An Investigation into the Attitudes of Teachers in Port Elizabeth to the Implementation of Computer Assisted Learning

By

Paul David Harvey

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Supervisor: Professor P Cunningham

ABSTRACT

In general, insufficient research has been done to validate the usefulness and relevance of computers in educational settings (Hitchcock, 2000; Robinson *et al.*, 2003; Baillie *et al.*, 2000; Housego *et al.*, 2000; Valdez *et al.,* 2004). Schools therefore tend to adopt educational technologies before determining whether and how the technology will be used to its full capacity, or what the human and educational impact would be on learners and teachers (Hobson *et al.*, 1998; McCabe *et al.*, 2003; Hugo, 2002).

In South Africa the e-Education policy, scripted by the Department of Education (DOE), has been created as an implementation and integration plan for educational technologies in South African schools, where all South African learners at schools are to be functionally computer literate by the year 2013 (DOE, 2003c). However, a limited amount of research has been performed investigating the educational relevance or optimal method for Computer Assisted Learning (CAL) implementation in South African schools.

The purpose of the undertaken research study is to create an understanding of teachers' attitudes toward CAL implementation and integration, as well as to provide insight into the optimal CAL implementation and integration methods in South African schools. The research problem under study therefore is: **What are teachers' attitudes toward the implementation and integration of CAL systems in South African schools?**

The research study is performed within the quantitative research paradigm and can be described as both exploratory and descriptive in orientation. In the context of this research the population under study is Grade 10 Mathematics teachers that teach in the city of Port Elizabeth. Out of a total of 153 teachers who form part of the study population, 78 successfully completed survey instruments, returning a high yield of 51% of the total study population. The analysis of the total teacher sample group provides the most statistically robust analysis breakdown of the study, and therefore can be reported with a high level of confidence. However, as the study is exploratory in nature, the analysis of various subject breakdowns have been included and reported in the study to provide anecdotal insight across diverse variable groups. Subject breakdowns include gender, demographic groups, and age groups, levels of qualifications and level of computer use experience.

The findings indicate that teachers in general feel very positive about the use of computers in schools, specifically for teaching purposes, and believe the use of computers in education is inevitable but provides value in the educational context. Though teachers demonstrate high levels of access to computers and fairly capable computer abilities, they demonstrate low levels of awareness of available computer facilities, as well as low levels of computer use. The findings therefore indicate a need for greater integration of CAL systems into the curricula and greater training opportunities.

However, teachers show that they have a preference for traditional teaching methods to CAL instructional methods, demonstrating a specific preference for traditional chalk and whiteboard media. The findings suggest that teachers do not value computers for their instructional purposes, but rather for their practical educational related activities. The findings also suggest that the use of computers to teach is not a priority of education related computer use. Teachers indicate that a variety of both traditional and modern media is best suited to various educational activities.

With regard to CAL instruction, teachers demonstrate a preference for a teaching scenario where teachers use computers to prepare and teach lessons, but learners only perform exercises on computers under teacher supervision. Teachers demonstrate greater aversion to teaching situations where learners learn independently off computers. Teachers therefore indicate that Drill and Practice and Testing software are the most suitable for general CAL implementation and use, in support of previous studies in South Africa.

Finally, from a developmental perspective in the context of South Africa, teachers overwhelmingly indicate that the widespread implementation of CAL systems should not occur before all schools have their basic needs of water, sanitation, electricity and human resources fulfilled.

KEYWORDS

Computer Assisted Learning

Educational technologies

Computers

Attitudes

Teachers

Learners

Mathematics

CONTENTS

LIST OF TABLES

List Of Figures

ABBREVIATIONS

The National Centre for Educational Technology and Distance Education	NCETDE
Department of Education	DOE
Computer Assisted Learning	CAL
Information Communications Technologies	ICTs
Compact Disc Read Only Memory	CD-ROMS
Electronic Mail	e-mail
National Qualifications Framework	NQF
Further Education and Training Phase	FET
The General Education and Teaching Phase	GET
Outcomes Based Education	OBE
Curriculum 2005	C2005

List Of Appendices

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DEDICATION

To my Mother who believed in education;

To my Father who believed in possibility.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND TO THE RESEARCH

The technological developments and expansion in the areas of telecommunications and computers have resulted in a primary reliance globally on the use of Information Communication Technologies[1] to store, transmit and process information and knowledge (The National Centre for Educational Technology and Distance Education[2], 1998). The informationisation of societies, a term propagated in Japan in the 1960's, has led to the increasing integration of ICTs into all sectors and facets of society and the advancement of information and knowledge as the world's primary commodities (NCETDE, 1998). Literature published by the South African Department of Communications indicates more specifically that the capacity to fully integrate the use of information, particularly in providing increased access to its citizens, is acknowledged to be the most essential facet in the competitiveness between countries internationally (Government Communications, 1996).

As society has become more reliant on information technology, the skills that job markets require from learners and university graduates, and therefore educational curricula, has changed along with the nature of work (Johnson, 2003). The ability to actively solve problems, work collaboratively, assess and utilize information from a variety of resources and communicate effectively, above the rote acquisition and retention of knowledge, have become the skills that will enable learners to succeed in the technological work environment after school (Johnson, 2003).

ICTs (termed as educational technologies) have therefore been adopted in the educational context with the aim of making the teaching and learning process more appealing, efficient and skills intensive (Semple, 2000). Educational technologies serve various functions in educational settings, from

[1] ICTs
[2] NCETDE

storing and searching through information, composing and processing personal work and receiving various forms of instruction (Semple, 2000). Technology enabled educational activities are demonstrated to fall under the all encompassing term of 'Computer Assisted Learning'[3] (Brown, 1997).

The South African Government, responding to the positive and progressive use of CAL systems worldwide, have reported that the relevance of such systems in the local educational systems would provide learners with the skills they require to achieve personal goals and to be active participants in the global community and economy (Department of Education[4], 2003c). In South African schools, however, the levels of technological resources, particularly in telecommunications and computers, fall at very low levels. Over 70% of schools in South Africa are without computers, while 34% of schools are without telecommunications resources (Asmal, 2000), that provide significant challenges to the integration of CAL systems into South African schools (Addison *et al.*, 1997). The infrastructure of basic sanitation, power, water and human resource needs in schools across the country also remains undeveloped in the largely rural populations (Asmal, 2000).

The e-Education policy has been created as an implementation and integration plan for educational technologies in South African schools, intended to be staggered in a three phase integration process (DOE, 2003c). The aim of the e-Education policy is that (DOE, 2003c: 10):

> "Every South African learner in the general and further education and training bands will be ICT (Information and Communications Technology) capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013".

