An investigation into the implementation of computer-assisted education in outcomes-based education: A case study at Sterling Primary School in East London

A mini-thesis submitted by

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Summary

An investigation into the implementation of computer-assisted education (CAE) in outcomes-based education: A case study at Sterling Primary School in East London

This study investigated the implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School in East London. A literature study was done on constructivism on which outcomes based education is based. The literature review also focused on computer-integrated education.

The integration of computer-assisted education at Sterling Primary School was appraised with the help of the Evolutionary Model developed by Miller (1997). It was observed that the educators and learners at this school were trying to integrate computers into their teaching and learning process.

Although this study focussed on the Intermediate Phase, it could provide a basis for further study in the field of computer-assisted education in Senior, and Further Education and Training Phases throughout the Republic of South Africa.

Key Words

Computer-assisted education

Computer-based education

Computer-integrated education

Constructivism

Evolutionary Model

Intermediate phase

Information and communication technologies

Learner-centred approach

Multi-dimensional methods

Outcomes-based education

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List of Abbreviations

ACOT	Apple Classrooms of Tomorrow
CAE	Computer-assisted education
CAI	Computer-aided instruction
CBE	Computer-based education
CAL	Computer-assisted learning
EMS	Economic and Management Science
FET	Further Education and Training
HSS	Human Social Science
ICDL	International Computer Driver's Licence
ICT	Information and Communication Technology
LLC	Language Literacy and Communication
MLMMS	Mathematical Literacy, Mathematics, Mathematical Science
NS	Natural Science
OBE	Outcomes-based education
PC	Personal computer

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Chapter 1   Introduction

1.1 Introduction

This essay reports on research conducted to determine what factors contribute to the successful implementation of computer-assisted education (CAE) in the outcomes-based education (OBE) system at Sterling Primary School in East London.

This study should provide useful information to teachers in other schools, as well as to officials in the Department of Education to see the implementation of computer-assisted education in the outcomes-based education system. It should be valuable for further study in the field of using computer-assisted education in Senior and Further Education and Training (FET) phases throughout the Republic of South Africa.

In preparation for this study, I have visited numerous schools and educational officials in the East London District in the Eastern Cape to gather information regarding the implementation of computer-assisted education in schools. I have found that most of these schools offer Computer Studies and Compu-typing as two separate subjects in their curricula. In the initial stage I was investigating three primary schools in East London- Clarendon, Gonubie and Sterling – but later decided to focus on Sterling Primary School. In all the other schools computers are not assisting in the teaching and learning of other subjects. In contrast, educators at Sterling Primary School are trying to incorporate computers in teaching and learning process, especially in the intermediate phase.

1.2 Background

South Africa's education system is in the process of sweeping and widespread change, involving not only the essential remodelling of an outdated system, but a paradigm shift in the attitude we adopt to the entire education process. The major change is in the focus of the education system, from content and the memorisation of statistics and facts to a system that places its primary emphasis on the development of an inquiring spirit, leading to the acquisition of knowledge, together

with the skills and attitudes to apply this knowledge in a constructive way (Eastern Cape Department of Education, 2000).

In a democratic society traditional authoritarian classroom environments are not appropriate and should be transformed into democratic environments. According to Fone (1995) classroom democracy should give learners ownership of the learning process. A democratic system of education is a participatory, open system in which all participants have a share in the learning process (Fone, 1995). For that to happen the educational practice should move away from the traditional teacher-centred approach to a learner-centred one.

The South African education system adopted a new educational approach entitled outcomes-based education, which revolves around the philosophy of constructivism. In constructivism, learners should be constructors and producers of personal knowledge rather than receivers and repeaters of inert knowledge. When learners actively construct knowledge, it is more meaningful, applicable and memorable. Computer-assisted education is a part of these new changes in South Africa's education system. The role of computer-assisted education in this new educational environment cannot be underestimated.

1.3 Field of Research

Computer-assisted education is neither computer literacy nor computer awareness nor Compu-typing. Computer literacy, computer awareness and Compu-typing refer to using computers to learn about computers or to gain computer skills. Computer-assisted education involves using computers to learn about other learning areas. It means using the computer where it is the best medium to support the learning goal (Anderson, 1996). It involves changes in a school. The entire school community of students, parents, teachers and administrators has to accept that computers are a part of everyday school life (Kearsley, 1992).

1.4 The context of the research

In recent years the National Department of Education in South Africa has been encouraging schools to implement computer education. Through specific projects, provincial governments and many private companies are supplying computers and materials to equip computer laboratories in schools. One such project is the 'Telkom 1000 Schools Project', which donated one personal computer (PC) to each of a thousand schools. However, most of these schools are not making use of computers in their teaching and learning process (Du Plessis, 2002).

Recognizing the use of computers as a tool in effective education, many schools in the Eastern Cape Province have integrated computers in their instruction. Many non-governmental organizations and private companies are donating computers to underprivileged schools in the Eastern Cape. Most of these schools offer Computer Studies or Compu-typing as two separate subjects in their curriculum. Computers are however not assisting in the teaching and learning of other subjects. In contrast, educators at Sterling and Clarendon Primary Schools are trying to inculcate computers in the teaching-and-learning process, especially in the intermediate phase (i.e. grades four to six).

Situated in the Eastern suburb of East London within the Buffalo Metropolitan area in the Eastern Cape, Sterling Primary School is one of the oldest schools in the city. It is a state school, but parents pay annual school fees to assist the school in meeting all of its educational needs.

Computer-assisted education has the potential to play a vital role in the new outcomes-based education system. With the assistance of computers, learners can easily acquire various learning skills. It assists educators to a greater extent in teaching and assessing their learners. I hope a study in the successful implementation of computer-assisted education in this school will motivate other schools in this province to implement computer-assisted education.

1.5 Research Question

The research aims to address the following question:

What factors contribute to the implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School in East London?

This question can be refined by the following sub-questions:

1. **Why has Sterling Primary School implemented computer-assisted education?**

2. **How does computer-assisted education support the implementation of outcomes-based education in this school?**

3. **What are the obstacles to the implementation of computer-assisted education in this school?**

1.6 Related Research

There is no research available on the implementation of computer-assisted education specifically in primary schools in South Africa. The following table aims to give an idea about research available on the implementation of computer-assisted education in South African Secondary Schools.

Related research

Author	Research Details	Short Description
Miller, P.	The integration of Computers at Pinelands High School: a case study. Mini-thesis. M. Ed. (CAE). 1997. University of Pretoria.	The research investigated the successful integration of computer-assisted education at the Pinelands High School.

Author	Research Details	Short Description
Cossa, G.	Introduction of Information and Communication Technologies (ICT) in secondary schools in Mozambique. Mini-dissertation. M. Ed. (CAE). 2002. University of Pretoria.	The research focused on the successful integration of Information and Communication Technology and Internet-based learning in secondary schools in Mozambique.
Bender, J.	Factors that determine successful computer implementation in schools. Mini-dissertation. M. Ed. (CAI). 1994. University of Pretoria.	The research describes the factors that determine the successful implementation of computers in schools.
Jacob, S.	The use of interactive computer simulations to engender conceptual changes about wave motion. Mini thesis. M. Ed. (ITE). 2001. Rhodes University.	The field of research is the role of interactive computer simulations in the conceptualization of wave motion by Grade 10 pupils of a school in the Zwelitsha District of the Eastern Cape.

1.7 Definition of the basic terms

Table 1.1   Definition of the basic terms

Term	Definition
Computer-assisted education Computer-aided education Computer-supported education	Somewhat akin to computer-based education (see below), but acknowledging the fact that a computer forms only part of the entire educational process.
Computer-based education Computer-assisted instruction Computer-assisted learning	Lippert (1993) proposes computer-based education (CBE) to be generally acceptable umbrella term for describing the field of computers in education, although the term does not intend to suggest that education in any specific context is *entirely* based on computers. While computer-assisted instruction (CAI) focuses on the instructional aspect of education, computer-assisted learning (CAL) highlights the learning aspect of education.

Term	Definition
Computer-managed education	The application of computers to teaching and learning where the computer provides administrative support and manages the process by assisting student progress and prescribes appropriate pathways (Knoetze, 1993; in Mostert, 2000).
Educational technology	The application of any technology (from a pencil to a personal computer) to teaching and learning.
outcomes-based education (OBE)	This is an internationally acclaimed educational approach, which starts by defining the outcomes that will be achieved through teaching and learning activities. It aims at equipping learners with knowledge, skills, values and attitudes needed for success after leaving school (Eastern Cape Department of Education, 2000).
Curriculum 2005	Curriculum 2005 is a South African model of outcomes-based education. It is an OBE curriculum derived from nationally agreed upon critical outcomes. The concept Curriculum 2005 was largely based on the initial plan that by the year 2005 the new curriculum will have been completely phased in throughout the education system of the country (Eastern Cape Department of Education, 2000).
Constructivism	Constructivism involves learners' activities and intrinsic motivation. In constructivism both learners and instructors should be constructors and producers of personal knowledge. When learners' activity construct knowledge, their learning become more meaningful, applicable and memorable.

1.8 Summary of the Research Design

Various sources were consulted to define computer-assisted education, and different measures were adopted to appraise the effectiveness of computer-assisted education in the outcomes-based education system. Various articles from journals, the World Wide Web and books were referred to in order to collect materials on computer-assisted education and the implementation of computer-assisted education in the outcomes-based education system.

This research design is primarily based on a qualitative approach. "Qualitative design allows researchers to discover what are the important questions to ask of a topic and what are the important topics in education to pursue empirically" (McMillan & Schumacher, 1997:391).

This research is a case study in which the phenomenon under an investigation is the implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School in East London. In this primarily qualitative approach in-depth semi-structured interviews and observations are used as data collection methods. Other data collection techniques such as document analysis (school prospectus, minutes of the meetings), survey and observations are also used. A questionnaire is developed to determine the use of computers in the teaching-and-learning process in these schools.

1.8.1 Data Collection Methods

Following data-collection methods and data-collection instruments are used:

Table 1.2   Data collection methods

Data-collection Methods	Data-collection Instruments
Document analysis	Task analysis from Flowchart
Interviews ▪ Face-to-face ▪ Telephone	Interview schedule
Observations	Observation schedule
Survey	Questionnaires

1.8.2 Data Collection Matrix

Table 1.3 below provides a matrix that relates the subsidiary research questions to the research instruments.

Table 1.3   Data collection matrix

Question	Inter-view	Question-naire	Obser-vation	Document Analysis
1. Why has this school implemented computer-assisted education?	✓	✓	✓	✓
2. How does CAE support the implementation of outcomes-based education in this school?	✓	✓	✓	✓
3. What are the obstacles to the implementation of CAE in Sterling Primary School?	✓	✓	✓	

1.8.3 Participants of this study

The participants of this study are the learners, educators (mainly those who are teaching computer studies), and the principal of Sterling Primary School.

1.9 Value of the Research

This study should provide useful information to teachers in various schools as well as to officials in the Department of Education to see the implementation of computer-assisted education in the outcomes-based education system. It should also provide valuable data for further study in using computer-assisted education in Senior (grade 7, 8 and 9) and Further Education and Training Phases (grade 10, 11 and 12) throughout the Republic of South Africa.

It is hoped that this study will lay the foundation for a comparative study of the effective implementation of computer-assisted education among the so-called Model C schools and previously disadvantaged schools in South Africa.

1.10 Limitations

This study is focused primarily on the implementation of computer-assisted education in the outcomes-based education system.

- Outcomes-based education is a relatively new concept to the educators and learners in South Africa and the process of integrating computers into various learning areas is experiencing initial problems.

