORM-compliant e-learning content prototype was developed based on crucial matters found in phase one of this study (i.e. the perceptions survey). The findings of this phase were that educators were not well trained in OBE curriculum; that Mathematics is the most difficult subject in which material is presented unsatisfactorily; the use of computers was unsatisfactory for academic administration; and computers were not available in many schools. A SCORM-

compliant e-learning prototype was therefore developed for training of Mathematics educators in OBE.

The researcher then concluded that a SCORM-based e-learning content prototype designed for Mathematics and Mathematical Literacy could help with the training of educators to help them understand OBE terminology and could provide exemplars for educators to use for their learners. As reflected in the research survey results of this study, educators complained that the study guides and teacher guides are not user-friendly, e.g. that indexes are not clear. The SCORM-based e-learning course content contains a clear index that directs the user to the specific information that he or she wants to view or study. The ability to communicate with other educators and subject experts while studying SCORM-based e-learning course content can help educators to share information about their teaching experiences in the OBE curriculum, which could help inexperienced educators to succeed in the OBE system. The researcher strongly believes that SCORM-based e-learning course content will help educators be more confident with teaching their subject in the OBE curriculum.

The survey in phase two of this study also revealed that SCORM-compliant e-learning teacher training helped the participating educators feel more confident in their understanding of OBE. The participating educators recommended the SCORM-compliant course content as the user-friendliest and most easily understandable training tool to help educators better understand the subject they are trained in. The way in which the material is structured in the software makes the users more interested in learning OBE.

The researcher therefore recommends SCORM-compliant software for the training of educators, as it provides all the documents that are needed during the training and provides information to educators whenever they want to refresh their memories about the content. A SCORM-based software program will not only help educators to better understand OBE terminology, but will also help them to broaden on the subject, as indicated by 88% of the participants in phase two.

5.3.4 Mobile technology

The findings of this study reflect that approximately all educators (100%) and 56% of the learners have their own cell phones and televisions at home. Therefore, the researcher recommends the use of text messaging to send educational messages to both educators and learners. The DoE can send text messages to educators on matters that deal with OBE terminology and the curriculum in general, including information on the subjects taught by the educator. The researcher strongly believes that the use of cell phones for educational purposes will motivate educators in their teaching and help them to have a better understanding of educational matters. An education mobile dictionary designed specifically for educators will also contribute to the success of the OBE system, as it will reach almost all educators teaching in primary and secondary schools. Digital videos could also be sent to educators' cell phones, so that whenever they want to view a specific section, a recorded video could clarify the concepts used for the section and actually display the whole training course.

Moreover, the researcher further recommends a mobile database of learners on which all learners must register to share communication with DoE officials. The DoE could send messages to learners and their parents so that information on educational matters can be viewed on cell phones. This includes access to previous question papers, national scope for Grade 12 learners, and information on projects, bursaries and scholarships. As the student assistant the mobile teaching and learning may also help learners to send mathematical problems that they cannot solve, after which the solution can be sent back to them – a tool that will reach a vast majority of learners in South Africa. The cheaper access or chat rooms provided by software such as MXIT can help learners share information at cheaper rates.

5.4 Responding to research questions

Two main research questions were raised in Chapter 1 of this thesis. The questions are answered below based on the research findings, the literature presented in Chapter 2 and the comparison of literature presented in Section 5.2 of this study.

5.4.1 Challenges faced by educators and learners in the outcomes-based education system

What are the challenges that are faced by educators and learners in the OBE primary and secondary education system in South Africa? Ramolefe (2006) found that educators and school principals in South Africa do not understand OBE. The results of Zengele's study (2004) indicated that both managers (80%) and educators (100%) complained about the training provided by the DoE, saying it was brief and haphazard, with trainers having little knowledge of OBE. They also complained that there were no facilities to support the implementation of OBE. Johanson (2007) concluded that factors that contribute to the failure or vast criticism of OBE system in Western Cape schools are under-resourced schools, dependence on external support in the form of voluntary workers and donations, infrastructural problems, absence of possible co-operating public libraries and locked libraries due to security problems. This concurs with the results of this study related to the shortage of resources in schools' basic infrastructure.

The research findings reveal the following challenges faced by educators and learners in South Africa: OBE terminology is not understood by educators and learners; schools' basic infrastructure is inadequate; textbooks arrive late and in some schools textbooks are not available; educators are not well trained in OBE; the DoE do not avail itself to clarify matters on OBE; and Mathematics is regarded as the most difficult subject.

In conclusion, if the abovementioned challenges are not resolved, the implementation of OBE in South African schools is destined to result in poor-quality education.

5.4.2 Role of e-learning in outcomes-based education

How can e-learning help resolve the problems faced by educators and learners in the OBE primary and secondary education system in developing countries? Nicholas (2006) recommend that organisations that utilise the SCORM standard would benefit from extensive instructional designer training in SCORM-based practices. The study reflected that students were satisfied with SCORM and that it made them confident abouth their course content. The study also indicated that the use of a SCORM-compliant prototype helped the so-called weaker students to improve from poor performance in mathematics to very good performance.

The SCORM-compliant e-learning course content was developed in this study to resolve the most acute problems that are experienced by educators and learners. The SCORM e-learning course content was developed only for the training of Mathematics educators in grades 10 and 11, because 100% of the participating educators and learners indicated that Mathematics is the most difficult subject and that educators are not well trained in the Mathematics OBE system. The clear index with links will help educators to learn more of the OBE curriculum anytime they wish to access the content. The e-learning content prototype will help educators in such a way that they do not have to have all the documents at hand, as is the case in face-to-face training, as all the necessary documents will be available at all times.

The researcher finally concludes that a SCORM-compliant e-learning content prototype will help educators to improve their understanding of the OBE curriculum by presenting a clear training manual with links that direct the educators to the information they need and by introducing them to the world of technology.

5.5 Recommendations for further research

This study opens up a door for many research areas regarding the South African OBE system. The researcher plans to continue research on SCORM and OBE in South Africa in his studies towards a doctoral degree.

5.5.1 The availability and effectiveness of teacher training for educators in the South African outcomes-based education curriculum

In light of all the concerns raised by educators and learners as well as the literature reviewed in this study, further research on the topic needs to be conducted and tested to find the most effective training methods. Different training models have to be reviewed to find the best training model to be used for educators in South Africa. Research on the effectiveness of trainers with regard to OBE matters has to be conducted, as this might affect educators' passion for education in the OBE system.