The trend internationally, however, is that large budgets are designated for the implementation of information computer technologies in educational institutions, where their potential at times are not being fulfilled (Hitchcock, 2000; Hobson *et al.*, 1998). More specifically, because of a general lack of infrastructure in developing countries, expensive technologies implemented

[3] CAL
[4] DOE

into schools tend to be under-used and over-budgeted (DOE, 2001a). Also, studies have determined that the availability of computers alone do not ensure the successful integration of computers into schools (Lafee, 2001).

Although a large number of research studies have been carried out to determine what factors contribute to good teaching practise in the traditional teaching setting, insufficient research has been done to determine whether or how the use of computers in educational settings helps to improve the quality of education delivered compared to its traditional alternatives (Baillie *et al.*, 2000; Hitchcock, 2000; Housego *et al.*, 2000; Robinson *et al*., 2003; Valdez *et al.,* 2004). The literature indicates that schools therefore tend to implement educational technology practises before investigating whether and how the technology will be used to its full capacity, or what the human and educational impact would be on learners and teachers (Hobson *et al.*, 1998; Hugo, 2002; McCabe *et al.*, 2003).

1.2 RESEARCH PROBLEM AND HYPOTHESES

A limited amount of research has been found performed investigating the educational relevance or optimal method for CAL implementation in South African schools. As levels of CAL implementation and integration in South African schools remain low, investigating the effect or best practise methods for CAL implementation remains challenging. The undertaken research has therefore relied on the exploration of teachers' attitudes to CAL implementation and integration, as literature indicates that:

- positive teacher involvement in the use of CAL methods at school level contribute to the successful integration of CAL systems into school contexts (McCabe *et al.*, 2003; NCETDE, 1998)

- teachers' beliefs and attitudes regarding the use and benefits of computers have a strong influence on how computers are used and successfully integrated into educational settings (MacArthur *et al.*, 2003)

- there is a need for the integration of educational technologies into schools, if teachers are to increase and maintain higher levels of productivity that are required in modern times (Johnson, 2003)

- the Department of Education intends to place greater responsibility on teachers to drive the CAL implementation and integration process forward, as they will be managed under an incentive encouragement scheme to integrate the use of ICTs into their teaching and administrative tasks, while the use of technology in schools will become part of the Development Appraisal System and part of school evaluations (DOE, 2003c).

Literature therefore, concludes that measuring teachers' attitudes to adopting and using educational technologies are relevant measures in predicting the extent that CAL systems would be accepted and integrated in the teaching and learning context (Koszalka, 2001).

The purpose of the undertaken research study is to create an understanding of teachers' attitudes toward CAL implementation and integration, as well as to provide insight into the optimal CAL implementation and integration methods in South African schools. The research problem under study therefore is:

What are teachers' attitudes toward the implementation and integration of CAL systems in South African schools?

The research aims to create insight into the following in South African schools:

- the current teacher computer usage precedents in schools

- teachers' attitudes toward the use of computers in education

- the needs and priorities for CAL implementation

- the optimal structure and layout for CAL implementation

- the levels of CAL most suited to the implementation of CAL

- the levels of CAL that teachers currently foresee in schools in the future.

1.3 JUSTIFICATION FOR THE RESEARCH

Various government documents have indicated the need for research in the field of technological innovation in South Africa and highlight the following:

- the need for research to facilitate suitable technological development and change in the South African society and economy in general (Government Communications, 1996)

- the need for research to evaluate and provide insight into social responses and challenges in the South African society as a result of technological innovation (Government Communications, 1996).

More specific to the educational context, the need for research is indicated for:

- enhancing the quality of education and educational innovation through systematic research, development, evaluation and training (President's Office, 1996)

- evaluating, developing and modifying ICT use in schools (DOE, 2003c).

However, literature indicates more specifically that the current use of ICTs in educational contexts are disorganised and lack clear and specific direction and remains challenging to mediate due to a lack of research in this area in South Africa (NCETDE, 1998).

With regard to the study of teachers' attitudes, literature indicates that measuring teachers' attitudes to adopting and using educational technologies are relevant measures in predicting the extent that CAL systems would be accepted and integrated in the teaching and learning context (Koszalka, 2001). The focus of this study is on Grade 10 Mathematics teachers. This is validated as literature indicates that the study of the use of computers in Mathematics, Science and Technology is valuable, as these learning areas provide greater opportunity for lasting transformation in the way that educational processes take place in schools (Pieters, 2001).

1.4 METHODOLOGY

The research study is performed within the quantitative research paradigm, as it involves the quantification of constructs, the use of variables in describing and analysing behaviour or phenomena and the control for various sources of error in the research process (Babbie *et al.*, 2001). In general, however, the research study can be described as both exploratory and descriptive in orientation, as it is has aimed to provide insight into a fairly unknown area of research inquiry in South Africa, while intending to provide an accurate description and measurement of various phenomena (Terre Blanche *et al.*, 1999).

In the context of this research the population under study is Grade 10 Mathematics teachers that teach in the city of Port Elizabeth, South Africa. Out of a total of 153 teachers who form part of the study population, 78 successfully completed survey instruments, returning a high yield of 51% of the total study population. The analysis of the total teacher sample group provides the only statistically robust analysis breakdown of the study, and therefore can be reported with a high level of confidence. However, as the study is exploratory in nature, the analysis of various subject breakdowns have been included and reported in the study. Despite low levels of sample statistical validity, this data provides anecdotal insight into the factors that influence attitudes toward CAL implementation across diverse variable groups. This information is intended to direct future research. Subject breakdowns include gender, demographic groups, age groups, levels of qualifications and level of computer use experience.

1.5 OUTLINE OF THE REPORT

The research report is divided into five chapters, namely:

- Chapter 1. Introduction
- Chapter 2. Literature Review
- Chapter 3. Methodology
- Chapter 4. Analysis of Data
- Chapter 5. Conclusions and Implications.

The literature review has three subsections that include:

- *Computer Assisted Learning*, that reviews the definition of CAL, the history of CAL, the types of CAL, the levels of CAL use, the advantages and disadvantages of CAL use, the comparison of CAL to traditional teaching methods and the future of CAL

- *CAL, Teachers and Learners*, that reviews the rationales for using computers in schools, the theories of educational programming, the association between CAL and learners and the association between CAL and teachers

- *CAL implementation in South African Schools*, that reviews the computer and education policies in South Africa, the computer resources in South African schools and the factors that influence CAL implementation in South Africa.

The methodology chapter illustrates the justification for the research paradigm and methodology, the research procedures and the ethical considerations of the study.

The data analysis chapter consists of a breakdown of the research subjects and presentation of findings that fall under two sections, namely Computers in the School Context and the Implementation of CAL.

The conclusions and implications chapter includes conclusions about each research question and the research problem as a whole. The implications for theory, policy and practise, limitations of the study and suggestions for further research are also discussed.