- The implementation of CAE in the outcomes-based education itself is a wide topic and presents a study of its own.

- This is a case study, so that the findings cannot be generalized.

1.11 Structure of the Research Report

Table 1.4   Structure of the research

No.	Chapter	Description
1	Introduction	The first chapter presents the introduction of the research, the field of research, the context of the research, research goals and the structure of the research.
2	Literature Review	In this chapter the following topics will be addressed. Definition of computer-assisted education. Successful implementation of computers in education. The role of computers in outcomes-based education.
3	Research Design	This chapter provides the detailed research design, research questions, target population, research instruments, data collection procedure and data analysis.
4	Results of the research (findings) and synthesis	This chapter synthesises the model of the integration of computer-assisted education and discusses the findings of the research.
5	Conclusions and Recommendations	The final chapter summarizes the research findings and makes recommendations. These recommendations may be a motivation to other schools in the province to implement computer-assisted education.

Chapter 2   Literature Review

2.1 Introduction

In this chapter I shall be covering the literature on **constructivism** in learning, **outcomes-based education** and **role of computer-assisted education in outcomes-based education**. This literature gives a clear idea of how constructivism can be applied in outcomes- based education and provides a model for the appraisal of a school's integration of computers into its curriculum.

The aim of this literature survey is to give an overall perspective of the literature on constructivism and role of computers in the outcomes-based education system.

2.2 Background

South Africa's education system is in the process of a change. The old South African system has not served the country well and is out of step with world trends. The changes are aimed at elevating the real skills and learning levels of the South African learner, by promoting a thirst for knowledge, a love of learning and a determination to succeed, so multiplying the number of South Africans who achieve marketable skills (Department of Education, 1997b:4).

Digital media has revolutionised the information society and advances in Information and Communication Technologies (ICTs) have dramatically changed the learning and teaching process. The provision of a telecommunication infrastructure available for learning and teaching is gradually increasing in South Africa and many schools are exploiting the benefits of ICTs to enhance the quality of teaching and learning (Department of Education, 2003).

2.3 Computer Education in South African Schools

Over the last five years, Government, the private sector, parastatals, and non-governmental organisations has responded positively to the implementation of computer education in South African schools. A draft White Paper on e-Education published by National Department of Education (2003) recognises the efforts made

by various firms' contributions to the implementations of computer education in South African schools. Some of those projects are listed below:

- Telkom Foundation has established Supercentres in more than 1 300 schools, providing computers, software applications, Internet connection, monthly subscription and a rent-free telephone line;

- Telkom Foundation, together with Telkom's strategic partner Thintana, has committed over R200 million to support education and training in the areas of ICT, mathematics and science;

- SENTEC is obliged to provide 500 schools with computer laboratories and teacher development, through licensing obligations;

- SchoolNet South Africa and the South African Institute for Distance Education have developed eleven Teacher Development Modules for introducing ICTs into schools; and

- SchoolNet South Africa provides online, mentor-based in-service training for teachers on introducing ICTs into the curriculum and management.

2.3.1 Schools with computers

Disparities reflected in South African society also find expression in computer integration into education. Although the number of schools with computers for teaching and learning increased from 12,3 per cent in 1999 to 26,5 per cent in 2002, there are still more than 19000 schools without computers for teaching and learning (Department of Education, 2003).

Based on data from the Education Management Information System and information received from provinces, Figure 2.1 reflects the distribution of computers in schools across all provinces (Department of Education, 2003).

Figure 2.1   Computers in schools, by province (2002)
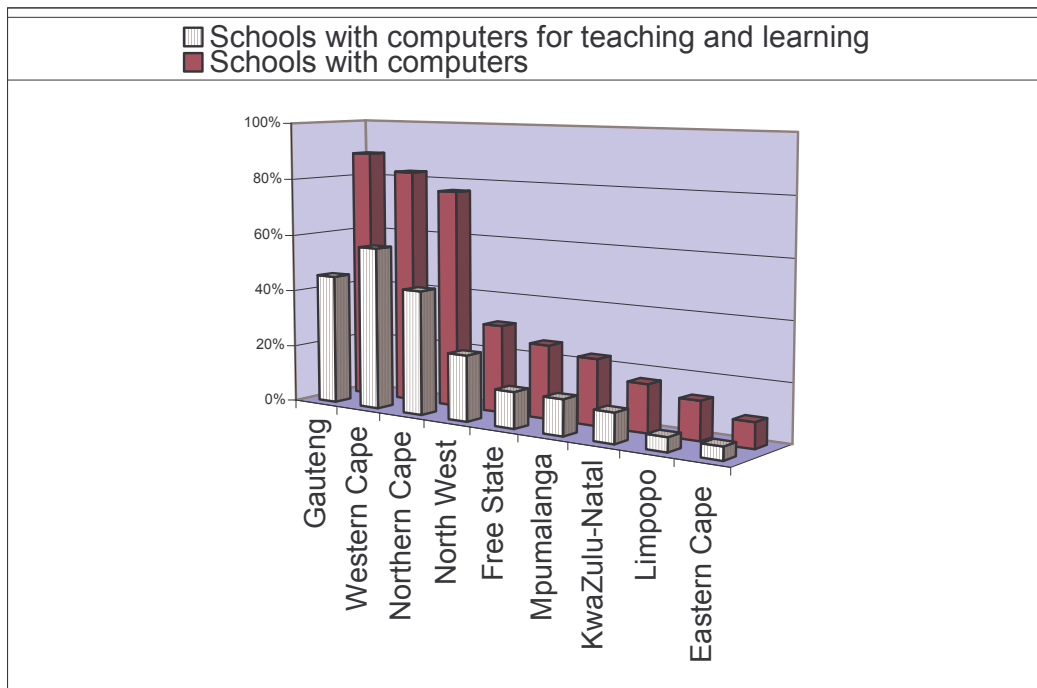
Provinces are clearly at different levels of computer integration into education. The above graph shows that significant progress has been made with provincial implementation mainly in the Western Cape, Gauteng and Northern Cape. Eastern Cape and Limpopo provinces are lacking well behind in the implementation of computers in schools.

Despite the difficulties that constrain the integration of computer-assisted education into management, teaching and learning, the Department of Education is determined to direct the implementation of a progressive programme for change. Like most of parts of the world, the South African education and training system has to respond to the pressures and challenges posed by the information revolution. It is for this reason that Government has expressed a strong commitment to the use of ICTs in education (Department of Education, 2003b).

This study investigates computer-assisted education in outcomes-based education, which is based on the philosophy of constructivism. In line with much of the world, the South African Education System has adopted a new educational approach,

entitled the outcomes-based education (OBE), which revolves around the philosophy of constructivism.

2.4 Constructivism in learning

A great deal of literature argues that learning is more meaningful when learners construct their own knowledge, following the views of the learning theory known as constructivism. In constructivism both learners and instructors should be constructors and producers of personal knowledge. When learners' activity constructs knowledge, their learning becomes more meaningful, applicable and memorable (Dick, 1991; Cunningham, 1991; Siegel & Kirkley, 1997; Willis, 1998; Chien Sing, 1999). In the opinion of Reeves & Reeves (1997), constructivism is a philosophy that emphasizes the development by learners of cognitive structures based on their previous knowledge and their experiences in learning environments.

2.4.1 Difference between objectivist and constructivist educational approaches

Objectivism and Constructivism are two educational approaches traditionally seen as opposite to each other. Reeves and Harmon (1994, in Cronjé, 2000) describes these approaches as the 'old' and the 'new' 'paradigm'. Table 2.1 contrasts the different elements of the old and new pedagogical dimensions.

Table 2.1   Old and new pedagogical dimensions (extracted from Reeves and Harmon, 1994 in Cronjé, 2000)

Category	Old	New
Epistemology	Objectivism	Constructivism
Pedagogical philosophy	Instructionist	Constructivist
Underlying philosophy	Behaviourist	Cognitivist
Instructional sequencing	Reductionist	Constructivist
Role of the instructor	Authoritarian	Egalitarian
Value of errors	Errorless learning	Learning from experience
Motivation	Extrinsic	Intrinsic
Structure	High	Low

Category	Old	New
Learner control	Non existent	Unrestricted
User-activity	Mathemagenic	Generative
Accommodation of individual differences	Non-existent	Multi-faceted
Cooperative learning	Unsupported	Integral

A dominant characteristic of constructivist learning is collaboration among learners. In contrast to objectivist instructional theories, constructivist theories posit that it is through communication with others that learners construct meaning from their experiences (Miller and Miller, 1999).

This division of 'old' and 'new' 'paradigm' finds its way into the writings of governmental education departments (Department of Education, 1997c), as presented in Table 2.2.

Table 2.2   Shift in government focus

Old	New
Passive learners	Active learners
Exam-driven	Learners are assessed on an on-going basis
Rote-learning	Critical thinking, reasoning, reflection and action
Syllabus is content-based and broken down into subjects	An integration of knowledge; learning relevant and connected to real-life situations
Sees syllabus as rigid and non-negotiable	Learning programmes seen as guides that allow teachers to be innovative and creative in designing programmes
Emphasis on what the teacher hopes to achieve	Emphasis on outcomes – what learner becomes and understands
Behavioural approach to learning and assessment	Cognitive approach to learning and assessment
Assessment of isolated knowledge or discrete skills	Knowledge, abilities, thinking processes, meta-cognition and affect assessed

Old	New
Knowledge and truth outside the mind of the individual and are therefore objective	Knowledge and truth are constructed by individual and do not exist outside the human mind
Learning is viewed as the acquisition and accumulation of a finite set of skills and facts	Learning is a change in meaning constructed from experience
Mainly concerned with the object to be known/learned	Emphasises personal construction of knowledge
Individual learning and products	Collaborative learning and products

2.4.2 The relationship between objectivism and constructivism

Cronjé (2000) proposes that objectivism and constructivism are not opposing paradigms, but complimenting to one another. His approach is to place objectivism and constructivism on independent axes at right angles (90 degree) on the Cartesian plane, instead of placing them at extremes (180 degree apart) on the same axis. The significance of this model is a proposed integration of the two traditionally conflicting stances to present them as complementary approaches. When objectivism and constructivism are put side by side on a right angular system of axes, four quadrants result, dependent on the degree of objectivist and constructivist learning appropriate for a particular content domain. Each of the four: instruction, integration, construction, and chaos have its own valid place in the field of teaching and learning (De Villiers, 2002).

The diagram in Figure 2.2 demonstrates Cronjé's (2000) pragmatic incorporation of objectivist and constructivist elements in learning events. Each of the four quadrants of learning has its own valid place in the field of teaching and learning.

Figure 2.2   Four quadrants of teaching and learning
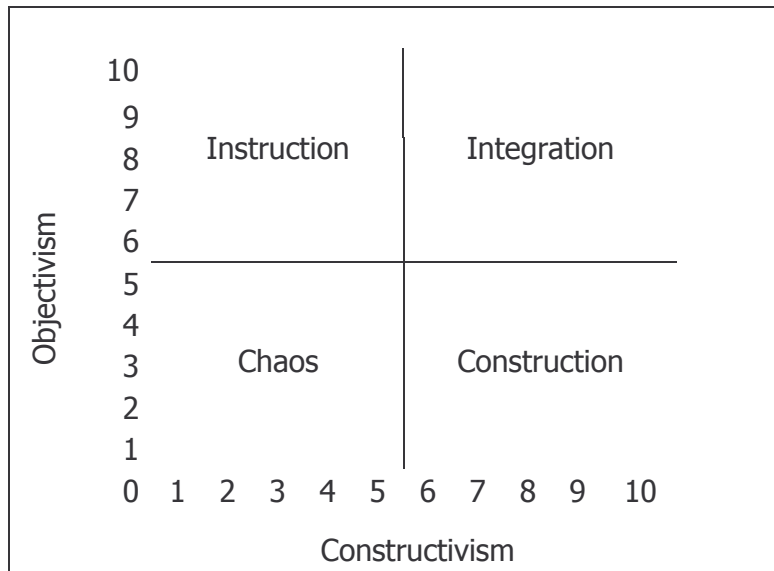
Chaos learning is low in objectivist and constructivist elements. Learning is not determined by an outside entity, nor is it placed in any given, pre-determined sequence. Learning experiences are opportunistic. The chaos quadrant is the domain of serendipitous and incidental learning.