5.5.2 The clarity of assessment methods and strategies

Assessment methods used in the OBE system should be effective in a way that the skill for that outcome has to be assessed by educators involved. Therefore, further research on assessment methods and strategies in the OBE curriculum should be conducted.

5.5.3 The use of e-learning in secondary schools

In the researcher's opinion, not much research is being done on e-learning and the OBE curriculum. As technology advances, the use of computers for learning will help learners to go the extra mile like research more work, and view expanded opportunities to learners. Therefore, research on the use of e-learning in South African curriculum has to be viewed to find out

whether South Africa, as a developing country, can succeed in using ICT in education. The comparison of e-learning models to find the best suitable model for South Africa is a field of research that needs to be investigated.

5.5.4 Public schools versus private schools on educational models and learner achievements

In general, learners in public schools seem to perform poorer compared to private schools. Therefore, research should be conducted to answer the following questions: What is it that private schools do to employ the best educators? Why do learners in private schools performing bettern than public schools? What exactly must public schools copy from private schools? If private schools can do it, why not public schools?

5.5.5 The use of mobile technology for sharing knowledge in education

Cell phone technology is popular in current times, and as this study has reflected, almost 65% of educational practitioners have their own cell phones. Therefore, more research needs to be conducted on the use of cell phones in teaching and learning in South Africa.

5.6 Conclusion

According to Thusi (2000), OBE is considered an important cornerstone in a democratic society. Thusi further posits that this system is vital for building the knowledge, skills and values that underpin a just and equitable social order (Thusi, 2000). As of 2008, the OBE curriculum is used in South Africa from Grade R up to Grade 12. However, the research conducted by Naicker (2000) reflected that considerable implementation problems were experienced.

This study therefore examined factors that can be constraints to the implementation of OBE in South Africa. The factors that were discussed were based on the following:

i. The understanding of OBE terminology
ii. Support and capacity building
iii. SCORM-compliant e-learning content prototype

The findings in terms of OBE were not encouraging. The challenges expressed by educators and learners that participated in this study are the following: learners from rural areas do not have access to basic ICT terminals, as they do not have cell phones and televisions; both educators and learners do not understand OBE terminology; schools' basic infrastructure is inadequate; classes are overcrowded, especially in rural and township schools; computers are not used sufficiently for academic purposes; libraries and laboratories are not available; textbooks arrive late; and Mathematics is the most difficult subject, followed by science. The literature presented in Chapter 2 of this thesis emphasised the effectiveness of ICT for education, as compared to the traditional way of studying.

DoE officials need to provide guidance and continue to monitor the implementation of OBE in South African schools. The curriculum must be treated as an ongoing process, giving consideration for improvement where necessary. Schools' basic infrastructure has to be taken into consideration in order to facilitate successful OBE implementation that will contribute to high-quality outcomes. The use of technology has to be considered in primary and secondary schools, as it effects the visual presentation of materials and contributes to the sharing of information between education practitioners of different schools. The impact of the attitudes of both implementers and people that are using OBE must be addressed in order for the OBE system to be successful in South Africa.

REFERENCE LIST

Acharya, C. 2003. *Outcome-based education (OBE)*: A new paradigm for learning. Former Research Assistant, CDTL, Volume 7.

Adam, F. 2005. Supporting education through technology: Development and implementation of a multimedia solution. Mindset Network: A South African case study. *Journal of International Education* 5(4):269–290.

Bokhove, K.G. 2003. *Using SCORM to monitor students' performance*: *Experiences from secondary school practice.* Place: University of Amsterdam.

Brown, J. 2000. Interview: *SCORM in higher education* [Online]. Academic ADL Co-Lab. Available at http://www.wiadlcolab.org [accessed 2 May 2006].

Brown, N.E. 2004. The shift from apartheid to democracy: Issues and impacts on public libraries in Cape Town, South Africa. New York: Pratt Institute. *Libri* 54:169–178.

Butler, M. 2004. Outcomes based/Outcomes focused education overview. Unpublished dissertation. University of Sydney, Sydney.

Conole, G., De-Laat, M., Dillon, T. & Darby, J. 2006. *An in-depth case study of students' experiences of e-learning: How is e-learning changing?* Proceedings of the 23rd Annual Ascilite Conference: Who's learning? Whose technology?, 12-15 March, University of Sydney, Sydney.

Dagada, R. & Jakovljevic, M. 2004. *Integration of online learning in the corporate training environment*: *Lesson from South Africa.* Place: Technikon SA and the University of the Witwatersrand.

Daziell, T. & Gourvenec, S. 2003. *Partnership in outcomes based education.* 12th Teaching and Learning Forum, 27 September, TLF Edith Cowan University, Perth.

Denvor, C.O. 2000. *Outcomes based education*: *An overview*. Place: North Central Regional Educational Laboratory, Education Commission of the States.

Department of Education. 2004. *White Paper on e-education*. Policy document. Pretoria.

Department of Education. 2005:2010. *Strategic planning* – The statement of Policy and commitment by the Minister of Education. Place.

Department of Education. 2007a. *Assessment Guidelines: Mathematics subject grade R–12* [Online]. Available at http://education.gov.za/Curriculum/Assessment.asp [accessed 7 September 2007].

Department of Education. 2007b. *Curriculum Guidelines: Mathematics subject grade R–12* [Online]. Availabe at http://education.gov.za/Curriculum/Mathematics.asp [accessed 7 September 2007].

Department of Education. 2007c. *Examination Guidelines: Mathematics subject grade 10–12* [Online]. Available at http://education.gov.za/Curriculum/Seniorphase_examplers.asp [accessed 7 September 2007].

Department of Education. 2007d. *Subject Statements: Mathematics Subject Statements grade R–12* [Online]. Available at http://education.gov.za/Curriculum/SubjectStatement.asp [accessed 7 September 2007].

Department of Education. 2007e. *Teacher training manual: Mathematics grade 11* [Online]. Available at http://education.gov.za/Curriculum/teacherManuals/Mathematics.asp [accessed 7 September 2007].

Department of Education. 2007f. *Vocational learning documents: Mathematics* [Online]. Available at http://education.gov.za/Curriculum/teacherManuals/Vocational/Mathematics.asp [accessed 7 September 2007].

Dunmill, M. & Arslanagic, TP. 2006. *ICT in Arts education: A literature review*. Te Puna Puoru National Centre for Research in Music Education and Sound Arts, University of Canterbury.

Engelbrecht, E. 2003. A looking at e-learning models: Investigating their value for developing an e-learning strategy. *Progressio* 25(2):38–47.