1.6 DEFINITIONS

As researchers tend to adopt various definitions that are not uniform, the purpose of this section to is to provide initial clarity to the key definitions relevant to the study. In the study, two terms require specific attention for definition purposes, namely the terms ‘attitudes’ and ‘CAL’.

The use of the term ‘attitude’ in the study is refers to (Koszalka, 2001: 2):

> “an evaluation disposition toward some object based upon cognitions, affective reactions, behavioral intentions, and past behaviors…[and therefore] is an informed predisposition to respond and is comprised of beliefs, feelings and an intent for action”.

In the scope of the study, the term ‘CAL’ is stated as “an all encompassing term to describe any educational use of computers…[and] can be divided into three main groups:

- when the computer is used as a tool (word processor, database, spread sheet, and graphics application)

- when the student 'teaches' the computer, for example, by issuing a set of instructions to the computer through a programming language such as Logo

- when the computer delivers some instructional material" (Brown, 1997: 1).

1.7 Delimitations of Scope and Key Assumptions

This section is included to provide clarification on the boundaries and scope of the research study.

Geographically, the study only included schools in the location of the city of Port Elizabeth, South Africa. The population consisted of Grade 10 Mathematics teachers. As no existing detailed information was available regarding the current population of Grade 10 Mathematics teachers in the Port Elizabeth area at the inception of the study, schools were telephoned and a population list was created by the researcher. Therefore, to an extent, only schools that could be contacted were included in the study, and the researcher found that many schools, particularly schools in previously disadvantaged areas, were unable to be contacted as calls were repeatedly not answered or telephone numbers had been discontinued. However, of the population list that was compiled, the researcher was able to survey more than 50% of the population, therefore returning a high sample yield of surveys.

As teachers' attitudes are the factors under study, any data presented in the research study is produced from information that is of a subjective nature. Any information that reports on performance and systems related facets would need to be evaluated and validated by objective performance and feasibility tests before information is used for any administrational or official purposes.

1.8 Conclusion

ICTs have been adopted in the educational context, termed as educational technologies, with the aim of making the teaching and learning process more appealing, efficient and skills intensive (Semple, 2000). However, little research has been done to determine whether or how the use of computers in educational settings helps to improve the quality of education delivered compared to its traditional alternatives (Baillie *et al.*, 2000; Hitchcock, 2000; Housego *et al.*, 2000; Robinson *et al.*, 2003; Valdez *et al.,* 2004). In the context of this study, a limited amount of research has been found performed investigating the educational relevance or optimal method for CAL implementation in South African schools. The purpose of the undertaken research study therefore is to create an understanding of teachers' attitudes toward CAL implementation and integration, as well as to provide insight into the optimal CAL implementation and integration methods in South African schools. In the context of this research the population under study is Grade 10 Mathematics teachers that teach in the city of Port Elizabeth, South Africa. However, as the study is exploratory in nature, the analysis of various subject breakdowns have been included and reported in the study, despite low levels of sample statistical validity, to provide anecdotal insight into the factors that influence attitudes toward CAL implementation across diverse variable groups, intended to direct future research.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A literature review involves the "identification and analysis or review of the literature and information related to what is intended to be, or has been, studied" (Terre Blanche *et al*., 1999). The literature review chapter includes three broad literature sections, namely: Computer Assisted Learning; CAL, Teachers and Learners; and CAL Implementation in South African Schools. A list of the research questions of this research study is also included at the end of the chapter.

Of the literature sections, the section entitled 'Computer Assisted Learning' provides an understanding of the various facets of CAL, as demonstrated in the literature. The section provides insight into the following regarding CAL:

- the definition of CAL
- the history of CAL
- the types of CAL
- the levels of CAL use
- the advantages and disadvantages of CAL use
- CAL vs. traditional teaching methods
- the future of CAL.

The section entitled ‘CAL, Teachers and Learners’, provides an understanding of the various facets involved in the effects and influences of CAL systems on teachers, learners and the educational context. The subjects included in this section are:

- the rationales for using computers in schools
- theories of educational programming
- the learner and CAL
- the teacher and CAL.

The section entitled ‘CAL Implementation in South African Schools’ focuses on the current status of CAL systems in South African schools, and the aspects that influence CAL implementation nationwide. Included in this section are the following topics:

- computer and education policy in South Africa
- computer resources in South African schools
- factors influencing CAL implementation in South Africa.

Finally, after the presentation of the literature sections, the list of research questions pertaining to this study is detailed at the end of the chapter.

2.2 COMPUTER ASSISTED LEARNING

2.2.1 DEFINING CAL

As a whole, the field of ICTs is defined as

> "all forms of electronic communication in both digital and analogue form…digital electronic devices include computers, CD players, cellular telephony and satellite broadcasting...analogue devices are largely confined to conventional radio broadcast technology and audio, such as tape records" (DOE, 2001a: 7).

While the definition of ICTs refers to the utilisation of different forms of electronic media, literature generally uses the term 'Educational Technology' when referring to the use of computer programmes, of educational content, for instructional purposes (Semple, 2000). As the field of information technology has progressed vastly in a short period of time, similar developments relating to the use and study of computers in educational contexts have simultaneously occurred across the globe. The result of these developments is a culmination of various definitions and terms related to the educational use of computers that essentially share a similar nature, but differ in terminology and level of involvement. Literature lists the following instructional variations in the context of Education Technology:

- Computer Assisted Instruction (Bitter *et al.*, 1993; Rosenberg, 1997; Semple, 2000)
- Computer Augmented Instruction (Kotze *et al.*, 1996)
- Computer Managed Instruction (Bitter *et al.*, 1993)
- Computer Based Instruction (Bitter *et al.*, 1993; Kotze *et al.*, 1996)
- Computer Based Learning (Kotze *et al.*, 1996; Semple, 2000)

- Computer Assisted Learning (Brown, 1997; Semple, 2000).

Computer Assisted Instruction is defined as "the use of a computer directly in the instructional process as either a replacement for or complement to books and teachers" (Rosenberg, 1997: 175), or more generally to "the use of computers for instructional tasks" (Bitter *et al.*, 1993: 61). Computer Assisted Instruction, generally characteristic of earlier educational computing, is evidenced to have distinct controlled learning situations, where the instructional flow is one-way from computer to user, and learning is achieved by responding accordingly to educational stimuli (Semple, 2000). Types of software associated with CAI are: drill and practise, tutorial, simulation and problem solving software (Bitter *et al.*, 1993). In literature, the terms Computer-Augmented Instruction, Computer Managed Instruction and Computer Based instruction are all used synonymously to describe this same education setting (Bitter *et al.*, 1993; Kotze *et al.*, 1996).