Instruction is high in instructivist elements. It is the domain of programmed learning, tutorials, lectures, and drill-and-practice. Its principal advantages are efficiency and focus.

Construction is designed in such a way that learners construct their own meaning intrinsically by building on previous knowledge. Its principal outcome is individual understanding and main advantages are effectiveness and transfer.

Integration is the combination of instruction and construction in appropriate conditions. Learning in this quadrant would depend on a goal analysis to determine the essential learning outcome. This integrative approach allows a learning event to be seen as both highly constructivist and highly behaviourist, without the one reducing the other.

In objectivism the instructor is the transmitter of knowledge and the learner is a receiver. In contrast to objectivism, the constructivist epistemology reflects a

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position that knowledge is not independent of the learner, but is internally constructed by the learner as a way of attaching meaning to experience (De Villiers, 2001). It is a learner-centred rather than an instructor-centred approach.

2.4.3 Role of constructivist teachers

If learning is a constructive process, and instruction must be designed to provide opportunities for such construction, then teachers should assume the roles of facilitators. French (1999, in Jacob, 2001) lists twelve practical strategies for developing constructivist teaching:

1. Constructivist teachers encourage and accept learner autonomy and initiatives.

2. Constructivist teachers use raw data and primary sources, along with manipulative, interactive and physical materials.

3. When framing tasks, constructivist teachers use cognitive terminology such as "classify", "analyse", "predict" and "create".

4. Constructivist teachers allow learner responses to drive lessons, shift instructional strategies, and alter context.

5. Constructivist teachers inquire about learner's understanding of concepts before sharing their own understanding of those concepts.

6. Constructivist teachers encourage learner inquiry by asking thoughtful, open-ended questions and encouraging learners to ask questions of each other.

7. Constructivist teachers encourage learners to engage in dialogue, both with the teacher and one another.

8. Constructivist teachers seek elaboration of learner's initial responses.

9. Constructivist teachers engage learners in experiences that might engender contradictions in their initial hypotheses and then encourage discussion.

10. Constructivist teachers allow waiting time after posing questions.

11. Constructivist teachers provide time for learners to construct relationships and create metaphors.

12. Constructivist teachers nurture learner's natural curiosity through frequent use of the learning cycle model, which consists of discovery, concept introduction and concept application.

2.4.4 Constructivism in various learning areas

The old South African educational system was driven by examinations, often entailed learning in parrot-fashion, and was characterised by a rigid adherence to a content-based syllabus, which was broken down into convenient compartments or subjects and therefore encouraged minimal cross-fertilisation. Teachers alone were responsible for motivating the learning process, for encouraging a love of learning, which in turn placed great demands on the personality and the attitude of teachers and what they hoped to achieve (Department of Education, 1997b).

Since 1994 the South African educational system has moved towards outcomes-based education, which follows the principles of constructivism. The new changes are aimed at making South Africans and South African products and services more competitive in an increasingly competitive world. In addition, these changes are aimed at producing a more qualified workforce, more consistently and more predictably, by equipping them with skills to survive in the real world (*ibid.*). The most profound effects of this change will be felt in changed attitudes to both teaching and learning strategies in various learning areas.

The new approach to Science education, for example, is based on a constructivist view of learning (Kuiper, 1998). Knowledge has to be constructed by learners based on a variety of experiments, investigations, observations and measurements and the interpretations of the results of the experiments. The constructivist approach aims at giving learners a conceptual understanding of the matter that is taught. Conceptual understanding differs importantly and principally from memorising facts. Memorising can be done without any real understanding.

2.5 Outcomes-based education

In 1995, Prof Sibusiso Bengu, the then Minister of Education, announced a new approach - outcomes-based education - to the educational system in South Africa. "Outcomes-based education is a learner-centred, result oriented approach to education and training that builds on the notion that all learners need to and can achieve their full potential, but that this may not happen in the same way or within the same period" (Eastern Cape Department of Education, 2000:7).

In outcomes-based education all the role-players (including learners, educators, parents and the community) are partaking partners in the education and learning process. Learners construct understanding of new knowledge and skills based on what they already know and can do.

2.5.1 Outcomes-based education: translating theory into practice

"South African education, training and development are in a developmental process where transformation is supported by legislative structures and frameworks as well as educational principles" (Olivier, 2000:4). Olivier refers to outcomes-based education as a holistic approach where learners will demonstrate critical outcomes that include personal thinking skills and life skills such critical thinking, problem-solving and effective communication skills. Group and self-assessment is a positive factor in this system in which learners will also become actively involved, responsible decision makers and successful members of society. Progress is demonstrated through integrated tasks and the application of skills to real world problems, and is monitored through multi-dimensional methods of assessment.

South Africa needs learners with a broad perspective who are adaptable to change. "Outcomes-based education starts with a nationally recognised learning programme, clustered into specific outcomes (knowledge, skills and values) to be achieved by the learner through an integrated learning experience that provides for gathering and analysis of data, critical thinking, problem solving, alternative solutions and application of knowledge, skills and values in an authentic environment " (Olivier, 2000:30).

2.5.2 The role of the educator in outcomes-based education

In the outcomes-based education system the educator is not simply a presenter of knowledge, but rather a facilitator of the learning process. Here educators are translating theory into practice. The learning programmes are seen as guides and educators are encouraged to be innovative and creative in designing effective courses for the learners entrusted to their care. The educator is also playing the role of an assessor, researcher, community member and mediator of learning. According to the national Department of Education (1997b), in the outcomes-based education educators will:

- serve as mediators of meaning by encouraging and stimulating construction and production of knowledge;

- serve as mediators of learning;

- apply learner-centred educational approaches – the design and planning of a variety of learning experiences for the learners;

- show learners how to use the different ways of learning, note-taking, research, memory, cooperation with others, learning by doing;

- understand and help learners understand, how to use information critically;

- help learners to solve problems and make decisions;

- encourage and demonstrate critical and creative thinking;

- show the benefits of developing effective communication and socialising skills;

- organise and facilitate group and collaborative work;

- organise classrooms for interactive teaching and learning;

- anticipate learner differences and provide separate teaching and support strategies for differing education needs;

- develop effective assessment skills by using a mix of assessment methods;

- write accurate and clear reports on learner outcomes, indicating progress and remedial requirements;

- revise planning to enable slow learners to make faster progress;

- apply democratic and non-discriminatory practices in classroom;

- create a supportive and caring atmosphere in the classroom; and

- identify and develop learning resources within the community.

In outcomes-based education the focus shifts from the consumption of knowledge to the construction of knowledge. The major change is in the focus of the education system, from content and the memorisation of statistics and fact, to a system that places its primary emphasis on the development of an inquiring spirit, leading to the acquisition of knowledge, together with the skills and attitudes to apply this knowledge in a constructive way.

2.5.3 Outcomes-based education and the role of the learner

Outcomes-based education can be seen as a learner-centred approach to learning. In OBE, learners are partners in the progress of their own development and interest is engaged and maintained through the education cycle. Learners will be:

- able to recognise and develop their own talents;

- able to realise the value of team work and also take responsibility of their own work;

- creative and analytical thinkers, good problem solvers and effective communicators; and

- able to understand why they learn.

Learners are encouraged to monitor and assess their own progress towards the achievement of the outcomes through various constructive methods of assessment such as portfolio assessment, performance assessment and tests.

2.6 The significance of e-Education in South Africa

The introduction of information and communication technologies in education represents an important part of Government's strategy to improve the quality of learning and teaching across the education and training system in South Africa. The policy intention is not just to build technological skills, but also to use information

and communication technologies to extend and enrich educational experiences across the curriculum. In a transformed teaching and learning environment, there is a shift from teacher-centred, task-oriented, memory-based education (with technology at the periphery), to an inclusive and integrated practice where learners work collaboratively, develop shared practices, engage in meaningful contexts and develop creative thinking and problem-solving skills (Department of Education, 2003).

e-Learning is about learning and teaching philosophies and methodologies within the context of outcomes-based education, using information and communication technologies in the learning environment: enriching the learning environment through the use of information and communication technologies (exploring what can be done with ICTs), learning with information and communication technologies (using ICTs to supplement normal process or resources), and learning through the use of information and communication technologies (using ICTs to support new ways of teaching and learning) (Department of Education, 2003).

2.7 The use of computers in outcomes-based education

Computer-assisted education is a clear example of the application of constructivism. With the help of computers learners improve their perceptual skills and reinforce various concepts in different learning areas. Here they construct knowledge based on their experience. Constructivist classrooms have the potential to stimulate multi-perspective, self-directed learning and to provide scaffolds for interactive, meaningful knowledge construction.

According to Knoetze (1993, in Mostert, 2000) the use of computers in education can be classified into three distinctive categories: (1) educational research, (2) administration and (3) teaching and learning. With regard to the use of computers for teaching and learning, Knoetze (*ibid.*) distinguishes between computer-assisted education, which focuses on teaching or mastery of subject content, and computer-managed education, which could be associated with the added function of controlling and managing the teaching/learning situation.

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Figure 2.3 (Mostert, 2000:34) categorises the uses of computers in education.

Figure 2.3   Computers in Education (Mostert, 2000:34)
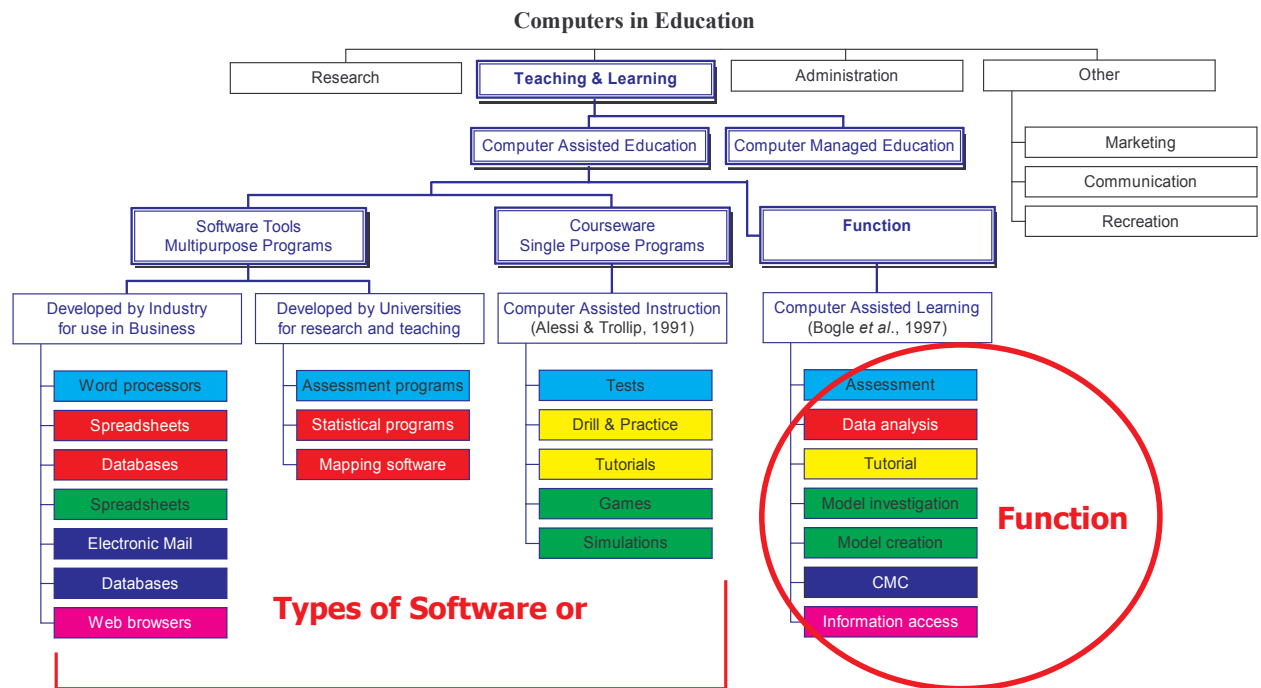
2.7.1 Constructivism and computer-assisted education

Although there are people who will argue that constructivism does not provide a model for implementation, numerous researchers, educators and authors are actively engaged in using constructivist principles to design and implement new learning environments (Murphy, 1997). Computer based education is increasingly being used as an optimal medium for the application of constructivist principles to learning.