Entanado, F.B. & Diaz, L.A. *A training proposal for e-learning teachers.* Bedajoz: Department of Education.

Fisher, K. 2005. *Building better outcomes: The impact of school infrastructure on student outcomes and behaviour*. DETYA.

Higgins, S. 2003. *Does ICT improve learning and teaching in schools?* New Castle University.

Jackson, B.M. 2000. The implications of the introduction of outcomes based education for Natural Science curriculum. *The Science Teacher* 12:35–44.

Jacobson I., Booch G, Rumbaugh j (1999). *The Unified Modelling Language* User guide. Addison-Wesley, USA.

Jansen, J.D. 1997. Why OBE will fail. In *Perspectives on outcomes based education*. Proceedings of National Conference on Outcomes Based Education, 20 March, University of Durban Westville, Durban: 65–76.

Jansen, J.D. 1998. Curriculum reform in South Africa: A critical analysis of outcomes based education. *Cambridge Journal of Education* 28(3):321–331.

Jansen, J.D. & Christie, P. 1999. *Changing curriculum: Studies on outcomes based education in South Africa.* Kenwyn: Juta.

Johansson, C. 2007. *School libraries and outcomes based education: A study of factors impacting in the development of school libraries with focus on disadvantaged areas in the Western Cape province.* Magisteruppsats I Biblioteks 2.

Josceanu, A.M., Isopescu, R., Plesu, V. & Zelch, O. 2004. *SCORM-based content delivery and e-learning platform* for chemical engineering education in University, Politehnica of Bucharest.

Killen, R. 2005. *Outcomes based education: Principles and possible solutions* [Online]. Available at http://www.acel.org.au/affiliates/nsw/conference01/ts_1.html [accessed 13 September 2006].

KwaZulu Natal Department of Education. 2006. *School information* [Online]. Available at http://www.kzneducation.gov.za/school_info/default.asp [accessed 15 September 2006].

Lujara, S.K., Kissaka, M.M., Trojer, L. & Mvungi, N.H. 2007. *Introduction of open source e-learning environment and resources: A novel approach for secondary schools in Tanzania*. Proceedings of World Academy of Science, Engineering & Technology, Volume 20, 12 October, Ohio: 11-13

Magi, T.E. 2008. Investigation of e-learning in a South African university: A case study of Walter Sisulu University. Unpublished thesis. School of Computing, Coventry University, Britain.

Makgato, M. & Mbanguta, Z. 2002. *Towards an outcomes-based teaching and learning module for teacher preparation programmes of FET institution engineering and technology educators in South Africa.* Pretoria: Technikon Northern and Gauteng, National Department of Education.

Malan, S.P.T. 2000. The 'new paradigm' of outcomes based education in perspective. *Journal of Family Ecology and Consumer Sciences* 28:22–28.

Milliken, J. & Barnes, P.L. 2002. Teaching and technology in higher education: Student perceptions and personal reflections. *Pergamon Journal on Computers and Education* [Electronic] 39:223–235. Available at www.elsevier.com/locate/compedu [accessed 6 September 2007].

Mugo, F.W. 2001. Sampling in research. *Merriam Webster* [Online]. Available at http://www.socialresearchmethods.net/tutorial/Mugo/tutorial.htm [accessed 21 August 2007].

Mutmaz, S. 2000. *Factors affecting teachers' use of information and communication technology: A review of the literature based on technology, pedagogy, and education.*

Naicker, S.M. 2000. An investigation into the implementation of outcomes based education in the Western Cape province. Unpublished dissertation. University of the Western Cape,.

Nicholas, R. 2006. The development of a Shareable Content Object Reference Model (SCORM): Best practices guide for instructional designers. Unpublished thesis. Emporia State University.

Parker, M. 2003. *Technology enhanced e-learning: Perceptions of first year Information Systems students at the Cape Technikon.* Proceedings of SAICSIT on Technology Enhanced E-learning, 17 April, Australia: 9-17.

Pressman, R.S. 1997. *Software engineering*: *A practitioner's approach.* Fourth edition. Publisher Nade (Pty)Ltd.

Rahman, S.A., Ghazali, M. & Ismail, Z. 2003. *Integrating ICT in mathematics teaching methods course: How has ICT changed student teacher's perception about problem solving*. School of Educational Sciences, Universiti Sains Malaysia.

Ramolefe, E. 2003. Secondary school educators' experience of the support by the principals. Unpublished thesis. University of Pretoria, Pretoria.

Richardson, J.V. 2006. *Open versus closed ended questions in the reference environment* [Online]. Available at http://polaris.ucla.edu/jrichardson/dis220/openclosed.htm [accessed 9 September 2006].

Ron, O. 2004. *Moving beyond instructional comfort zones with online courses* [Online]. Availabe at http://www.ascilite.org.au/conferences/perth04/procs/oliver–r.html [accessed 1 May 2006].

Schneider, M. 2003. *Public school facilities and teaching.* Report paper. Washington, DC: State University of New York Press.

Sieborger, R. 1998. *Transforming assessment: A guide for South African teachers.* Cape Town: Juta.

Stoffels, N. & Onwu, G. 2001. Instructional functions in large, under resourced science classes: Perspective of South African teachers. *Perspectives in Education Journal* 23: 73-79.

Thusi, initials. 2006. The implementation of outcomes based education in township primary schools. Unpublished dissertation. Educational Science University of South Africa..

Turker, B. 2005. *Literature review: Outcome focused education in universities*. Curtin University of Technology, Learning Support Network.

Ungerleider, C.S. & Burns, T.C. 2002. *Information and communications technologies in elementary and secondary education: A state of the art review.* Paper delivered at the Pan-Canadian Education Research Agenda Symposium Information Technology and Learning, 17 September, Quebec.

Were, E., Rubagiza J., Denley P. & Sutherland, R. 2007. *The use of ICT to support basic education in disadvantaged schools and communities* [Online]. Available at http://www2.unescobbk.org/education [accessed 7 September 2007].

Zengele, T.V. 2004. Implications for educational managers during the implementation of outcomes-based education in the Gauteng West district. Unpublished mini-dissertation. Rand Afrikaans University, Johannesburg.

APPENDIX A: QUESTIONNAIRE FOR LEARNERS

101 Dolphin court
57 Prince Street
South Beach
Durban
4001

To whom it may concern:

Dear Sir or Madam,

I, Xolisa Piyose, a student at Durban University of Technology, currently studying for a Master's degree in Information Technology am humbly inviting you to participate in the research project titled: "*Testing SCORM (Sharable Content Object Reference Model) with OBE (Outcome Based Education*".