In recent times, a shift from the one-way process of "instruction", to that of "learning" has led to a more flexible approach to using computers in education, allowing the user more involvement in a student centred learning process. This has led to the inclusion of the "learning" rather than "instruction" in terms of Computer Based Learning and CAL (Semple, 2000). In Computer Based Learning, learners are able to manipulate the domain of knowledge to suit their liking, and the source of the knowledge can be pre-existing on computer software or can be developed and sourced by the user (Kotze *et al.*, 1996).

CAL, a term used to describe any educational use of computers, includes facets described in Computer Assisted Instruction and Computer Based Learning, but extends itself further towards the use of computers as tools to achieve educational outcomes through standard computer applications such as word-processing, spreadsheet, database and computer programming (Brown, 1997).

CAL, therefore is "an all encompassing term to describe any educational use of computers…[and] can be divided into three main groups:

- when the computer is used as a tool (word processor, database, spreadsheet, and graphics application)

- when the student "teaches" the computer, for example, by issuing a set of instructions to the computer through a programming language such as Logo

- when the computer delivers some instructional material" (Brown, 1997: 1).

2.2.2 THE HISTORY OF CAL

The origin of educational computing is traced back to a few government funded projects on large mainframes and computers at the University of Illinois in the United States of America, where the PLATO project began in 1960 (Alessi *et al.*, 2001). The PLATO project, that enabled the integration of computer graphics and text, for the first time provided instructors with a programming environment conducive to instruction through the medium of computers (Alessi *et al.*, 2001).

As the use of computers became established in educational settings, the earliest software were based on the underlying intellectual foundations of the behavioural learning theory, giving birth to systems of programmed instruction (Lelouche, 1998; Rosenberg, 1997). Systems of programmed instruction relied on a simple instructional process where software users, after being provided with new learning material, were required to answer short multiple choice questions based on the learned material to assess the assimilation of information. Users were simply assessed as having answered items correctly or incorrectly by the software, that then guided the instructional flow based on the level of knowledge learnt (Lelouche, 1998). Programming systems for educational computing advanced to allow the programming of multiple answers into software programmes, referred to as frame oriented instruction, that were then able to give users more constructive feedback on answers assessed as incorrect, and so instructional flow became less rigid (Lelouche, 1998).

The drawbacks of these larger systems were that they were too costly to develop and maintain (Alessi *et al.*, 2001). They were bound to larger mainframes and networks, and along with the rise of microcomputers, fell to the takeover of the smaller and cheaper alternative. However, it took many years to develop software of the same standard for smaller system (Alessi *et al.*, 2001). Software such as PLATO, was designed to function on larger systems, became insignificant in the new market (Alessi *et al.*, 2001). Software for the smaller microcomputer at first followed previous developments such as that of PLATO, but new methods began to develop rapidly as the function of the computer evolved to that of “a tool” that allowed a user to think and manipulate the domain of information (Rosenberg, 1997). Most significantly was the development of LOGO in the early 1980’s by Seymour Papert of the Massachusetts Institute of Technology (Rosenberg, 1997).

By the mid 1980s the emphasis of programming on systems such as LOGO decreased as criticism rose regarding the superficiality and educational irrelevance of the working systems (Rosenberg, 1997). At the same time, computer application programmes, such as word processing software, were becoming significant as mediums for assisting learners achieving educational outcomes, and led to an increase in productivity (Rosenberg, 1997). Meanwhile, vast progress was being made in the field of information technology, and the development of educational software increased rapidly in the early 1990s, exerting significant influence worldwide on learning policies and how school curricula were delivered (Rosenberg, 1997).

The creation of the World Wide Web (WWW) and the development of Multimedia, though, had the greatest impact on Educational Technology in the 1990’s. The concept of the World Wide Web originated in Switzerland in the late 1980s, and was developed by the National Center for Supercomputing Applications (NCSA) at the University of Illinois in the United States of America (Brown, 1996). Originally developed to create a non-linear approach to navigating through and searching texts as opposed to the hierarchical structure characteristic of books (Brown, 1996), the system allowed less restrictive networks, and therefore masses of information and software, was made available and accessible to people (Alessi *et al.*, 2001). This development also allowed computer mediated communication via electronic mail[6] (Alessi *et al.*, 2001). Systemic restrictions, though, still do not allow the effective development of intricate Web-based instructional software (Alessi *et al.*, 2001).

However, despite the increased widespread use and reliance on ICTs in the field of education over the last decade; and that departments and agencies continue to fill schools, colleges and universities with costly electronic media, the field of Educational Technology continues to receive widespread criticism as research studies fail to effectively conclude whether learning really improves through the use of electronic media (Alessi *et al.*, 2001; Lai, 1996).

2.2.3 **TYPES OF CAL**

Several methods of CAL exist (Kotze *et al.*, 1996). These vary on a continuum of involvement from purely instructive and demonstrative on the one end, to exploratory and investigative on the other (Kotze *et al.*, 1996). Instructive software is characteristically systematic and rigid and succeeds when the user has acquired knowledge within the specified cognitive structure (Kotze *et al.*, 1996). Exploratory methods of learning are however, more flexible and based on viewing the computer as a tool used to achieve learner-centred educational outcomes through processes of investigation or discovery (Kotze *et al.*, 1996).

Methods of CAL traditionally associated with Computer Based Instruction, or more "instructive" forms of education, consist of (Bitter *et al.*, 1993; Brown, 1997; Kotze *et al.*, 1996; MacArthur, 2003):

- Drill and Practise
- Tutorials
- Simulations

[5] e-mail

- Problem Solving Software
- Games
- Computer based testing.

More recent methods of CAL are associated with more learner-centred 'investigative' forms of education include the following are (Lelouche, 1998):

- Programming
- Compact Disc Read Only Memory[7] based software and information banks
- Hypertexts and Hypermedia
- Multimedia
- Internet Use
- Online Learning.

Other methods of CAL focus on the use of computers as tools to achieve educational outcomes are (Cousins *et al.*, 1993; Lelouche, 1998, MacArthur, 2003):

- Word Processing Software
- Spreadsheets
- Databases
- Presentation Software.

[6] CD-Rom

Opinions regarding which methods work better, and the acceptable level of involvement the user has with the computer in the educational situation, differ considerably in the literature. A majority of opinions though appeal for the integration of educational technologies into schools, if teachers are to increase and maintain higher levels of productivity that are required in modern times (Johnson, 2003). Johnson (2003) also asserts that regardless of the levels of integration, if there is not a specific pedagogical agenda for the use of educational technologies in schools, whatever skills are learnt would be meaningless and out of context. The decision to use different methods of CAL should then be dictated by the intention, direction and content of lessons, rather than by debate on which methods are superior (Semple, 2000).