The outcomes-based model accords well with the use of computers at a variety of levels and computers can be used to support teachers in the "teacher as facilitator" paradigm. Computers can be used to support both educators and learners in every aspect of their work.

The potential uses of computers in the constructivist classroom include:

- Access to information (stored either locally and remotely)

- Testing, either for revision or assessment purposes

- Record keeping

- Simulations

- Data visualisation

- Experimental analysis

- Presentation using standard software

- Communication

- Data logging

The above list shows that computer-assisted education challenges learner's abilities by providing data, which they should manipulate and process to achieve a learning experience.

2.7.2 Integration of computer-assisted education

The integration of computer-assisted education means using the computer as a tool to teach subject matter, and to promote problem-solving and higher-order thinking skills (IFIP, 1993 in Miller, 1997).

The integration of computer-assisted education is neither computer literacy nor computer awareness. It means using the computer where it the best medium to support the learning goal (Anderson, 1996). The entire school community of students, parents, teachers and administrators has to accept that computers are a part of everyday school life (Kearsley, 1992).

Successful integration takes place when technology becomes invisible or transparent and both the teacher and students can concentrate on the content of the course, thus making it possible for students to use computers in the natural flow of classroom activities (Smith, 1995 in Miller, 1997).

2.7.3 Evolutionary Model of the integration of computer-assisted education

Miller (1997:15) develops an evolutionary model of the integration of computer-assisted education in schools by synthesising three models, namely, the *Apple Classrooms of Tomorrow (ACOT)*, *CAMI Mathematics* and the *Make It Happen!* models. This evolutionary model consists of five cumulative phases: introduction; entry; intermediate; penultimate and creation, each of which representing a higher type of mental activity.

Miller's evolutionary model of integration of computer-assisted education in school is summarised in Table 2.3.

Table 2.3   Evolutionary Model of integration of computer-assisted education developed by Miller (1997:18-25)

Phase	Description
Phase 1 Introduction	Introduction of technology into the school. Computers, network system and modems are installed. Teachers may try to use computers to teach by doing simple work. Computer replicates traditional instructional and learning activities. The important supporting factors here are the communication of enthusiasm and sharing the vision of a different kind of education or methodology. This phase may appear to be time-consuming but it is the foundation on which the integration of computer-assisted education rests.
Phase 2 Entry	In this phase educators start using the computers to support classroom instruction by means of drill-and-practice instruction or text-based work. Established teaching methods and activities are supported by computer technology. Teaching is based on behaviouristic approach to learning. The educators need to develop new strategies for the new classroom dynamics. Educators are given new support infrastructure to develop their confidence in using hardware and to facilitate students to make use of computers in their learning areas. Time is required for planning, evaluating outcomes, sharing success and frustrations.

Phase	Description
Phase 3 Intermediate	In this phase both educators and learners use computer as a tool. There is a move from text-based instruction and drill-and-practice to word processors, databases, spread- sheets and graphics. The learners' computer work is completed more quickly than before and the quality improves. Classroom interaction with learners changes to sharing instructional strategies and the educator starts to play the role of a facilitator, as opposed to being the focus of the instruction. Educators experiment with different computer applications and investigate teaching strategies for problem-solving and higher-order learning. Curriculum is modified to accommodate team teaching, peer observation, sharing of frustrations and successes, sharing vision, enthusiasm and training.
Phase 4 Penultimate	Many changes in instructional strategies occur during this phase. As a result of peer observation team teaching is consolidated. Learners are experimenting with different computer applications and are actively involve in knowledge construction. Constructivist approach to learning replaces the behaviourist approach. Learners involved in collaborative and creative project work. Role of educator gradually changes form facilitator to collaborator. Educators need more time for more training in team teaching. The teaching staffs needs new and better technology. School timetable is rescheduled for team teaching and teachers experiment with collaborative, interdisciplinary, project-based learning.
Phase 5 Creation	Computer-assisted education is an ongoing process as new technologies are constantly being developed. Each school must decide which new technologies are best suitable for their instructional needs and adapt accordingly. The main features of this phase are: ▪ educators work in collaborative teams and timetables are adjusted to allow team teaching and collaborative work; ▪ educators must evaluate their methods of teaching and assessment strategies; ▪ learners must be encouraged to use the latest technology to create knowledge in the form of multimedia documents and multimedia presentations; ▪ learning is done in constructivist mode, educators act as collaborator in the learning process; ▪ training in new and innovative technologies and directed to new educators.

The Evolutionary Model shows that the integration of computer-assisted education in schools can be accomplished through the introduction of necessary infrastructure, innovative methods of teaching and learning, changes in the school organization, finances and changes in learners' and educators' attitude. It also describes the changes that take place within a school when technology is introduced. In Chapter 4 the Evolutionary Model will be used to report on the integration of computer-assisted education in Sterling Primary School.

2.8 Summary

This literature study investigated the recent changes in the South African education system and the role of computers in the new educational approach of outcomes-based education, which is based on the educational philosophy of constructivism. Computers can be used to support both educators and learners in every aspect of their work. The outcomes-based model accords well with the use of computers at a variety of levels and computers can be used to support teachers in the "teacher as facilitator" paradigm. The constructivist approach aims at giving learners a conceptual understanding of the matter that is taught. It is completely different from memorising facts. The introduction of computer-assisted education results in a total change in teaching and learning process, which now involves collaborative learning, the creation of knowledge and active involvement of the learners. These principles in education are focused on the adoption of a new educational approach entitled outcomes-based education as described in Curriculum 2005 (Department of Education, 1997b).

This chapter has also described Miller's (1997) Evolutionary Model as a benchmark for the appraisal of the level of integration of computers into schools' curricula. Chapter 4 will describe the findings of this research into the integration of computer-assisted education at Sterling Primary School in relation to the five phases of the Evolutionary Model.

Chapter 3   Research Design

3.1 Introduction

In this section a detailed description of the research design is presented. This chapter also aims to locate the research in a particular research paradigm as well as to describe the research problem, research objectives, research questions, target population, data collection procedures and data analysis.

3.2 Qualitative and quantitative approaches to research

McMillan and Schumacher (1997) suggest that quantitative and qualitative research methods are based on different assumptions about the world, the research purpose, prototypical studies, the researcher's role, and the importance of the context in the study.

Table 3.1   Quantitative and Qualitative Research Approaches (McMillan and Schumacher, 1997).

Orientation	Quantitative	Qualitative
Assumption about the world	A single objective reality, i.e., measured by an instrument	Multiple realities, e.g., interviews of principal, teachers and students about a social situation
Research purpose	Establish relationships between measured variables	Understanding a social situation from participants' perspectives
Research methods and process	Procedures are established before study begins	Flexible, changing strategies, design emerges as data are collected
Prototypical study (clearest example)	Experimental design to reduce error and bias	Ethnography using "disciplined subjectivity"
Researcher role	Detached with use of instrument	Prepared person becomes immersed in social situation
Importance of context	Goal of universal context-free generalizations	Goal of detailed context-bound generalizations

Most qualitative research describes and analyzes people's individual and collective social actions, beliefs, thoughts and perceptions. Qualitative researchers collect data by interacting with selected persons in their settings (field research) and by obtaining relevant documents.

According to McMillan and Schumacher (1997) qualitative research is more concerned with *understanding* the social phenomenon from the participants' perspective. Understanding is acquired by analyzing the many contexts of the participants and by narrating participants' meanings for these situations and events.

Eisner (1991) outlines the following six features of a qualitative study.

1. Qualitative studies tend to be field focused. In education, those conducting qualitative research go out to schools, visit classrooms, and observe teachers.

2. Qualitative research (considers) the self as an instrument. The self is an instrument that engages the situation and makes sense of it. This is most often without the aid of an observation schedule; it is not a matter of checking behaviours, but rather of perceiving their presence and interpreting their significance.

3. Another feature that makes the study qualitative is its interpretive character. Interpretive here has two meanings:

    a. Inquirers try to account for what they have given an account of.

    b. Qualitative inquirers aim beneath manifested behaviour to the meaning events have for those who experience them.

4. Qualitative studies display the use of expressive language and the presence of voice in the text.

5. A fifth feature of qualitative studies is their attention to particulars.

6. A sixth feature of qualitative studies pertains to the criteria for judging their
   success. Qualitative research becomes believable because of its coherence,
   insight, and instrumental utility.

3.3 Research paradigm

Paradigms are all-encompassing systems of interrelated practice and thinking that
define for researchers the nature of their enquiry along three dimensions: ontology,
epistemology and methodology (Terre Blanche and Durrheim, 1999). **Ontology**
specifies the nature of reality that is to be studied and what can be known about it.
Epistemology specifies the nature of the relationship between the researcher
(knower) and what can be known while **methodology** specifies how the researcher
may go about practically studying whatever he or she believes can be known.

3.3.1 Positivist, interpretive and constructionist paradigms

Terre Blanche and Durrheim (1999:4) explain the three dimensions of paradigms in
the following table.

Table 3.2   Positivist, interpretive and constructionist paradigm

	Ontology	**Epistemology**	**Methodology**
Positivist	Stable external reality Law-like	Objective Detached observer	Experimental Quantitative Hypothesis testing
Interpretive	Internal reality of subjective experience	Empathetic Observer inter-subjectivity	Interactional Interpretative Qualitative
Constructionist	Socially constructed reality Discourse	Suspicious Political Observer constructing versions	Deconstruction Textual analysis Discourse analysis

The three dimensions of these paradigms shown in the above table constrain each
other. If the researcher believes that what is to be studied consists of a stable and
unchanging external reality, then she or he can adopt an objective and detached

epistemological stance towards that reality, and can employ a methodology that relies on control and manipulation of reality. If, on the other hand, the researcher believes that the reality to be studied consists of people's subjective experiences of the external world, she or he may adopt an intersubjective or interactional epistemological stance toward that reality, and use methodologies (such as interviewing or participant observation) that rely on a subjective relationship between researcher and subject. This is characteristic of the interpretive approach, which aims to explain the subjective reasons and meaning that lie behind social action. Finally, if the researcher believes that reality consists of a fluid and variable set of social constructions, she or he may adopt a suspicious and politicized epistemological stance, and employ methodologies that allow the researcher to deconstruct versions of reality. This is the characteristic of the constructionist research (*ibid.*).