You are requested to assist in the project by filling in the attached questionnaire. The questionnaire seeks to gather information on problems/difficulties contributing to the failure of OBE. The questionnaire is designed for both educators and learners. Your anonymity and confidentiality will be highly ensured. This study will need you to be free and open in answering questions.

Your assistance with this research would be greatly appreciated.

Yours Sincerely

_____

Xolisa Piyose (Mr.)

QUESTIONNAIRE A: Primary and Secondary Schools

The primary objective of this questionnaire is to seek difficulties/problems experienced by educators and learners in KwaZulu-Natal schools when implementing OBE features.

Procedure

Please try to fill in as many questions as you can (possible all questions of this questionnaire). You are free to ask the researcher any questions regarding questionnaire. After you have completed all the questions in the questionnaire, turn your questionnaire face down and raise your hand or wait until the researcher collects the questionnaire.

Confidentiality

Your anonymity and confidentiality will be highly assured, as the information you provide will be strictly confidential. The completed questionnaires will be destroyed after the research is completed and will be read by the researcher and his supervisors namely: Doctor Seraphin Eyono Obono and Professor Thiruthlall Nepal.

Directions

This survey includes three kinds of questions:

1. Checklist questions

For these questions, please put a cross in the box that best answers the question. In some cases you may be required to put a cross in more than one box.

For example:

Do you understand what OBE is?

Yes ☐ *No* ☐

In this example, the person answered that he or she does not understand OBE.

2. Scale questions with numbered boxes.

These questions have a scale ranging from 1 to 5. *1* represents *strongly disagree*, *2* represents *do not agree*, *3* represents *not sure*, *4* represents *agree*, and *5* represents *strongly agree.*

You are required to put a cross in the box that best answers the question (to the best of your knowledge).

For example:

Option	*1*	*2*	*3*	*4*	*5*
OBE is problematic		*X*			

In the above case the cross is in column 2, meaning that the participant feels that (s)he *disagrees* with the fact that OBE is problematic.

3. Ranking questions

These questions require a participant to rank the different criteria's according to his or her preference. You are required to write a letter to the number that corresponds with according to your own understanding.

For example:

Options	1	2	3
Rank the sport you like the most from the following *(Please specify the first 3 sport codes that you prefer):* Soccer(S), Cricket©, Netball(N), Basketball(B), Hockey(H), Rudby®, *where 1 represents the mostly preferable sport, and 3 represents the least preferable sport from the first three that the participant prefer.*	C	S	H

In the above case the participant prefer only cricket, soccer and Hockey, but cricket being given the first priority, followed by soccer and thereafter hockey.

4. Open ended questions

The answers to these questions must be written in the space provided.

For example:

Question:

Could computers be introduced to primary schools? Why? _____*WRITE YOUR ANSWER HERE*_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

SECTION A: BACKGROUND INFORMATION

This questionnaire is to be filled by only learners at primary or secondary schools. *Please tick appropriate answer to you personally:*

1. Are you a learner?

Yes ☐

No ☐

2. Which category do you belong?

Primary level ☐

Secondary level ☐

3. What type of school is your school?

Public school ☐

Private school ☐

4. Which grade are you studying?

Grade	Option	Grade	Option
1		7	
2		8	
3		9	
4		10	
5		11	
6		12	

5. Please indicate your gender.

Female ☐

Male ☐

6. Please indicate the race group(s) of learners an educators in your school (*You may put a cross in more than one answer).*

African ☐

Coloured ☐

Indian ☐

White ☐

Other (specify) …….

7. Please indicate your race group.

African ☐

Coloured ☐

Indian ☐

White ☐

Other (specify)

……

8. Indicate your home language?

Afrikaans		Venda	
English		Tswana	
Zulu		Swati	
Xhosa		Ndebele	
Sotho			
Other (specify)			

9. Where is your school located?

Major urban city ☐

Small town ☐

Rural area ☐

10. Indicate your age.

Less than 6 years		16 To 18 years	
6 To 9 years		19 To 21 years	
10 To 12 years		Above 21 years	
13 To 15 years			

11. Do you have a computer? (*You may put a cross in more than one answer)*

Home ☐

School ☐

Telecentre ☐

No computer ☐

12. Does the computer mentioned above have internet access?

Yes ☐

No ☐

13. How much did the computer cost?

No computer		R4000.00 to R5999.00	
Do not know		R6000.00 to R7999.00	
Less than R2000.00		R8000.00 to R9999.00	
R2000.00 to R3999.00		R10000.00 to above	

14. What do use the computer for?

No computer		Watching DVD's	
Playing Games		Playing music	
Typing		E-mail	
Study		Internet	
Work		Watching TV	

15. Do you have a cell phone?

Yes ☐

No ☐

16. How much did your cell-phone cost?

No cell phone		R900.00 to R1199.00	
Someone gave it to me		R1200.00 to R1499.00	
Less than R300.00		R1500.00 to R1799.00	
R300.00 to R599.00		R1800.00 to R2099.00	
R600.00 to R899.00		R2100 to above	

17. If you do not have a computer at home, are you willing to have one?

Yes ☐

No ☐

18. Indicate, what you would use your computer for?

Playing Games		E-mail	
Typing		Internet	
Study		Watching TV	
Work		Not applicable	
Watching DVD's		Other specify	
Playing music			

19. Is there a Television at your home?

Yes ☐

No ☐

20. If Yes, how often do you watch your television?

Less than 2 hours a day		8 To 9 hours a day	
2 to 3 hours a day		More than 10 hours a day	
4 to 5 hours a day		Do not watch it at all	
6 to 7 hours a day		Other please specify	

21. Which programme(s) do you watch the most?

News		Soaps		Music	
Education programmes		Movies		Comedy	
Talk shows		Magazines		Other please specify	
Drama		Sport			

SECTION B: SCALED RESPONSE QUESTIONS

This section is based on questionnaire hypotheses and four basic principles of South African OBE for both leaner and teacher support which are: clarity of focus, design down, high expectations, and expanded opportunities.

Principle One: *Clarity of focus* infers that curriculum development, implementation and evaluation should be geared by the outcomes which are expected as the culminating demonstrations of the learners.
Principle two: *Design down* states that begin curriculum design with a clear definition of the significant learning that learners are to achieve by the end of their formal education.
Principle three: *High expectations* state that establish high, challenging performance standards by engaging deeply with issues learners are learning.
Principle four: *Expanded opportunities* – provide multiple learning opportunities matching learner's needs with teaching techniques.