The methods of CAL outlined above are therefore grouped together homogenously in the following manner, for the purposes of explanation and discussion:

- General CAL Delivery Software
    - Word Processing
    - Spreadsheets
    - Databases
    - Presentation Software
- Instructive CAL
    - Tutorials
    - Simulations
    - Instructional games
- Constructive CAL

    - Problem Solving Software
    - Programming
    - Feedback
- Audio Visual based CAL
    - CD-Rom based software
    - Hypertext and Hypermedia
    - Multimedia
- Evaluative and Assessment based CAL
    - Drill and Practise Software
    - Testing and Questionnaires
- Internet based CAL
    - e-mail
    - Internet use
    - Online learning.

2.2.3.1 General CAL Delivery Software

2.2.3.1.1 Word Processing

The use of word processing software allows users to generate various forms of written communication that can easily be generated, revised and edited as well as proof read and printed much more efficiently than traditional pencil and paper methods (Bitter *et al.*, 1993; Heide *et al.*, 2001). The use of word processing software allows the use of digital facilities such as: electronic spell and grammar check, glossaries, dictionary and thesaurus functions that generally improve levels of productivity and composition (Heide *et al.*, 2001). Also, levels of motivation and interest of learners generally improve along with the work quality and volume of written work (Cousins *et al.*, 1993).

The use of word processors creates extra focus on facets beyond that of content (Brown, 1997; Stinson *et al.*, 2000). These include planning, pre-writing, composition, revising, editing, critiquing and the development of skills beyond that of functional literacy (Brown, 1997; Stinson *et al.*, 2000). The ability to recognise, create and manipulate symbols in such a way allows learners to transform what it means to be functionally literate, as levels of self-expression, cognitive structure and creativity improve at higher levels than traditional manual methods (Brown, 1997; Stinson *et al.*, 2000). Also, learners who develop computer literacy skills on simpler software such as word processors tend to adapt successfully to other types of software as they find their skills transferable (Bitter *et al.*, 1993).

2.2.3.1.2 Spreadsheets

Spreadsheets are calculating tools that are used for the manipulation of data for the purposes of financial planning or budgeting, data analysis or record keeping (Heide *et al.*, 2001). Users are able to create and use custom formulas that can automatically recalculate when changes are made to the numbers in the data (Heide *et al.*, 2001). Final workings and analysis can also be displayed in graph or chart formats, in word processing or presentation software (Heide *et al.*, 2001).

The educational benefit of using spreadsheets is that learners are better able to understand the relationships of numerical data, or information, when viewed and manipulated in spreadsheet format and presented graphically (Merrill *et al.*, 1996).

2.2.3.1.3 Databases

A database consists of a set of information that is compiled and stored in an organised manner, such as electronic telephone directories or dictionaries, that can easily be read, retrieved or analysed (Heide *et al.*, 2001). By using database software, learners learn to orientate and manipulate organised information in a complex fashion, developing the ability to explore data in new and creative ways, while at the same time improving their own individual problem-solving abilities (Merrill *et al.*, 1996).

A database allows the user to (Heide *et al.*, 2001; Merrill *et al.*, 1996):

- Swiftly locate and trace information in a systematic fashion
- Edit or update information when needed
- Sort information alphabetically or by any order required
- Order information by importance and relevance
- Examine trends
- Use desktop publishing facilities to create mailing lists and other publications dependent on lists of information.

2.2.3.1.4 Presentation Software

Presentation software is used to organise concise information in a creative and structured manner intended for presentation in a range of formats (Heide *et al.*, 2001). Presentations are usually in slide format, with colourful arrangements and backgrounds, intended to maintain interest from screen to screen. The inclusion of graphs, tables, graphics or animated video and audio clips can be included to enhance the presentations (Heide *et al.*, 2001; Mayer, 2000). Presentations improve the clarity of lesson content as pivotal information is presented concisely and in linear fashion, and the flow of lessons are consequently more systematic and efficient (Mayer, 2000). Presentations can be conveniently stored after preparation, and modified and adapted for future use (Heide *et al.*, 2001). The creation of presentations, however, is usually a very time consuming exercise that, although standard in corporate environments, may not find suitability in the classroom (Mayer, 2000).

2.2.3.2 Instructive CAL

2.2.3.2.1 Tutorials

In general, tutorials aim to teach the user new information (Brown 1997; Morrison *et al.*, 1999; Rosenberg, 1997). Typically, tutorial systems work by presenting the learner with new information, assessing what has been learnt through drill and practise testing, and then providing the next set of information, be it remedial or more advanced, in response to the results of assessments (Bitter *et al.*, 1993; Brown, 1997; Hitchcock, 2000). At times, learners are evaluated before being exposed to the new information in a pre-test fashion, and are then tested again as a post-test, to determine the extent of learning (Bitter *et al.*, 1993). A system of feedback during assessment periods identifies and communicates processing errors to the learner and then redirects to remediate answers or recast instructions (Kotze *et al.*, 1996; Ortega, 2001).

Two basic structural styles are used in the creation of tutorials (Bitter *et al.*, 1993):

- Linear Tutorials function in a linear fashion, presenting the same set sequence of displays to all users, regardless of individual characteristics and abilities

- Branching Tutorials allow users to follow different paths in the software, and direct users to specific lessons based on the results of pre-test and post-test assessments, or on responses made to embedded queries in the tutorial itself.

Typically, tutorial software does not present an environment for investigative and exploratory study (Morrison *et al.*, 1999), and information is structured in a tree format where learners aggregate up and down the information hierarchy (Rosenberg, 1997). Importance is placed on factors such as the display of objectives and learning prerequisites, memorisation and the assessment of gained knowledge (Ortega *et al.*, 2001). Tutorials are therefore, constructed and programmed in a way that allows set reactions, learning experiences and explanations to all the possible ways that users can respond while using the software, so as to expose learners to the correct learning material required based on continuous computerised evaluations (Bitter *et al.*, 1993). The focus of tutorials are didactic (Kotze *et al.*, 1996), and are used for self-directed learning for the purposes of remedial teaching, detailed or repetitive study, or are used in place of teaching lessons (Hughes, 1998).

2.2.3.2.2 Simulations

Simulation software aims to model or re-enact a real life situation, allowing users to explore the subject matter by creating hypotheses, experimenting, manipulating variables and drawing conclusions within the bounds of the situation presented (Brown, 1997; Heide *et al.*, 2001; Kotze *et al.*, 1996; Rosenberg, 1997). Simulations are used to replicate situations that are usually too dangerous, expensive, potentially harmful, impossible to re-visit historically or geographically or time consuming in reality (Brown, 1997; Franklin *et al.*, 2002; Heide *et al.*, 2001).