Many researchers conduct most of their research within a single paradigm, in the same way that artists typically prefer a certain style. Thus positivism may suit those who are after what they believe to be objective facts. Interpretive research may be suited for those who care about the meanings people attach to such "facts", and social constructionism may suit those who wonder how the social world gets constructed as one which contains "facts" in the first place.

Since people's subjective perceptions and experiences are such an important, if not defining factor in the implementation of computer-assisted education, I believe an interpretive approach to be the most appropriate for the objectives of this study. I tried to find out how the implementation of computer-assisted education supports an outcomes-based education system at Sterling Primary School. I also attempted to determine the major obstacles obstructing the implementation of computer-assisted education in the schools. For this qualitative approach in-depth, semi-structured interviews, document analysis, survey and participant observation were used as data collection methods.

3.4 Case study methodology

Case studies have been increasingly used in Education. It is a valuable method of research, with distinctive characteristics that make it ideal for many types of investigations. According to McMillan and Schumacher (2001) a case study design is the one phenomenon, which the researcher selects to, understands in-depth, regardless of the number of sites, participants or documents for study. It examines a "bounded system" or a case over time in detail, employing multiple sources of data found in the setting. The case may be a programme, an event, and activity or a set of individuals bounded in time and place. The researcher defines the case and its boundary. The focus may be one entity (with in-site study) or several entities (multi-site study). However, the more cases of individual sites added, the less depth of analysis of any single site. The study provides a detailed description of the case, an analysis of the themes or issues, and the researcher's interpretations or assertions about the case. Case studies do not claim to be representative, but the emphasis is on what can be learned from a single case (Tellis, 1997).

I employed a case study design because I wanted to gain insight and deeper understanding of the factors that leads to the successful implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School.

3.5 Research question

According to Leedy (1992) the wise choice of a researchable problem can lead the researcher into a truly unexpected and fascinating domain. Research can be defined as a systematic process of collecting and analyzing data for some purpose. In most cases, research consolidates knowledge and helps to improve practice. Research looks for answers and is directed towards the challenges stated in the research problem (McMillan & Schumacher, 1997).

The objective of this study is to determine the factors that contribute to the implementation of computer-assisted education in Sterling Primary School in East London. The primary research question therefore is:

What factors contribute to the implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School in East London?

3.6 Subsidiary research questions

To answer the primary research question, the following subsidiary research questions need to be answered:

1. Why has Sterling Primary School implemented computer-assisted education?

2. How does computer-assisted education support the implementation of outcomes-based education?

3. What are the obstacles to the implementation of computer-assisted education?

3.7 Research participants and location of the study

This research was carried out in Sterling Primary School in East London in the Eastern Cape. The participants of this study are the teachers, grade 7 learners, educators and principal of this school. Sterling Primary School is a former 'Model C' school and the largest English medium school in East London. In this school, Computer Study is one of the subjects in the school curriculum. Most of the educators in this school are using computer-assisted instruction in the various learning areas. It is significant that in outcomes-based education computers assist both educators and learners in the teaching and learning processes.

In this study I investigated how educators and learners were using computers in their teaching and learning processes in various learning areas.

3.8 Data collection procedures

For the purpose of conducting this study, I have written letters and obtained permission from the Eastern Cape Department of Education, East London District, to visit a few schools in East London. The letter of request and approval letter is attached in Appendix A. In the initial stage I was focusing on three primary schools in East London – Clarendon, Gonubie and Sterling – but later decided to focus on

Sterling Primary as a genuine effort of integrating computer-assisted education is being made in this school.

Mr. S M Hall, Principal of Sterling Primary School extended his assistance to conduct this study and introduced me to Mrs. C Dean, the Head of the Department of Computer Studies. She was very encouraging and cooperative during this study.

Firstly, a **questionnaire** was given to all learners in grade 7. This questionnaire mainly focused on the learners' use of computers in their various learning areas. The questionnaire is found in Appendix B.

Interviews were conducted with a number of educators and the principal to gather information about the computer-related infrastructure and use of computers at Sterling Primary School. These interviews were in the form of informal discussions on computer-assisted education at this school.

The data collection took place at Sterling Primary School from April to August 2003.

3.9 Data collection techniques

In this study qualitative data gathering techniques were used. Data was collected by means of a survey, in-depth semi-structured interview, observation and document analysis.

3.9.1 Survey

Survey questionnaires were developed to elicit data from the principal, educators and one class of Grade 7 learners (See Appendix B).

3.9.2 Semi-structured Interviews

According to Leedy (1992) interviews should be considered professional situations that demand equally professional planning and conduct on the part of the interviewer. The semi-structured interview is almost the exact parallel of the observation procedure. All the prior decisions concerning what to look for, categorization, recording and the construction of a schedule, are the same.

Interviews were conducted with the selected Grade 7 learners identified by the Head of the Computer Studies Department. Educators that were interviewed included the Computer Studies and Mathematics teachers. The principal has a big influence in the policy decisions of the school and I therefore also interviewed him. The purpose of these interviews was to get more information about how computer-assisted education is helping in the outcomes-based education system. Questions asked during the interview focused on specific items from the questionnaire, but varied depending on the responses given by the learners. Questions such as "Do you feel that you can understand better if the subjects are taught with computers?" were included in the interviews to encourage the learner to respond on their views about the integration of computers in their learning process. These interviews assisted in balancing the viewpoints.

3.9.3 Observation

In McMillan and Schumacher's (1997) view, observation is used to describe the data that are collected, regardless of the technique employed in the study. I chose an interpretive, participatory observation study as the appropriate strategy for addressing the questions of the research.

The first step in building up an observation schedule is to identify the limited ranges of behaviour which is relevant to one's research and which is therefore to be observed. One cannot just 'observe'; one must observe something. The range of behaviour is vast and complex and only a limited amount of it bears upon the study one is making (*ibid*.).

In this study, I actively engaged with Grade 7 learners and educators and observed the way in which the learners were using computers to learn and apply various skills in different learning areas.

3.9.4 Document analysis

Documents such as the school prospectus and minutes of the strategic planning committee meetings were analysed to get a clearer picture of the implementation of computer-assisted education in various phases at school.

3.10 Data analysis

Maykut and Morehouse (1994) argue that our approach to data analysis is to understand more about the phenomenon we are investigating and to describe what we learn with a minimum of interpretation. McMillan and Schumacher (1997) state that qualitative data analysis is primarily an inductive process of organizing the data into categories and identifying patterns or relationships among the categories. Data can be managed by both manual and computer-assisted methods.

In my study data was analyzed by listening to recorded interviews. Interview notes were categorized into units to find common themes. Field notes prepared from observations were also used as important tools to identify the advantages as well as the challenges faced by both learners and educators in the implementation of computer-assisted education in the school.

3.11 Summary

In order to provide a conceptual overview of the research process, this chapter describes the research paradigm, research problem, research objectives, research questions, research population and location of the study, data collection techniques and data analysis. The analysed data are reported on in Chapter 4.

Chapter 4   Research Findings and Synthesis

4.1 Introduction

In order to determine the factors that contribute to the implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School this chapter will report on the following three subsidiary questions:

1. Why has Sterling Primary School implemented computer-assisted education?

2. How does computer-assisted education support the implementation of outcomes-based education in this school?

3. What are the obstacles to the implementation of computer-assisted education in this school?

Using Miller's (1997) Evolutionary Model as a benchmark, the data will then be synthesised to report on the current state of implementation of computer-assisted education in this school.

Sterling Primary School is the largest English medium school in East London. Even though there are quite a number of primary schools in and around the East London area, the school administrators of Sterling Primary are constantly experiencing an increasing demand for admission to the school. This is a former Model C public school where learners from all racial and ethic groups are attending. Most of these learners are from middle- to upper class family backgrounds whose parents can afford to pay an annual school fee of R 6 000,00 for their children's education. The Governing Body of the school has always taken decisions on behalf of the parent body of the school.

At Sterling Primary there are 1320 students from Grade 1 to 7. For Grades 5 to 7 there are a total of eighteen classes consisting of about 30 learners each. The teaching staff of Sterling Primary School comprises of the Principal, two deputy principals, six heads of departments and forty-four educators, totalling fifty-three. There are also eight administrative members of staff working in this school.

4.2 Participants and responses

The participants of this study included the principal, two of the educators and one class of 31 Grade 7 learners at this school. To investigate the use of computers in the teaching and learning process a questionnaire was administered to the class of Grade7 students at this school. This class was also observed during a practical session in the computer laboratory. Interviews were conducted the school principal, the head of the Computer Studies department and the Mathematics educator. Documents that were analysed include the school's prospectus and annual reports.

A 100% response rate to the questionnaire reflects the learners' positive attitude to computer-assisted education in their schools. Most of these learners agree that computer-assisted education is playing a vital role in outcomes-based education. They feel that it encourages them to demonstrate critical and creative thinking, is very productive in the area of "learning by doing" and enables them to do their group and project work.

4.3 Why has Sterling Primary School implemented computer-assisted education?

In line with recent curriculum changes in South African schools, Sterling Primary School introduced the new outcomes-based education system into their school curriculum.

Some of the reasons for the implementation of computer-assisted education are:

1. The outcomes-based model accords well with the use of computers at a variety of levels and computers are used to support the teaching and learning process. When computers are used in education they are more than just another medium of teaching, like a chalkboard. Outcomes-based education follows the principle of constructivism in which learners have to construct their own knowledge based on a variety of drill and practice exercises, experiments, investigations, observations, measurements and interpretations to get the results.

2. Computer-assisted education is creating the best learning environment possible for students through applying learner-centred education approaches.

3. Computer-assisted education is supporting both educators and learners in every aspect of their work. Computers are assisting the learners in numerous ways such as preparing and presenting projects and assignments, experimental analysis, record keeping, data logging, data visualisation, testing, et cetera. Project assessment, performance assessment, self-assessment and peer assessment are done through computers in an efficient manner.

4. The school authorities are convinced that computer-assisted education is a key resource in outcomes-based education and its use has the potential of improving the quality of learning.

4.3.1 Learners

This study found that with the effective implementation of computer-assisted education the following seven critical outcomes in the outcomes-based education system are easily achievable.

Learners should be able to:

1. identify and solve problems and make decisions using their critical and creative thinking.

2. work effectively with others as members of a team, group, organization and community.

3. organize and manage themselves and their activities responsibly and effectively.

4. collect, analyse, organise and critically evaluate information.

5. communicate effectively using visual and symbolic language skills in various modes.

6. use science and technology effectively to improve the environment as well as health of others.

7. demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

The study conducted in Sterling Primary School revealed that learners found computer-assisted education valuable and that it has the following advantages for them:

- Learners are exposed to different computer applications such as MS Word, MS Excel, MS Access, MS PowerPoint, Netscape Navigator, MS Outlook Express, MS Visual Basic, MGI Photo Suit, et cetera.

- It is noticed that computer-assisted education focuses on a flexible, learner-oriented approach to teaching and learning. Learners find it exciting to discover various learning experiences by using computers effectively. Few of their own comments are given below."It will be better than a normal lecture lesson. If you are taught with computers it makes the lesson more interesting and useful."

- It is excellent for drill and repetitive tasks as these need not be written on the black board. "If your answer is wrong the computer tells you and explains it in a simpler way. You can also go back if you don't understand thoroughly."