The objective is to test principle three and four with respect to principle one and two, the documents provided by the Department of Education as guidelines for teaching and learning.

The numbers presented in the following statement explain your response to a particular question where *1* represents *strongly disagree*, *2* represents *do not agree*, *3* represents *not sure*, *4* represents *agree*, and *5* represents *strongly agree.* Please put a cross for your answer in a space provided for your answer.

PART 1: LIKERT SCALE

A) Clarity of focus	1	2	3	4	5
Most outcomes are clearly stated					
Educators well define lesson's outcomes just at the beginning of a lesson.					
Most outcomes are clearly broken down by the teacher into learning activities that can allow the learner to meet the outcome					
Educators differentiate between short and long term learning intentions and are able to clarify them					
The timeframe is clearly included in the definition of outcomes and learning activities					
The department is available for clarification or correction on ambiguous outcomes					
The assessment criteria for most outcomes is clear					
h) The use of computers in the assessment process is satisfactory.					
Study guides are available, have clear identifiable sections and have a clear usable table of content					
B) Design down	1	2	3	4	5
Educators are able to link planning, teaching and assessment decisions to significant learner outcomes.					
I am able to differentiate between different levels of outcomes					
I understand vertical integration of outcomes					
I understand horizontal integration of outcomes					
The combination of outcomes usually makes sense					
Educators usually identify learning building blocks to help students acquire skills sequentially.					
Learning building blocks are usually easily clarified					
Timeframe is usually included in the definition of learning blocks					

C) High expectations	1	2	3	4	5
1) ACADEMIC					
Educational standards set for learning and teaching are usually high.					
b) Most educators are competent enough.					
Learners' performance is mostly high.					
My own performance is mostly high.					
Most educators are well trained to perform their duties.					
2) LEARNING ENVIRONMENT					
a) Class-rooms are overcrowded.					
b) Learners attitude towards studying is adequate.					
c) Educators attitude towards teaching is adequate.					
d) OBE is a good education system					
Timeframe for extra curricula activities is adequate.					
The archiving of subjects records is satisfactory.					
The usage of computers for academic administration is satisfactory.					
My school management support me in using OBE and their approaches.					
D) Expanded opportunities	1	2	3	4	5
a) Learning techniques are easily identified					
b) Working in groups helps to improve student's performance.					
c) The use of computers in the learning process is satisfactory.					
d) Different learning methodologies promote laziness to learners.					
e) School basic infrastructure(water, electricity, classrooms, playgrounds) is adequate					
f) Laboratory infrastructure (excluding computer laboratories) is adequate					
g) Library infrastructure(books, staff, space, time) is adequate					
h) Learning activities lay foundations for basic knowledge.					
i) learning activities lay foundations for basic career needs					
j) learning activities lay foundations for hands on oriented careers					

k) learning activities lay foundations for futuristic career needs					
l) Educators and school management organize experts to solve student's problems and classroom activities.					
m) Educators and learners get support materials from their neighbouring schools					
n) Learners are given opportunity to assess one another to promote networking between students					
o) My School is taking the first step to contact other schools to assist in matters concerning OBE					

PART 2: RANKING RESPONSE QUESTIONS

Please rank the following statements according to your own knowledge:

A) Assessment	1	2	3
a) Rank the type of assessment you prefer: Theory only(T), practice only (P), Theory and practice(B) *where 1 represent the most preferable assessment, 3 represent the least preferable assessment.*			
b) Rank the communication mode that is used the most during assessment: Oral(O), written(W), mixed(M), *where 1 represents mostly used and 3 represents the least used*.			
Rank the mostly used assessment method (*Please specify only 3 assessment methods you use the most*), group assessment in class(G), group home assessment(W), classical(C), play(P), individual class assessment(I), individual home assessment(H), home self-assessment(S), *from left(1) to right(3), starting with the one that you use the most* .			
d) Rank the mostly used learning approach (*Please specify only 3 assessment methods you use the most*), group work in class(G), group home work(W), classical(C), play(P), individual class work(I), individual homework(H), home self-study(S), *from left(1) to right(3), starting with the one that you use the most* .			
B) PERFORMANCE	1	2	3
a) Rank the following subjects according to their level of difficulty *where 1 means very easy, 2 means easy, 3 means neutral, 4 means difficult, 5 means very difficult*: Maths(M), English(E), Science and Technology(S), Arts and Culture(A), Business and Management(B), Other(O).			

SECTION C: OPEN-ENDED QUESTIONS

1. According to your personal view, does OBE system support learners in terms of skill acquiring? Please reasons for your answer

---

---

2. Do you view OBE in general problematic or successful? Why?

---

3. As a student studying under OBE system, what are the problems that you experience personally?

---

4. What do you think are possible solutions to the problems mentioned above?

---

5. According to your personal view, are the students at your school in favor of OBE?

---

6. Are you receiving the support necessary from your educators and management of your school? Elaborate

---

---

7. Please explain whether you think introduction of e-learning to primary and secondary school will be useful or not.

---

8. What are your personal views as far as training of your educators to OBE curriculum is concerned?

---

9. What do you think educators must do to set high standards of education?

---

10. What do you think must be done to improve and maintain the performance of learners to the Educational system used currently?

---

11. With OBE being implemented, what factors do you think contribute to the difficulty of educators to adopt OBE?

---

12. Comment on the type of support do you receive from district Department of Education?

---

13. Comment on provision of resources to schools.

APPENDIX B: QUESTIONNAIRE FOR EDUCATORS

101 Dolphin court
57 Prince Street
South Beach
Durban
4001

To whom it may concern:

Dear Sir or Madam,

I, Xolisa Piyose, a student at Durban University of Technology, currently studying for a Master's degree in Information Technology am humbly inviting you to participate in the research project titled: "*Testing SCORM (Sharable Content Object Reference Model) with OBE (Outcome Based Education*".

You are requested to assist in the project by filling in the attached questionnaire. The questionnaire seeks to gather information on problems/difficulties contributing to the failure of OBE. The questionnaire is designed for both educators and learners. Your anonymity and confidentiality will be highly ensured. This study will need you to be free and open in answering questions.

Your assistance with this research would be greatly appreciated.

Yours Sincerely

_____

Xolisa Piyose (Mr.)

QUESTIONNAIRE B: Primary and Secondary Schools

The primary objective of this questionnaire is to seek difficulties/problems experienced by educators and learners in KwaZulu-Natal schools when implementing OBE features.