Simulations either intend to teach the user certain subject matter, or teach the user how to perform certain tasks (Heide *et al.*, 2001). Simulations help learners develop experimental and data handling, critical thinking, problem-solving, decision-making, interpretation, communication and reporting skills (Heide *et al.*, 2001; Hughes, 1998). Results of previous studies identify the following benefits when using simulation software in educational settings:

- learners are better able to recognise learnt material when exposed to the real-life situation (Baillie *et al.*, 2000; Franklin *et al.*, 2002)

- simulations allow flexibility in learning that is not limited by time restraints and allow learners to work at their own pace (Franklin *et al.*, 2002)

- learners who use simulations retain more learnt information than counterparts who do not (McCabe *et al.*, 2003)

- learners who use simulations have a better understanding and orientation to critical subject matter when exposed to the real-life situation (Baillie *et al.*, 2000)

- learners who use simulations are more motivated to learn than learners who are taught traditionally (Baillie *et al.*, 2000).

However, a common difficulty identified in the use of simulations is that learners are usually required to learn in an unstructured trial and error format. Learners are also required to reach desired results without an overt systematic understanding of what educational rules and notions led to its production (Heide *et al.*, 2001; Kotze *et al.*, 1996).

2.2.3.2.3 Instructional games

Outside the educational context, video games have created huge appeal amongst younger people, and consequently the educational establishment has adopted these to adapt for teaching children in a manner that minimises any reservations children have of using computers (Rosenberg, 1997). The use of instructional games are aimed at reinforcing skills and information already learnt, and therefore serve a similar purpose as drill and practise or rote learning systems, but sometimes factor in a time element (Brown 1997; Kotze *et al.*, 1996; Morrison *et al.*, 1999).

Instructional games usually provide interesting themes that appeal to the users, much like the themes used in traditional video games (Morrison *et al.*, 1999). Intended to motivate learners (Kotze *et al.*, 1996), instructional games usually allow learners to reach various levels of proficiency and reward the user with intricate graphics and sound presentations as tasks are mastered or completed correctly (Morrison *et al.*, 1999).

However, criticism aimed at the use of instructional games indicate that the games usually have little effect as purely instructional material as they usually have no relevance or integration in the classroom curriculum (Balajthy, 2000), but remain effective for rote learning and motivational purposes (Morrison *et al.*, 1999).

2.2.3.3 Constructive CAL

2.2.3.3.1 Problem Solving Software

Problem solving software usually presents users with problem situations which they attempt to solve (Bitter *et al.*, 1993). Problem-solving software therefore develops learners' strategic thinking abilities (Bitter *et al.*, 1993). In essence, problem-solving software does not teach new material, but requires learners to apply concepts previously learnt and refine skills through learning from errors and therefore ultimately developing problem-solving techniques (Bitter *et al.*, 1993).

Problem-solving software varies with regard to how much learner control is accommodated in working through the software, as some software allows little learner control where the user is required to make guesses and simple attempts in response to problem queries (Bitter *et al.*, 1993). Other software allow the user to navigate freely from one task to another (Bitter *et al.*, 1993). Problem-solving software share similar features to simulations and educational games and are often confused with these varieties of software (Bitter *et al.*, 1993).

Problem solving software helps all learners develop problem solving abilities, particularly lower average learners who get much needed opportunity and practise to develop critical thinking skills that they usually do not get in classrooms (Bitter *et al.*, 1993).

2.2.3.3.2 Educational Programming

Educational programming software has been likened to the use of educational construction kits, such as Lego, and has allowed the use and development of abstract thinking and ideas (Brown, 1997). Programming is a process that allows users to design and use commands to create a variety of objects, displays and scenarios, involving a certain degree of creativity and problem-solving, while developing thinking skills (Heide *et al.*, 2001).

Programming software, such as LOGO, allow the learner uncomplicated methods of expression, opportunity to view and interact with clear representations of works created and continuous response and feedback throughout the process, while learning simple programming principles (Rosenberg, 1997). Programming allows learners to learn through processes of discovery and feedback (Rosenberg, 1997). Although very simple work is produced by novices, learners constantly improve as their programming vocabularies increase, added to the educational benefits that mastery of tasks provide (Rosenberg, 1997). Also, as a learning environment, programming software allow more opportunity for exploration and self discovery than traditional classroom learning environments (Rosenberg, 1997).

2.2.3.4 Audio Visual based CAL

2.2.3.4.1 CD-Rom Based Software

Compact Disc Read Only Memory, or commonly known as CD-Roms, based on the same technology as and resembling Compact Discs, is used as storage facilities (Brown, 1997). More relevant to instructional purposes though, CD-Roms are available as informational resources that contain electronic versions of books, encyclopaedias, maps and other factual banks of information (Heide *et al.*, 2001; Merrill *et al.*, 1996).

CD-Roms allow digital media to take advantage of the multimedia capabilities available on computer systems such as animation, sound and voice properties, graphics including photos and general interactivity (Heide *et al.*, 2001; Merrill *et al.*, 1996). CD-Roms allow easy search and navigation through masses of text, while engaging learners and maintaining general interest (Heide *et al.*, 2001; Merrill *et al.*, 1996).

The use of CD-Rom based software benefit beginning or reluctant readers (Heide *et al.*, 2001) and is shown to help develop higher levels of comprehension (MaCabe *et al.*, 2003). Studies however show that learners learning to read on digital versus physical reading material show no significant difference in reading ability (MaCabe *et al.*, 2003), and that CD-Rom based software, unless used within the scope of the curriculum subject matter, distract learners and should not be the sole medium used in lessons (Lipley, 2003).

2.2.3.4.2 Hypertext and Hypermedia

Hypertext refers to the electronic display and representation of large amounts of text in a way that allows the user easy navigation and multiple access possibilities in a non-sequential manner, overcoming the linear and sequential nature of printed text (Brown, 1997; Lelouche, 1998). In essence, hypermedia involves the use of hypertext with the addition of graphics, sound, music, digitised speech, animation and other formats of information included (Brown, 1997; Lelouche, 1998).

In a hypertext or hypermedia document, links are created that allow readers to branch out to other related text passages, and are normally created by placing ‘buttons’ on the document that, when ‘clicked’ with a computer mouse, automatically show a definition or idea linked to the particular word or idea (Brown, 1997). This then exposes another part of the same document or redirects the reader to a completely new document (Brown, 1997). Information therefore is not structured in a hierarchical mode, and allows users to explore a piece of information form many viewpoints and in different contexts, creating a dynamic information processing experience (Brown, 1997). Readers are not limited by the structure of the subject matter or the layout of the text content, and therefore navigate through the information in a way that is conducive to their own individual cognitive structure, abilities and experiences (Brown, 1997).

Hypertext and hypermedia are not intended as instructive systems, but are used in conjunction with instructional lessons for information retrieval and therefore support learner centred discovery learning, as learners are more involved in the subject matter than passive readers (Kotze *et al.*, 1996; Lelouche, 1998).