- The learner is helped by the so-called on-line "help file", by the built-in properties of the programme and by the educator/facilitator only when it is absolutely necessary. All learners agree that computers are helpful and assisting them a lot to do their projects and assignments. "It makes easier to find information than looking around the whole library to find a book for reference." "Projects and assignments are done quickly with the help of computers." Since valuable information for project work can be downloaded, time and energy is saved.

- Learners with physical disabilities find computers a useful tool to learn.

- Computer-assisted education motivates learners who discover new learning fields in the Internet.

- Learners obtain a hands-on experience with computers. Learners construct knowledge of their own and get opportunity to experience the real learning environment.

- In computer-assisted education learners have access to teachers, tutors and trainers, peer groups and mediators in other places.

- Active learning and outcomes-related assessment is possible.

- There is improved linkage between what happens inside classroom and outside the school. They can watch debates or communicate with other learners online.

- It is useful to explore on any topic of research.

- It provides more information and better explanation of research topics.

- It makes lessons more interesting and challenging.

- Computers are used as a demonstration tool. Time consuming drawings and sketches can be replaced with online tools.

- Through computer-assisted education, application of creative thinking is taking place. That is a key aspect of outcomes-based education.

- At a computer each learner can work at his or her own pace. In the traditional classroom situation, this is not possible, as the educator has to determine a uniform pace for the learners in his class.

- Learners are using computers for creating projects and assignments and presenting it in the class with the help of PowerPoint.

- Progress will be monitored by constructive methods of assessment such as portfolio assessment, performance assessment, tests et cetera.

Learners emphasised through following comments that collaborative learning is possible in computer- assisted education. "Help learners to work together." "In a group we can all work on the same thing at the same time on different computers. One can type out while others search for more information."

In the design and implementation of collaborative learning projects, learners and educators act as a team, and the role of the teacher is changing from an instructor to a collaborator.

4.3.2 Educators

Different educators are following different methods and strategies when they are using the computer in education. In outcomes-based education, educators are considered to be the partners in the system, and not merely the conduits through which a syllabus is transmitted.

Stirling Primary School is a better-resourced school and educators have easy access to a range of electronic equipment such as computers, video machines, and colour printers both to access resources for information and for students' use (for example, through schools networks established on the Internet). Educators expressed following views on computer-assisted education. "Learners are 'turned on' by computers." " Learners are working at their own pace." " Virtual reality is powerful." With the help of computers these educators are adopting a positive attitude and creating the climate and conditions for meeting their outcomes.

It is the responsibility of educators to construct meaningful learning experiences that lead to the achievement of outcomes. In outcomes-based education progress will be monitored by integrated methods of assessment such as portfolio assessment, performance assessment, tests, et cetera. As the focus changes from the consumption of knowledge to the construction of knowledge, stress levels of educators will be reduced. They are acting as partners in the new system, and not merely the conduits through which a syllabus is transmitted. In Stirling Primary School educators are playing vital roles as a facilitators, assessors, researchers, community members and mediators of learning.

According to the educators the main advantages of computer-assisted education are:

- that it enables educators to fulfil the role of mediators in encouraging and stimulating construction and production of knowledge.

- applying learner-centred educational approaches, computer-assisted design and planning is helpful for the learners and a variety of learning experiences can be acquired.

- that computers help learners to solve problems and make decisions.

- computers help to show learners different ways of learning, researching, note taking, cooperation with others and learning by doing.

- encourage and demonstrate critical and creative thinking.

- organise and facilitate group and collaborate work.

- with the help of computers educators can write clear and individualised reports on learner outcomes, indicating progress and remedial requirements.

- that computers help to find out learner differences and provide customised teaching and support strategies for different education needs.

- it can enhance teaching effectively of both the "good" teacher, as well as the teacher with "poor" qualifications.

- use computer aided instruction programmes for specific learning and drill objectives, such as Mathematics, Physics, History, Geography and Technical subjects

- expose learners to particular software packages such as Windows, word processors, databases, spreadsheets, presentations packages, et cetera.

- teach the fundamentals of various subjects through the use of programmes like MS Office, Mathematics Programs, Encarta, MS Front page, Spex, Evalunet (all subjects), HSRC spelling and comprehension, Maths Circus, Tabs, Logo et cetera.

4.3.3 Principal and School Governing Body

At Sterling Primary School the school authorities are working together to provide a climate in which educators and learners can exercise their creativity meaningfully and achieve a better result. The new education system's greatest successes occur where leadership is based on participation; that is the constructive engagement of all staff in decision-making and day-to-day management (Department of Education,

1996). Participatory management recognises the creativity, flexibility and resilience of staff members and honours their contribution to the common goal. This type of recognition and participation is quite evident in the administration of this school.

4.4 How does computer-assisted education support the implementation of outcomes-based education in Sterling Primary School?

The introduction of an outcomes-based approach to education provides a unique opportunity for the integration of computer-assisted education as a support for teaching and learning process (Department of Education, 1997a). Computer-assisted education is focused on skills mastery, drill and practice, problem solving, exploratory project work and applied knowledge (Department of Education, 1996).

4.4.1 Computer infrastructure and teaching facilities

The computer department of Sterling Primary is highly regarded in comparison with other schools in East London. There are two computer laboratories with a total of 81 computers at Sterling Primary School. The Senior Computer Laboratory is equipped with 41 Pentium 3 computers and two printers mainly for Grade 5 to 7 learners. There are 40 Pentium computers in the Junior Computer Laboratory for Grade 1 to 4 learners. The administrative staffs of the school use the administrative network, which educators and learners do not have access to.

4.4.2 Computer access to educators and learners.

Almost 80 per cent of learners and 95 per cent of the educators have computers at home. Due to the high number of learners and the limited availability of computers at school the use of computers by learners is restricted. Despite this, all of the learners in the school make use of computer laboratories during allotted times. In a five-day cycle, for example, Grade 7 learners get one and a half hour while the remaining grades get only one hour per week which means that every learner at the school has at least one computer period scheduled per cycle. Those who want to spend more time at the computer are able to join the Computer Clubs to do computer literacy and computer skills training every afternoon.

4.4.3 Availability of software for teaching

The school has more than sixty computer-assisted learning packages like Microsoft Word, Excel, Access, PowerPoint, Logo, MS Paint, Encarta Encyclopaedia 2000 and 2002, Maths Story, Maths Trek, Wiki Maths, Maths Circus, animated Multiplication, World of Words, Evalunet, Internet Explorer, Tabs, Chess master, HSRC - Spelling and Comprehension, Spex, Sim City and Shareware Programs.

The technology is integrated into the curriculum wherever possible. Learners in the senior primary grades are familiar with Microsoft Office 2000 Professional and they are using various applications for their project work and assignments. Using Excel they have the opportunity to capture the data of their cyclic tests. PowerPoint presentations are created on topics such as food, festivals and advertisements. Grade 7 learners' basic skills in these applications are tested and assessed.

4.4.4 Computer Clubs

Due to the high demand for access to computers eight computer clubs – four in junior and four in the senior laboratories- are functioning after normal school hours. These computer clubs are used mainly for computer literacy skills development. Group work is also encouraged in these sessions. Senior Primary Computer Clubs concentrate primarily on problem-solving skills and web designing. It is commendable that many learners designed their own web pages.

The learners reported that they found the problem-solving skill programmes that they are exposed to during the afternoons are interesting. One such programme, Desert Quest (Tennille), for example, presents challenging problems that are fun and within the pupils' ability to solve, but are different from anything they have seen before. The user is a pilot in a desert region and the task is to search for a party of survivors whose plane has been grounded with engine trouble. In this task learners have to construct different routes to find the correct location of the plane. They develop new problem-solving skills and enjoy discovering new routes. Learners feel that they learn better by experimenting as compared to listening, which is the main focus of constructivism.

In the junior grades learners become familiar with keyboard skills through a variety of educational games. During the year they do activities relating to Mathematics, Phonics and Literacy, as well as those focused on perceptual skills. Basic word-processing skills are introduced in Grade 1.

4.5 Obstacles to the implementation of computer-assisted education in Sterling Primary School

Most of the educators in Sterling Primary School use computers in teaching but the main users are those in the Computer Studies Department. Even though computer-assisted education is introduced in this school, they are facing problems of effective implementation. Some of these problems faced by this school are listed below:

1. Mrs. C E Dean, the Head of the Computer Studies, points out the major problem that they are facing at the school is limited number of computers. "Not enough computers. 1300 learners, having 2 laboratories of 40 computers each in a laboratory. How can we implement computer-assisted education in all learning areas effectively?" Sterling Primary School, with more than one thousand three hundred students having access to only eighty computers (in two laboratories of forty computers each) has a computer:learner ration of 1:16. To provide each learner a computer is an expensive business. So the unit cost is much higher than in the traditional face-to-face classroom context.

2. Even if the computer laboratories are available, they are not well equipped or well-resourced. Colour printers and an Internet connection to each computer are very expensive. The school find it difficult to afford colour printers, the maintenance of the computers and Internet fees.

3. Only two-thirds of the 53 educators have attended computer courses. The remaining educators find it difficult to inculcate computer-assisted education into various learning areas.

4. Unavailability of the latest computer programs hinders the smooth implementation of computer-assisted education in these schools. Computer programs have to be replaced with updated versions and are very expensive.

5. Time is another problem faced by both educators and learners in the implementation of computer-assisted education in these schools. All the learners complained that they are not getting enough time at computer laboratories. "The time should be extended and we should be allowed to communicate with other schools over the Internet." Very often a period of 45 minutes is not sufficient for completing the work assigned to them.

6. According to Mrs. Dean, "lack of enthusiastic educators is another problem that we are facing here at Sterling." There is also a strong resistance to using computers, as some of the teachers strongly believe that the traditional way of teaching is still relevant to the teaching and learning process.

7. The national and provincial Departments of Education is not providing enough support to the implementation of computer-assisted education.

8. "Computer teachers must continuously be motivated and exposed to other computer educators in South Africa and all over the world. Computer training and in-service courses are vital for the integration of computer education." The principal categorically emphasised the importance of in-service courses in computer education to all educators in his school. Lack of in-service and refresher courses are reflected in the teaching approach and methods of educators. Educators must always be up-to-date and aware of new trends and new technologies taking shape in the world.

9. Lack of proper planning creates problems in the effective implementation of computer-assisted education.

4.6 Synthesis: Evaluation of the computer-assisted education at Sterling Primary School

The Evolutionary Model of the integration of computer-assisted education in schools developed by Miller (1997) was used to compare the integration of computer-assisted education at Sterling Primary School. This model provides a definition of computer-assisted education and specifies the infrastructure required by the model, as discussed in Chapter 2. This will help to evaluate the implementation of computer-assisted education at Sterling Primary School. The five phases in the Evolutionary Model are Introduction, Entry, Intermediate, Penultimate and Creation.

4.6.1 Phase 1: Introduction

In the introduction phase of the Evolutionary Model the infrastructure for computer-assisted education such as installation of computers, printers, network, and modems are established. Educators try to teach with computers by doing simple work and most of the time the computer replicate traditional instructional and learning activities (Miller, 1997).

Table 4.2 compares the integration of computer-based education at Sterling with Miller's Evolutionary Model (1997).

Table 4.1   Phase 1: Introduction

Evolutionary Model Phase 1: Introduction	Computer integration at Sterling Primary
- Installation of the computers and complementary technology such as printers, modems and telephone lines. - Computer use replicates traditional and learning activities. - Training of educators with word processing.	- Two computer laboratories with 81 computers and four printers were installed. Internet dial-up system was also established. - Educators and learners are using computers for different applications like sending e-mail messages or downloading information from Internet. Graphics and word processor applications are also used. - One-month basic training for all educators in the introduction of computers and to MS Windows, Word, Excel, PowerPoint and Internet were given.