Procedure

Please try to fill in as many questions as you can (possible all questions of this questionnaire). You are free to ask the researcher any questions regarding questionnaire. After you have completed all the questions in the questionnaire, turn your questionnaire face down and raise your hand or wait until the questionnaire is collected by the researcher.

Confidentiality

Your anonymity and confidentiality will be highly assured as the information you provide will be strictly confidential. The completed questionnaires will be destroyed after the research is completed and will be read by the researcher and his supervisors namely: Doctor Seraphin Eyono Obono and Professor Thiruthlall Nepal.

Directions

This survey includes three kinds of questions:

1. Checklist questions

For these questions, please put a cross in the box that best answers the question. In some cases you may be required to put a cross in more than one box.

For example:

Do you understand what OBE is?

Yes ☐ *No* ☐

In this example, the person answered that he or she does not understand OBE.

2. Scale questions with numbered boxes.

These questions have a scale ranging from 1 to 5. ***1*** represents ***strongly disagree***, ***2*** represents ***do not agree***, ***3*** represents ***not sure***, ***4*** represents ***agree***, and ***5*** represents ***strongly agree.***

You are required to put a cross in the box that best answers the question (to the best of your knowledge).

For example:

Option	*1*	*2*	*3*	*4*	*5*
OBE is problematic		*X*			

In the above case the cross is in column 2, meaning that the participant feels that (s)he *disagrees* with the fact that OBE is problematic.

3. Ranking questions

These questions require a participant to rank the different criteria's according to his or her preference. You are required to write a letter to the number that corresponds with according to your own understanding.

For example:

Options	1	2	3
Rank the sport you like the most from the following *(Please specify the first 3 sport codes that you prefer):* Soccer(S), Cricket©, Netball(N), Basketball(B), Hockey(H), Rudby®, *where 1 represents the mostly preferable sport, and 3 represents the least preferable sport from the first three that the participant prefer*.	C	S	H

In the above case the participant prefer only cricket, soccer and Hockey, but cricket being given the first priority, followed by soccer and thereafter hockey.

4. Open ended questions

The answers to these questions must be written in the space provided.

For example:

Question:

Could computers be introduced to primary schools? Why? _____***WRITE YOUR ANSWER HERE***_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

SECTION A: BACKGROUND INFORMATION

This questionnaire is to be filled by only educators at primary and secondary schools. *Please tick appropriate answer to you personally:*

1. Are you an educator?

Yes ☐
No ☐

2. Which category do you belong?

Primary level ☐
Secondary level ☐

3. What type of school is your school?

Public school ☐
Private school ☐

4. Which grade(s) do you teach?

Grade 1 To 2 ☐
Grade 3 To 4 ☐
Grade 5 To 6 ☐
Grade 7 to 8 ☐
Grade 9 to 10 ☐
Grade 11 to 12 ☐

5. Please indicate your gender.

Female ☐

Male ☐

6. Please indicate the race group(s) of learners in your school (*You may put a cross in more than one answer).*

African ☐

Coloured

Indian ☐

White ☐

Other (specify)

…….

7. Please indicate the race group(s) of educators in your school (*You may put a cross in more than one answer).*

African ☐

Coloured

Indian ☐

White ☐

Other (specify)

…….

8. Please indicate your race group.

African ☐

Coloured

Indian ☐

White ☐

Other (specify)

…….

9. Indicate your home language?

Afrikaans		Venda	
English		Tswana	
Zulu		Swati	
Xhosa		Ndebele	
Sotho			
Other (specify)			

10. Where is your school located?

Major urban city ☐

Small town ☐

Rural area ☐

11. Indicate your age.

Less than 20 years		35 To 39 years	
20 To 24 years		40 To 44 years	
25 To 29 years		45 To 49 years	
30 To 34 years		50 and above	

12. Do you have a computer? (*You may put a cross in more than one answer)*

Home ☐

School ☐

Telecentre ☐

No computer ☐

13. Does the computer mentioned above have internet access?

Yes ☐

No ☐

14. How much did the computer cost?

No computer		R4000.00 to R5999.00	
Do not know		R6000.00 to R7999.00	
Less than R2000.00		R8000.00 to R9999.00	
R2000.00 to R3999.00		R10000.00 to above	

15. What do use the computer for?

No computer		Watching DVD's	
Playing Games		Playing music	
Typing		E-mail	
Study		Internet	
Work		Watching TV	

16. Do you have a cell phone?

Yes ☐

No ☐

17. How much did your cell-phone cost?

No cell phone		R900.00 to R1199.00	
Someone gave it to me		R1200.00 to R1499.00	
Less than R300.00		R1500.00 to R1799.00	
R300.00 to R599.00		R1800.00 to R2099.00	
R600.00 to R899.00		R2100 to above	

18. If you do not have a computer at home, are you willing to purchase one?

Yes ☐

No ☐

19. If the answer to the above is ***Yes***, how much are you willing to pay for your computer?

Less than R2000.00	
R2000.00 to R3999.00	
R4000.00 to R5999.00	
R6000.00 to R7999.00	
R8000.00 to R9999.00	
R10000.00 to above	

20. Indicate, what you would use your computer for?

Playing Games		E-mail	
Typing		Internet	
Study		Watching TV	
Work		Not applicable	
Watching DVD's		Other specify	
Playing music			

21. Do you have a Television?

Yes ☐

No ☐

22. If Yes, how often do you watch your television?

Less than 2 hours a day		8 To 9 hours a day	
2 to 3 hours a day		More than 10 hours a day	
4 to 5 hours a day		Do not watch it at all	
6 to 7 hours a day		Other please specify	

23. Which programme(s) do you watch the most?

News		Soaps		Music	
Education programmes		Movies		Comedy	
Talk shows		Magazines		Other please specify	
Drama		Sport			

24. Rate your understanding OBE

Not al all		average		Excellent
1	2	3	4	5

SECTION B: SCALED RESPONSE QUESTIONS

This section is based on questionnaire hypotheses and four basic principles of South African OBE for both leaner and teacher support which are: clarity of focus, design down, high expectations, and expanded opportunities.

Principle One: *Clarity of focus* infers that curriculum development, implementation and evaluation should be geared by the outcomes which are expected as the culminating demonstrations of the learners.
Principle two: *Design down* states that begin curriculum design with a clear definition of the significant learning that learners are to achieve by the end of their formal education.
Principle three: *High expectations* state that establish high, challenging performance standards by engaging deeply with issues learners are learning.
Principle four: *Expanded opportunities* – provide multiple learning opportunities matching learner's needs with teaching techniques.