The benefits associated with the use of hypertext and hypermedia systems are:

- the associations between different aspects of a specific subject matter are made more explicit when explored in unstructured hypertext and hypermedia format than in linear printed text (Bussey *et al.*, 2000)

- learners are able to organise and structure information according to their own individual cognitive needs, that results in an effective learner centred learning effect (Brown, 1997; Kotze *et al.*, 1996)

- hypertext and hypermedia expose learners to large amounts of information arranged on many levels and formats, therefore allowing more exposure to detailed and relevant information (Brown, 1997)

- hypertext and hypermedia can be used as an idea generating, organisational tool as well as an organised storage system, linking key ideas for easy retrieval (Brown, 1997).

Criticism for the use of hypertext and hypermedia include:

- navigation in unstructured systems is not supported by structured learning guidance and therefore may be ineffective (Brown, 1997; Kotze *et al.*, 1996)

- the complex structure at times leads users to become disorientated and confused and also exposes learners to unnecessary information (Brown, 1997)

- the freedom of navigation distracts learners from the tasks at hand (Brown, 1997)

- the greater number of learning options available create extra demands on the learners who experience an overload of information (Brown, 1997)

- the use of hypertext and hypermedia systems do not allow for assessment of learners' performances, or the opportunity for evaluative and corrective feedback (Kotze *et al.*, 1996).

2.2.3.4.3 Multimedia

Multimedia is considered as an application oriented technology that aims for expression that appeals to the human multi-sensory capability, by developing the capacity of computers to transmit various type of information (Brown 1997). Multimedia thus refers to the fusion of various computer media into a single platform, with the inclusion of (Brown 1997; Heide *et al.*, 2001):

- Text components
- Graphics
- Sound or audio
- Video
- Animation.

Two distinct types of multimedia exist (Brown 1997):

- Presentation Media includes the use of computers to control multiple types of media, such as sound, graphics, animation and video technology, to produce presentations that are flexible and portable; it is adaptable to the user's needs and allow simple editing and additions during lesson or presentation time, transcending current stationary media such as overhead projectors or slide projectors (Bitter *et al.*, 1993; Brown 1997; Heide *et al.*, 2001; Schrum *et al.*, 1997)

- Interactive Media is when users and viewers of the media are able to control, manipulate or interact with the multiple elements of the media, so that information can be accessed in non-linear fashion (Brown, 1997; Heide *et al.*, 2001).

Multimedia has shown to be effective in educational contexts in the following ways:

- learners are able to produce work that is of high quality, and therefore take a great interest during task execution (Brown, 1997)

- Work is professionally produced, and learners learn skills that are transferable into the job market after school (Brown, 1997)

- Learners find the use of multimedia dynamic and motivating (Brown, 1997)

- The use of multimedia increases the interest, concentration levels and therefore the quality of feedback, of the learners (Brown, 1997)

- The use of multimedia help develop organisation, thinking and communication skills (Heide *et al.*, 2001).

2.2.3.5 Evaluative and Assessment based CAL

2.2.3.5.1 Drill and Practise Software

Drill and practise software aims to allow the learner to exercise material that has already been taught until required skills or competencies have been refined or information has been committed to memory (Bitter *et al.*, 1993; Brown, 1997; Heide *et al.*, 2001; Hughes, 1998; Ortega *et al.*, 2001). Based on the Behavioural Learning Theory's stimulus-response model, drill and practise software promote repeated use by users to ensure the establishment of stimulus response connections needed for the rote memorisation of specific facts (Bitter *et al.*, 1993).

Drill and practise software functions by presenting users with questions in a sequential order (Bitter *et al.*, 1993), receiving answers and then providing immediate feedback in the form of programmed responses appropriate to answers provided (Rosenberg, 1997). Correct answers usually receive positive affirming feedback, while incorrect answers receive feedback relevant to the type of error made (if the software has been programmed to predict the possible error) otherwise incorrect answers not accommodated in the system are usually re-directed to other items at similar levels (Rosenberg, 1997). Some software are programmed to provide additional items to users who show difficulty in certain sections or show delays in acquiring certain skills required by the curriculum (Ortega *et al.*, 2001).

The software process therefore, includes the display of an introduction, that includes the directions of tasks to be performed, and then a repeated cycle of the following (Alessi *et al.*, 2001):

- the user selects an item
- the software displays the selected item
- the learner responds to the item
- the software evaluates the response

- the software provides the learner with feedback about the response.

After the session is complete, the software is able to provide a summary of the user's performance as it stores data on each item answered while users progress through the items (Alessi *et al.*, 2001; Hughes, 1998).

The benefits associated with drill and practise software are:

- drill and practise software is effective for the transmission of simple facts in structured contexts (Rosenberg, 1997)

- learners are able to progress at their own pace (Bitter *et al.*, 1993)

- drill and practise software has been shown to be effective in language development, particularly with regard to the improvement of spelling and grammar abilities (Bitter *et al.*, 1993; Ortega *et al.*, 2001)

- appropriately developed items can effectively assess levels of understanding, inference and interpretation (Hughes, 1998)

- drill and practise software is effective in remedial activities (Ortega *et al.*, 2001).

The criticisms associated with drill and practise software include the following:

- the use of drill and practise software that is not in line with the specific instructional purposes has proven to be ineffective (Balajthy, 2000)

- drill and practise software does not possess the evaluative skills that teachers do when assessing learning (Balajthy, 2000)

- teachers are unable to keep progress of the actual learning that takes place for each learner (Heide *et al.*, 2001)

- current educational practices question the effectiveness of rote learning methods (Morrison *et al.*, 1999).

2.2.3.5.2 Testing and Questionnaires

The aim of test and questionnaire software is to assess learners through the medium of computers (Kotze *et al.*, 1996). This type of software can be used in conjunction with instructional material as a means of continual assessment, or it can be used as tests in the traditional method of assessment separate from instruction (Kotze *et al.*, 1996). Some more sophisticated test and questionnaire software work by assisting the tester to create a bank of test items linked to the testing objectives, while other software only allow testers to type in specific test questions (Bitter *et al.*, 1993).

When undergoing testing, learners activate the test on the computer, answer test items by typing responses via the keyboard or the use of the computer mouse (Bitter *et al.*, 1993). When the test is completed, the computer automatically marks the answers provided, and displays the results in graphic or table format (Bitter *et al.*, 1993).

Literature indicates the following benefits associated with the use of test and questionnaire software (Russo, 2002):

- the use of technology in the testing process increases learners' motivation levels

- test and questionnaire software allows more flexibility than the traditional paper testing methods

- test and questionnaire software has the capability to provide individualised assessment

- test and questionnaire software has a short turnaround time in administration and assessment, providing almost instant feedback

- in the long term, the use of test and questionnaire software is cheaper than the use of paper questionnaires as the preparation, administration and marking times are much less

- scoring errors are minimised when performed by computer software

- test and questionnaire software allows for easy retesting of learners when required

- the use of test and questionnaire software provides scientific and continuous measurement of learner performance, and can link learner growth to specific aspects of instruction

- Educational testing software makes provision for special education needs, accommodating the use of audio-visual multimedia such as sound, or providing larger size fonts for easier reading.