At Sterling Primary, 81 computers in two separate computer laboratories and computers together with overhead projectors in all Grade 6 and 7 classrooms were installed. In the initial stage computers were mainly used to support traditional teaching methods of drill-and-practice and word processing.

Supported by private funding, the school was able to arranged low cost loans to purchase computers for educators. Out of 53 educators 45 have computers at home. All educators were given one month's training course on MS word, Excel, PowerPoint and the Internet. Mrs. Dean, the head of department of Computer Studies was in charge of this course and she has made herself available to other educators in the implementation of computer-assisted education in various learning areas.

At Sterling Primary more than sixty different software applications were purchased for various learning areas. The principal and the Governing Body of the school have allocated sufficient funds for the purchase of various support materials for the computer department. The Governing Body usually consults the Head of the Department before taking any policy decision regarding computer education.

There is both community and private sector involvement in the implementation of computer education at Sterling Primary. One company donated a new printer to the school and a few private firms are willing to assist in purchasing more computers.

4.6.2 Phase 2: Entry

In the Entry phase educators begin to use the equipment to support classroom teaching by means of drill-and-practice or text based work.

Table 4.2   Phase 2: Entry

Evolutionary Model Phase 2: Entry	Computer integration at Sterling Primary
- Computers are used mainly in drill-and-practice or text-based work. - Computer supports established teaching methods and activities. - Technical assistance is given to learners and educators. - Stress level of educators is kept low with basic skill computer work. - Further training to educators.	- Educators use word processors to prepare their lessons and learners use them to prepare assignments and project work. - Learners use Excel to capture data of their cyclic tests and PowerPoint presentation on various topics like festivals, different foods and advertisements. - The head of the department of computer studies gives technical assistance. - Educators attended a three months course in basic computer skills. It increases the educators' confidence in their use of computers in the classroom. - Five educators attended an International Computer Driving Licence (ICDL) course.

Educators use word processors to prepare their lessons and learners use these to prepare assignments and project work. Learners also use Excel and PowerPoint for projects and presentations. It is found that teaching methods are still traditional in many of the classes where learners work on their own, each needing a computer. Access to the Internet is also another problem that learners and educators encounter. The head of the department of computer studies gives technical assistance to both educators and learners.

4.6.3 Phase 3: Intermediate

In the intermediate phase, educators start using computers as a tool to achieve an educational objective. In this stage interactions with learners change from sharing technical information to sharing instructional strategies. Educators start using the computers in creative ways as they develop expertise in applications. Educators' roles change from a focus on the lesson to facilitator of learning (Miller, 1997).

Table 4.3   Phase 3: Intermediate

Evolutionary Model Phase 3: Intermediate	Computer integration at Sterling Primary
- Move from text-based instruction and drill-and-practice to word processors, databases, spreadsheets and graphics. - Role of educator gradually changes from instructor to facilitator. - Learners peer tutor. - Collaboration on instructional topics between educators. - Educators observe fellow educators classes. - Curriculum is modified to make use of the different technologies.	- Educators continue to use word processors to prepare their lessons and learners use these for their assignments and projects. Use of graphics and PowerPoint presentations are common. - Few educators are changing their role to facilitators. - A few skilled learners assist and share their knowledge with other learners. Slow learners receive assistance from these skilled learners. - In various learning areas educators are trying to collaborate with others. Few educators collaborate with educators from other countries like Australia, Ireland, United Kingdom and Romania. - Those educators handling Mathematics, Technology and Natural Science observe one another's class occasionally. - Mathematics, Technology and Arts and Culture educators link their curriculum to integrate computers.

Learners start using different applications like Word, Excel, PowerPoint and Access in their work. Group learning and sharing of ideas are taking place at this stage. Learners are assisting one another in the use of computers as a tool in the preparation of assignments and project works. At Sterling primary educators and

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learners have collaborative learning programmes within and outside the country. They have e-mail contacts with learners from Russia, Romania, Hawaii, Ireland, Australia and Czech Republic.

4.6.4 Phase 4: Penultimate

In the penultimate phase the curriculum is modified to make use of different technologies and the school timetable is rescheduled to allow for team teaching and mentoring. Constructivist learning approaches gradually replace behaviourist teaching methods. It is noticed that this approach is very productive in the area of learning by doing. Learners are involved in collaborative and creative project work by constructing their own knowledge. The educator becomes a collaborator as opposed to a facilitator. Various applications are used in learning (Miller, 1997).

Table 4.4   Phase 4: Penultimate

Evolutionary Model Phase 4: Penultimate	Computer integration at Sterling Primary
- Constructivist approach to learning replaces the behaviourist approach. - Different computer applications are used in learning. - Role of educator gradually changes from facilitator to collaborator. - Learners involved in knowledge construction. - Learners involved in collaborative and creative project work. - Desire for new and better technology. - Modification of curriculum makes use of different facilities. - School timetable is	- Learners are encouraged to develop new problem-solving skills. They are experiencing constructivist approach in learning. - Educators encourage getting involved in collaborative project works. Educators and learners act as a team and the role of educator changes to a collaborator. - Learners involve in different knowledge construction activities in various learning areas. - Learners involve in group work in various learning areas. Few learners are designing their own web pages. - Learners and educators are interested have access to Internet facilities and they believe that scanners and digital cameras will be helpful for various multimedia presentations. - Attempts are made to integrate computers in various learning areas. - The school timetable has been rescheduled

Evolutionary Model Phase 4: Penultimate	Computer integration at Sterling Primary
rescheduled for team teaching. ▪ Learners peer tutor.	to accommodate team teaching. ▪ Skilled and talented learners are assisting educators and learners.

During this phase team teaching and new instructional methods are encouraged. Educators start using various applications for collaborative and creative work. Learners also get involved in collaborative and creative work. At Sterling Primary it is evident that in various learning areas a number of new applications are used to fit in with the availability of technology. In Language Literacy and Communication (LLC) programmes like World of words, HSRC spelling and comprehension exercise and Evalunet programmes are used. Maths Trek, Maths Story and Animated multiplication, Maths Circus and Wiki Maths give chance to learners to apply the constructivist approach in their Mathematical Literacy, Mathematics, Mathematical Science (MLMMS) Learning area. Learners are using Tabs, Sim City and Microsoft Paint for their Arts and Culture creative works. They are also using Evalunet, Encarta, Graphics, Logo and FrontPage programmes for Natural Science (NS), Human Social Science (HSS) and Economic and Management Science (EMS) learning areas.

4.6.5 Phase 5: Creation

In the creation phase there is a total change in the teaching and learning process. In this phase educators use the technology to adapt to the learner's learning styles, needs and preferences. Computers and associated technologies help in collaborative learning, educator mentoring and creation of knowledge, peer tutoring and active involvement of learners. The grading system is reassessed to accommodate new learning styles and methods especially of constructivist nature. Creation phase is never complete as new technologies continue to be developed (Miller, 1997).

Table 4.5   Phase 5: Creation

Evolutionary Model Phase 5: Creation	Computer integration at Sterling Primary
▪ Accommodation of more learning styles, individual needs and preferences. ▪ Active involvement of learners in knowledge construction. ▪ Constructivist approach to learning replaces behaviourist approach. ▪ Different computer packages used in learning. ▪ Learners involved in collaborative and creative project work. ▪ Learners peer tutor. ▪ Educator acts as a collaborator in the learning process. ▪ Interdisciplinary project based learning. ▪ Team teaching. ▪ Desire for new and better technology. ▪ Modification of curriculum makes use of different facilities. ▪ School timetable rescheduled for team teaching.	▪ There is no evidence of accommodating more learning styles, individual need and preferences. ▪ Found in few learning areas like Technology, Mathematics and LLC. ▪ Learners are encouraged to experiment and construct their own ideas to a limited extent. ▪ Learners and educators are exposed to different computer applications. ▪ Very useful packages like Encarta, Graphics, Evalunet, World of words and Maths Story are used. ▪ Learners are involved in collaborative and creative project works. ▪ Learners help one another. A Grade 7 learner passed the ICDL course. She is playing the role of a peer tutor. ▪ In a few learning areas educators act as collaborators in the team project work. ▪ Found among educators in collaborative learning projects. ▪ Team teaching was not evident. ▪ Each learner has a computer with Internet facility. ▪ In the junior computer laboratory School Management Team and learners desire to have faster computers. ▪ There is a deliberate attempt to integrate computers in a few learning areas. ▪ Timetable is not rescheduled for team teaching.

The Evolutionary Model was used to determine the level of integration of computer-assisted education at Sterling Primary School. An overall view of the level of

computer-assisted education at Sterling Primary School based on the Evolutionary Model is given below.

Table 4.6   Level of computer-assisted education at Sterling Primary School based on the Evolutionary Model

Phase	Integration based on the Evolutionary Model
1. Introduction	Completed by the educators.
2. Entry	It is evident that the educators have also completed this phase.
3. Intermediate	Change is taking place and it is towards the finishing stage.
4. Penultimate	Change is beginning to take place in all departments.
5. Creation	Little evidence.

In the integration of computer-assisted education, we notice that Sterling Primary School is moving from the Entry to the Penultimate phase. It is evident that Phases 1 to 4 has been mostly completed. A lot of work has to be done in Phase 5.

It is evident that Sterling Primary School has provided the basic infrastructure as well as the other requirements for the integration of computers. The School Governing Body and the School Management Team are giving the required support towards the fulfilment of the integration of computer-assisted education at school.

4.7 Summary

The research findings showed that the effective implementation of computer-assisted education in outcomes-based education is the main requirement for the improvement in the quality of education in Sterling Primary School. This system of education is very useful in the area of "learning by doing." The principal together with the School Governing Body are showing keen interest to install more computers to accommodate more learners in computer-assisted education.

These findings of my study may be useful for schools in this province who are eager to introduce computer-assisted education in outcomes-based education in the Senior (Grade 7, 8 and 9) and Further Education and Training phases (Grade 10, 11 and 12).

Chapter 5   Conclusion and Recommendations

5.1 Introduction

The aim of this study was to investigate the implementation of computer-assisted education in the outcomes-based education system at Sterling Primary School in East London. This necessitated

- finding the reasons for the implementation of computer-assisted education;

- investigating how computer-assisted education is supporting the implementation of outcomes-based education, and

- examining the obstacles to the implementation of computer-assisted education in this school.

5.2 Summary

5.2.1 Reasons for the implementation of computer-assisted education

Through the introduction of computer-assisted education, Sterling Primary School find it easy to adapt to the newly introduced outcomes-based education, which revolves around the philosophy of constructivism. Computer-assisted education allows the paradigm shift from a teacher-centred to a learner-centred approach to teaching and learning. It is noticed that when learners' activity constructs knowledge, it becomes more meaningful, applicable and memorable. In this context the educator is the facilitator, whose responsibility is to construct meaningful learning experiences that will lead to the attainment of outcomes.

5.2.2 Computer-assisted education and implementation of outcomes-based education

The role of the educator changes to become more of a facilitator as opposed to being focus of the instruction. Classroom interaction with learners changes from technical assistance to sharing instructional strategies. Educators move beyond drill-and-practice and text-based work to work of a more creative nature as they develop expertise in the new system.

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Through the introduction of computer-assisted education, Sterling Primary School finds it easy to implement outcomes-based education effectively into their teaching and learning practices. Computer-assisted education supports both educators and learners in every aspect of their work.