The objective is to test principle three and four with respect to principle one and two, the documents provided by the Department of Education as guidelines for teaching and learning.

The numbers presented in the following statement explain your response to a particular question where ***1*** represents ***strongly disagree***, ***2*** represents ***do not agree***, ***3*** represents ***not sure***, ***4*** represents ***agree***, and ***5*** represents ***strongly agree.*** Please put a cross for your answer in a space provided for your answer.

PART 1: LIKERT SCALE

A) Clarity of focus	1	2	3	4	5
Most outcomes are clearly stated					
Most outcomes are clearly broken down by the Department into learning activities that can allow the learner to meet the outcome					
Most outcomes are clearly broken down by the teacher into learning activities that can allow the learner to meet the outcome					
The timeframe is clearly included in the definition of outcomes and learning activities					
The department is available for clarification or correction on ambiguous outcomes					
The assessment criteria for most outcomes is clear					
g) The use of computers in the assessment process is satisfactory.					
Subject guidelines have a clear usable table of content					
Subject guidelines have a clear index					
Subjects guidelines have clear identifiable sections					
B) Design down	1	2	3	4	5
I am able to differentiate between different levels of outcomes					
I understand vertical integration of outcomes					
I understand horizontal integration of outcomes					
The combination of outcomes usually makes sense					
I have contributed to the design of some of the outcomes					
Learning building blocks are usually identifiable					
Learning building blocks are usually easily clarified					
Timeframe is usually included in the definition of learning blocks					
C) High expectations	1	2	3	4	5
1) ACADEMIC					
Educational standards sets for learning and teaching are usually high.					

b) Most educators are competent enough.					
Learners' performance is mostly high.					
My own performance is mostly high.					
Most educators are well trained to perform their duties.					
2) LEARNING ENVIRONMENT					
a) Class-rooms are overcrowded.					
b) Learners attitude towards studying is adequate.					
c) Educators attitude towards teaching is adequate.					
d) OBE is a good education system					
Timeframe for academic administration is adequate.					
Timeframe for extra curricula activities is adequate.					
The archiving of students academic records is satisfactory.					
The archiving of subjects records is satisfactory.					
The usage of computers for academic administration is satisfactory.					
My school management support me in using OBE and their approaches.					
D) Expanded opportunities	1	2	3	4	5
a) Learning techniques are easily identified					
b) Working in groups helps to improve student's performance.					
c) The use of computers in the learning process is satisfactory.					
d) Different learning methodologies promote laziness to learners.					
e) School basic infrastructure(water, electricity, classrooms, playgrounds) is adequate					
f) Laboratory infrastructure (excluding computer laboratories) is adequate					
g) Library infrastructure(books, staff, space, time) is adequate					
h) Learning activities lay foundations for basic knowledge.					
i) learning activities lay foundations for basic career needs					
j) learning activities lay foundations for hands on oriented careers					
k) learning activities lay foundations for futuristic career needs					

PART 2: RANKING RESPONSE QUESTIONS

Please rank the following statements according to your own knowledge:

Assessment	1	2	3
a) Rank the type of assessment you prefer: Theory only(T), practice only (P), Theory and practice(B) *where 1 represent the most preferable assessment, 3 represent the least preferable assessment.*			
b) Rank the communication mode you use the most during assessment: Oral(O), written(W), mixed(M), *where 1 represents mostly used and 3 represents the least used.*			
Rank the mostly used assessment method (*Please specify only 3 assessment methods you use the most*), group assessment in class(G), group home assessment(W), classical(C), play(P), individual class assessment(I), individual home assessment(H), home self-assessment(S), *from left(1) to right(3), starting with the one that you use the most* .			
d) Rank the mostly used learning approach (*Please specify only 3 assessment methods you use the most*), group work in class(G), group home work(W), classical(C), play(P), individual class work(I), individual homework(H), home self-study(S), *from left(1) to right(3), starting with the one that you use the most* .			

SECTION C: OPEN-ENDED QUESTIONS

1. What is your view to the introduction of OBE approach in South Africa's secondary and primary schools?

---

2. Is OBE easy or difficult to use? Reason for your answer?

---

3. According to your personal experience, is there a gap between implementation of education through learning methodologies, assessment, and time?

---

4. Please explain whether you think whether e-learning is useful or not.

---

5. What are your personal views as far as training of educators to OBE curriculum is concerned?

---

6. What do you think educators must do to set high standards of education?

---

7. What do you think must be done to improve and maintain the performance of learners to the educational system used currently?

---

8. What would you recommend concerning the support of OBE for curriculum development and about the curriculum in general?

---

9. With OBE being implemented, what factors do you think contribute to the difficulty of educators to adopt OBE?

---

10. Comment on the type of support do you receive from school management and district Department of Education?

---

11. What do you think school management and district Department of Education should do to make educational system to be more effective and efficiency?

---

12. What are some of the problems you experience personally when using OBE?

---

13. What techniques do you use to overcome problems experienced when implementing OBE?

---

14. Comment on provision of resources to schools.

APPENDIX C: LETTER TO THE DEPARTMENT OF EDUCATION

101 Dolphin court
57 Prince Street
South Beach
Durban
4001

Dr. B.M. Mthabela
Research Director
Department of Education
KwaZulu-Natal
Republic of South Africa

RE: APPLICATION FOR A PERMISSION TO CONDUCT A RESEARCH TO SCHOOLS

I, Xolisa Piyose, a student at Durban University of Technology, currently studying for a Master's degree in Information Technology am humbly asking you to provide me with a database of primary and secondary schools in KwaZulu-Natal. The database will be used to select schools in order to conduct a research on OBE in South African schools.

I further request the department to provide me with a permission letter to conduct the research on the selected schools. The research will contribute to the educational system in both provisionally and nationally. The research seeks the perceptions of educators on OBE system as well as the problems if any they are facing during the implementation of OBE.
Your assistance with this regard would be greatly appreciated.

Yours Sincerely

_____

Xolisa Piyose (Mr)

APPENDIX D: SCORM QUESTIONNAIRE

101 Dolphin court
57 Prince Street
South Beach
Durban
4001

To whom it may concern:

Dear Sir or Madam,

I, Xolisa Piyose, a student at Durban University of Technology, currently studying for a Master's degree in Information Technology am humbly inviting you to participate in the research project titled: "*SCORM based e-learning content prototype for OBE mathematics teachers"*.

You are requested to assist in the project by filling in the attached questionnaire. The questionnaire seeks to gather information your experience on using SCORM and on whether the e-learning mathematics teachers' training course is effective or not as compared to the traditional way. Your anonymity and confidentiality will be highly ensured. This study will need you to be free and open in answering questions.

Your assistance with this research would be greatly appreciated.

Yours Sincerely

_____

Xolisa Piyose (Mr)

Purpose

The primary objective of this questionnaire is to seek the usability of the proposed software developed for this research.

Procedure

Please try to fill in as many questions as you can (possible all questions of this questionnaire). You are free to ask the researcher any questions regarding questionnaire. After you have completed all the questions in the questionnaire, turn your questionnaire face down and raise your hand or wait until the researcher collects the questionnaire.

Confidentiality

Your anonymity and confidentiality will be highly assured, as the information you provide will be strictly confidential. The completed questionnaires will be destroyed after the research is completed and will be read by the researcher and his supervisors namely: Doctor Seraphin Eyono Obono and Professor Thiruthlall Nepal.

Directions

This survey includes two kinds of questions:

1. Checklist questions

For these questions, please put a cross in the box that best answers the question. In some cases you may be required to put a cross in more than one box.

For example:

Do you understand what OBE is?

Yes ☐ *No* ☐

In this example, the person answered that he or she does not understand OBE.

2. Scale questions with numbered boxes.

These questions have a scale ranging from 1 to 5. *1* represents *strongly disagree*, *2* represents *do not agree*, *3* represents *not sure*, *4* represents *agree*, and *5* represents *strongly agree.*

You are required to put a cross in the box that best answers the question (to the best of your knowledge).

For example:

Option	*1*	*2*	*3*	*4*	*5*
OBE is problematic		*X*			

In the above case the cross is in column 2, meaning that the participant feels that (s)he *disagrees* with the fact that OBE is problematic.

SECTION A: PERSONAL BACKGROUND

1. Are you an educator under OBE system?

Yes ☐
No ☐

2. Please indicate your gender.

Female ☐
Male ☐

3. Please indicate your race group.

African ☐
Coloured
Indian ☐
White ☐
Other (specify)
…….

4. Indicate your home language?

Afrikaans		Venda	
English		Tswana	
Zulu		Swati	
Xhosa		Ndebele	
Sotho			
Other (specify)			

5. Indicate your age.

Less than 20 years		35 To 39 years	
20 To 24 years		40 To 44 years	
25 To 29 years		45 To 49 years	
30 To 34 years		50 and above	

SECTION B: PROFESSIONAL BACKGROUND

1. What type of school is your school?

Public school ☐

Private school ☐

2. What subject(s) are you teaching?

Languages	
Mathematics	
Mathematical Literacy	
Science	
Arts and Culture	
Business	
Human Social Science	
Other	

3. Which grade(s) do you teach?

Grade 1 To 2 ☐

Grade 3 To 4 ☐

Grade 5 To 6 ☐

Grade 7 to 8 ☐

Grade 9 to 10 ☐

Grade 11 to 12 ☐

4. Provide us with your highest one or two qualifications?

---

5. Have you attended any training courses on teaching, learning and curriculum?

Yes ☐

No ☐

6. If yes rate your satisfaction with regard to the training course(s) you attended?

Very satisfied	
Satisfied	
Not satisfied at all	

.

SECTION C: COMPUTER LITERACY BACKGROUND

1. Have you used a computer prior the central energy fund (CEF) computer training

Yes	
No	

2. If yes, rate the effectiveness of the training?

Very effective	
Effective	
Not effective at all	

3. After CEF computer training, what is your attitude in using a computer for teaching and learning?

I feel that computers must be used for teaching and learning	
There is no need for the use of computers in teaching and learning	

4. Can you operate (use) a computer?

Yes	
No	

5. Have you used an e-learning standard prior the e-learning content prototype of this research?

Yes	
No	

6. If yes, for how long?

Less than 1 year	
1-2 years	
3-4 years	
5 years or more	

SECTION D: USABILITY OF THE PROPOSED SOFTWARE

PART A: LIKERT SCALE

A) Understanding of OBE	**1**	**2**	**3**	**4**	**5**
1. Basic terms are clearly defined					
2. Assessment types are easily understandable					
3. National Curriculum statement are clarified					
4) I understand OBE terminology					
B) Presentation of the training					
1) Sessions are well presented					
2) Sub-sessions are also well presented					
3) The aim of each session is easily identified					
4) Structure of the training is adequate					
5) Introduction to NCS and NSC SESSION 1 is satisfactory					
6) Introduction to mathematics and mathematical literacy SESSION 2 is satisfactory					
7) Explanation with regard to planning for teaching and learning SESSION 3 is satisfactory					
8) Annual Assessment Plan is satisfactory					
C) Quality issues					
1) An improvement on training methods					
2) Ease to follow training manual					
3) A broad understanding of the subject					
4) I am satisfied with SCORM e-learning training as compared to the traditional way of training					
5) I recommend this type of training for mathematics					

PART B: MIXED QUESTIONS

1. Since taking this course, has do you feel about your attitude towards the understanding of OBE?

My attitude has not changed	
I feel better about understanding OBE	
I feel confident about OBE terminology	
I feel worse about the understanding of OBE	

2. Should SCORM based training be used for other subjects?

Yes	
No	

3. COMMENTS:

Thank you for participating in this research, your input is worth a lot and will be kept as confidential as possible.

APPENDIX E: LETTER TO CEF-WSU coordinator

101 Dolphin court
South Beach
Durban, 4001
25 October 2008

Mr. J. Lukose
Head of coordinator and CEF project coordinator
Walter Sisulu University
Eastern Cape, South Africa

RE: APPLICATION FOR A PERMISSION TO CONDUCT A RESEARCH TO EDUCATORS OF THE CEF PROJECT

I, Xolisa Piyose, a student at Durban University of Technology, currently studying for a Master's degree in Information Technology am humbly asking you for a permission to conduct a research to educators of the CEF project attending computer training. The educators will be trained on SCORM compliant software for two days and they will be required to fill the questionnaire to rate the effectiveness of the software on training teachers to OBE teachers

The research will also be helpful even to CEF stakeholders as to outline educators' perceptions on the use of Information and Communication Technology for teaching and learning.

Your assistance with this regard would be greatly appreciated.

Yours Sincerely

_____

Xolisa Piyose (Mr)