Outcomes-based education follows the principle of constructivism in which learners construct their own tasks based on a variety of drill-and-practice, experiments, investigations, observations, measurements and interpretations (Department of Education, 1996). Learners are able to work independently and in collaborative teams, think critically, solve problems and see themselves as life long learners. They prepare and present their group work, assignments and projects with the assistance of computers. It is valuable for adopting a positive attitude for a successful outcome (Department of Education, 1996).

5.2.3 Obstacles in the implementation of computer-assisted education

The integration of computer-assisted education in the outcomes-based approach to education is still unfamiliar in South Africa, but potentially constitutes one of the key points of leverage for change towards quality provision. Even though this school have tried to inculcate computer-assisted education in its teaching and learning process, it is facing a few obstacles in the implementation process. The main problems identified are unavailability of well equipped computer laboratories, insufficient support from the government, lack of motivation and enthusiasm from a number of educators, lack of proper planning and lack of in-service training and refresher courses.

In order to meet its unique challenges and those common to other countries, South Africa needs a culture of education and training. Such a culture should be marked by commitment to a flexible, learner-oriented approach that uses whatever combinations of strategies appropriate to the needs, demands and circumstances of learners education and training providers and interest groups from community, industry and government (Department of Education, 1996). While the introduction of an outcomes-based approach to education and training provides a unique opportunity for the integration of technology as a support for teaching and learning,

educators need to be clear about the constraints under which we are presently operating (*ibid.*). It must be made clear to decision-makers so that they have a picture of the teaching and learning environment in their planned or existing educational programme. In implementing computer-assisted education the following challenges must be taken into consideration.

- Physical infrastructure is essential for the effective use of technologies in education.

- It is essential to develop the human capacity required for technologies to be used effectively in education and training.

- Introducing technological hardware into education and training is generally the easiest part of the process, but other costs such as maintenance, staff *et cetera* is more expensive (*ibid.*).

5.3 Implications of the findings on computer-assisted education

- The integration of computer-assisted education wholly depends on adequate infrastructural provision, such as computer laboratories and electricity and telecommunication facilities. The Ministry of Education needs to mobilize resources and human capacity and manage computer-assisted education throughout the country.

- Teaching styles and methods are to be reviewed. Problem-solving skills must be developed.

- Since assessment is continuous, time frames should be flexible and learners should learn at their own pace. Slow learners should be accommodated in this system.

- A large number of educators lack skills, training and confidence. It is important to raise the awareness of every educator about the new developments in education. Individual educators must develop computer-based resources in teaching. They must develop the skills to use the Internet as well as to evaluate and select

wisely those computer programs that are suitable for teaching their own learning areas.

- Courseware which is to be used by learners in their various learning areas must be designed by a team of specialists, ranging from the subject specialist, to media experts, educational design experts, experts familiar with the language, abilities, customs and problems of the learners. This medium must be used where it is most effective in fulfilling the objectives of every part of the lesson.

5.4 Limitations of this study

This study is mainly focused on the implementation of computer-assisted education in the outcomes-based education in the Intermediate Phase and not in other phases such as the Senior and Further Education and Training Phases.

- Outcomes-based education is a new concept to the educators and learners in South Africa and the implementation of computer-assisted education into outcomes based education could experience initial problems.

- The implementation of computer-assisted education in the outcomes-based education itself is a wide topic and presents a study of its own.

- This is a case study, so its findings cannot be generalized.

5.5 Recommendations for further research

This investigation shows that implementation of computer-assisted education in outcomes-based education has the capacity of providing more active learning and learner-centred education, and encourages educators to serve as facilitators of learning rather than deliverers of knowledge. More research is needed on the implementation of computer-assisted education and its impact on teaching and learning process in the various levels of our education system in South Africa. I conclude this report by recommending the following areas for future research.

- The Department of Education in South Africa is planning to introduce outcomes-based education in senior classes. Research on the implementation of computer-

assisted education in the Senior and Further Education and Training phases is advisable.

- About three quarters of the South African schools are located in rural areas and categorized as 'underprivileged' schools (Department of Education, 1996). A study on computer-assisted education in the rural schools is highly recommended. A comparative study on the implementation of computer-assisted education in privileged and underprivileged schools is necessary, as it will reveal the problems associated with the digital divide.

- It would be useful to have a study on learners with physical disabilities who use computers as a tool to learn.

- An analysis of the improvement of the quality of education in the new approach to education is important.

5.6 Conclusion

This investigation shows that computer-assisted education can be used to improve the quality of education in the outcomes-based education system. The main goal of the new education and training system is to redress the imbalances of the past through the implementation of new teaching and learning strategies for the effective and flexible delivery of education within various learning contexts and through the equitable distribution of technological and other resources (Department of Education, 1996).

Recognizing the use of computers as a tool in effective education, many schools in the Eastern Cape have started integrating computers in their daily school instructional programme. There are many impediments to overcome, but the findings of this study may be beneficial for schools in this province that are keen to introduce computer-assisted education in various learning areas of outcomes-based education.

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Appendix A1: Letters of request

<div style="text-align: right">

12A Windermere
15 St. James' Road
East London

14/11/02

</div>

The Principal
Sterling Primary School
East London

Dear Sir

Request to do research

I am a final year Master's Degree student in Computer-Assisted Education at University of Pretoria. My research work is on the factors that contribute to the successful implementation of computers in schools in the Eastern Cape Province.

I would be much obliged if you could kindly permit me to get access to your educators and few learners to get few information regarding computer education in your school.

With regards

Mathew SKP
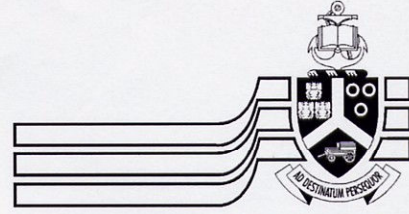
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jcronje@up.ac.za

To Whom It May Concern:

Research on implementation of computers in schools

Messrs E. Alexander and S.K. Mathew are studying towards a Masters' Degree in Computer-Assisted education under my supervision and under the co-supervision of Mr Markus Mostert of Rhodes University.

They are researching factors that contribute to the successful implementation of computers in schools in the Eastern Cape Province of South Africa.

It would be appreciated if they could be given reasonable access to staff and learners of ten schools in the province.

Obviously the Education Department will be consulted before the results are made available, and a copy of the research report will be made available on request.

It is hoped that this research will contribute to the successful implementation of computers not only in the Eastern Cape, but also in the whole of South Africa.

Your participation in our project could be of immense value and will be greatly appreciated.

Best wishes

Johannes Cronjé (Prof)
Supervisor

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Appendix A2: Letters of approval

Province of the Eastern Cape

DEPARTMENT OF EDUCATION
EAST LONDON DISTRICT OFFICE
Private Bag X9007, EAST LONDON, 5200

Reference:	Enquiries:	Tel:	Fax:	Date:
S.K. Mathew	HP Greeff	043-7431210	043-7434030	9 April 2002

Mr. S.K. Mathew
12A Windermere
15 St. James Road
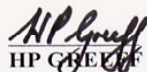EAST LONDON
5200

Dear Mr. Mathew

RE REQUEST TO DO RESEARCH

Receipt is acknowledged of Prof. Cronjé's letter dated 4 April 2002.

Kindly be informed that your request is conditionally approved, pending the final approval by Head Office. You are however, allowed to start your research if you are prepared to comply with the following conditions:

- The Principal and Governing Body of the school must give permission for the research project to be undertaken in the school.
- No school or individual must be identified.
- Teaching time may not be used for the completion of the questionnaires.
- The questionnaire must be sanctioned by the Education Department.
- The school programme must not be disrupted.
- No teacher or principal will be under any obligation whatsoever to provide the information required or in any other way be of assistance in the research project.
- Without the prior approval of the Education Department a principal shall, under no circumstances make available for research purposes, any confidential documents with regard to pupils (e.g. IQ's).
- Where pupils are involved written permission must be obtained from the parent/guardian before pupils become involved.
- Prospective researchers must show the Principal the Education Department's written approval before any research is undertaken.
- The Education Department reserves the right to monitor the research.
- The Education Department must be informed about the outcome of the research.

Yours faithfully

HP GREEFF
CES

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CLARENDON HIGH SCHOOL FOR GIRLS

CONNAUGHT AVENUE
EAST LONDON
5201
SOUTH AFRICA

29 May 2002

Mr S K Mathew
12A Windermere
15 St James Road
EAST LONDON
5201

Dear Mr Mathew

PERMISSION FOR CONDUCTING RESEARCH ON IMPLEMENTATION OF COMPUTERS IN SCHOOLS

Your request to conduct research at this school was put to the Governing Body and approval has been granted.

Yours truly,

O J NEL
Headmaster

TEL.: 043 722 4887 (Reception)
043 743 1603 (Headmaster)

FAX: 043 722 5308
E-mail: ojncghs@iafrica.com

Postal Address: Postnet 104, Private Bag X9063, EAST LONDON 5200

Appendix B1: Survey Questionnaire: Learners

Computer Assisted-Education

Learner

Name of learner:

Name of school:

1. Would you like to study with computers?

2. Do you feel that you can understand better if the subjects are taught with computers? Give reasons.

3. Have you ever been taught with computers before?

4. Have you ever had any short course in computer literacy?

5. At present, what do you learn with your school computer?

6. What is the role of computers in doing your projects and assignments?

7. Is it helpful for you to do your group work? How?

8. Are you satisfied with the way you are being taught with computers?

9. Do you think more hours are necessary in computer education?

10. In your opinion what must be done to improve learning with computers at school?

Appendix B2: Survey Questionnaire: Educators

Computer Assisted-Education

Educator

Name of Educator:

Name of school:

1. What is your subject?

2. Would you like to teach your subject with the help of computers? Why?

3. What computer programmes are you using for teaching your subject?

4. In your opinion, which programme is the most useful for the teaching and learning process?

5. Do you think teaching the learners with computers will help them understand better or bring better results? State the reasons.

6. What hinders you from teaching most of the learning areas with computers?

7. What do you think is the role of computers in the Outcome Based Education (OBE)?

8. What role can the following agencies play in the implementation of computer-assisted education in your school?

    (a)   The Principal

    (b)   Head of the Department

    (c)   Dept. of Education

(d)   Government Agencies

(e)   Private Agencies

(f)   Parents

(g)   Community

9. Do learners use computers in your class;

(a)   To learn the subject
(b)   Only for typing
(c)   Only for the purpose of learning a package
(d)   Creating presentation
(e)   Sending e-mails
(f)   For playing educational games

10. What suggestions would you make to implement teaching with computers a

   success?

Appendix B3: Survey Questionnaire: Principal

Universiteit van Pretoria
University of Pretoria

Computer Assisted-Education

Principal

Name of Principal:

Name of school:

1. Do you think that teaching with computers can give your learners better results?

2. Are all the subjects taught with the aid of computers at your school?

3. Do you think the existing number of computers is sufficient to teach the present umber of learners?

4. From which grade do you start teaching with computers?

5. Do you have enough software for different subjects?

6. Are the teachers
   (i)   Provide with access to programme experts when necessary?

   (ii)   Given technical assistance?

   (iii) Allowed to have a say in the purchase of various software needed?

7. Are your teachers capable of making their own mind-tools for different subjects, in the absence of needed software?

8. Do you have qualified teachers to teach with computers?

9. Do the teachers get together to exchange ideas regarding teaching with computers?

10. Are your learners more enthusiastic to learn when they are taught with computers?

11. Approximately, what percentage of time per subject is spent to teach with computers?

12. Did the learners score well in subjects that you taught with computers?

13. What are the problems you have encountered while introducing computer-assisted education in your school?