2.2.3.6 Internet based CAL

2.2.3.6.1 E-mail

E-mail, or electronic mail, allows users to communicate from one-computer to another single computer, or from one computer to many computers, by transmitting text, pictures or software packages over the Internet (Brown, 1996; Schrum *et al.*, 1997).

Each e-mail user has their own mailbox with an e-mail address, similar to that of traditional postal mail, where they are able to send to and receive messages from, other mailboxes (Brown, 1996). Messages can be sent and received at any time by logging onto and downloading or receiving material from the appropriate mailbox (Brown, 1996).

The greatest benefit of e-mail is that despite the similarity between the use of e-mail and traditional postal methods, e-mail messages arrive at the destination address within minutes of being sent (Brown, 1996).

2.2.3.6.2 Internet use

The Internet allows a platform where learners are able to perform research or information gathering activities via the World Wide Web (French *et al.*, 1999; Heide *et al.*, 2001; Loschert, 2003). Learners are also able to communicate outside the classroom through methods such as audio and video conferencing, online chat rooms and / or e-mail (French *et al.*, 1999; Heide *et al.*, 2001; Loschert, 2003).

Material on the Internet is located through the use of Internet Browsers, such as Microsoft Internet Explorer, and information is electronically linked though hypertext formatting (French *et al.*, 1999). Information on the Internet is usually presented in numerous text passages of small quantities and students are very involved, as they interact with information in the direction that information searches lead them (French *et al.*, 1999). Documents on the Internet are usually produced with high quality multimedia facilities; including colourful graphics, photos, animations, sound, music and video, that make searching for information on the Internet very appealing to learners (French *et al.*, 1999).

Audio and video conferencing facilities allow users to see and communicate with each other in real-time while in different locations, through the use of the Internet and audiovisual hardware such as web cameras and microphones (Heide *et al.*, 2001; Loschert, 2003). The benefit of the use of such systems is that learners at different schools are able to communicate across continents, or teachers are able to train learners in numerous locations in a single sitting (Loschert, 2003).

The use of the Internet for educational purposes has the following benefits:

- learners are not bound by time or place when searching for information on the Internet (French *et al.*, 1999)

- learners are able to source multiple information types off the Internet, such as text passages, photos and graphics, sound clips, video clips and animation (French *et al.*, 1999)

- learners are able to source and validate information from multiple sources on the Internet (Loschert, 2003)

- use of the Internet provides time saving capabilities (Loschert, 2003)

- learners are able to collect information that is of relevance or interest to them, and therefore tend to be more attentive and motivated when collecting information off the Internet than in other traditional contexts (Loschert, 2003)

- learners are able to source information from, and communicate with, experts in their own distinct fields over the Internet, providing an interactive learning experience (Lai, 1996).

The use of the Internet for educational purposes harbours the following criticisms:

- the Internet places higher demands on learners than traditional learning environments, as learners have the responsibility to make their own cognitive associations between their own existing knowledge, and new information collected (Wolfe, 2001)

- the non-linear hypertext format of information on the Internet does not have the coherence, that learners are accustomed to, of linear text passages characteristic of books (Wolfe, 2001)

- collecting information on the Internet means sifting through numerous shorter passages of text, creating an incoherent learning structure (Wolfe, 2001)

- responsibility falls on the learner when receiving inconsistencies in the information content received off the Internet, to clarify and validate information which is confusing, time consuming or not possible at times (Wolfe, 2001)

- research shows that inequalities related to race, gender, class and homeland are also reflected in the usage patterns of computers and the Internet (Brabazon, 2000)

- with free reign on the Internet, it could be problematic to monitor learners spending time on information that is irrelevant or websites of an inappropriate nature (Forsyth, 2001).

As a compromise, literature suggests that the correct combination of both Internet based and traditional information searching methods provide the best of both methods and creates less dependence on either method (Pieters, 2001).

2.2.3.6.4 Online learning

Having its origin in distance education, at its most basic online learning refers to education achieved through computer based technologies such as e-mail, the Internet and multimedia (Lafee, 2001). More specifically, online learning entails instructional text and multimedia based presentation formats, presented and received in a web-based delivery system (Brewer *et al.*, 2001).

Variations of online learning capabilities differ in levels of involvement, ranging from just posting course information on the World Wide Web, to combining traditional teaching methods with web-based resources, to fully web-based courses where teachers and learners never meet in person (Brewer *et al.*, 2001). In online education, written communications for clarification and feedback purposes replace the traditional face to face communication that takes place in traditional classroom contexts (Brewer *et* *al.*, 2001). Thus the teacher and learner may meet prior and after instruction, or may not meet at all (Brewer *et al.*, 2001). Technological communication facilities such as e-mail, video messaging and chat capabilities allow for regular communication between learners and teacher, and as technology progresses, online face to face communication will become more widespread (Brewer *et al.*, 2001).

The general effect of online learning is the shift in teaching roles where teachers have less involvement and learners become more independent in the teaching process (Lafee, 2001). Teaching roles change as teachers move from being the 'sage on the stage' to 'the guide on the side', guiding and challenging learners who learn through discovery and exploratory learning, to take more responsibility for their own learning (Lafee, 2001).

An online magazine dedicated to online learning, entitled the *E-learning Magazine*, performed an online learning user survey at the E-learning Conference and Expo held in April 2001 (E- Learning Magazine, 2001). The following were found to be the benefits of online learning among those who use it.

Table 1: The Benefits to E-learning

BENEFITS	Corporation/ Company Users - % agree	Government/ Military Users - % agree	Higher Education Users - % agree
Available anytime, anywhere	80	75	80
Cost Savings	65	57	65
Allows for self-paced learning	57	75	57
Provides just-in-time learning – (available when required.)	52	52	52
Ease-of-use	44	44	44
Content can be altered easily	42	42	42
Fast distribution	32	32	32
Improves instructor availability	25	NA	25

Source: (E- Learning Magazine, 2001)

In the same survey, the following was found to be the biggest challenges to the successful use of online learning among those who use it.

Table 2: The Challenges to E-learning

CHALLENGES	Corporation/ Company Users - % agree	Government/ Military Users - % agree	Higher Education Users - % agree
Cultural Resistance	42	71	63
Bandwidth	58	64	44
Lack of Interaction	42	42	30
Lack of Engaging Content.	34	13	19
Firewalls	22	20	19
No Standards	13	13	15
Browser Problems	10	13	22

Source: (E- Learning Magazine, 2001)

Literature indicates the following as educational benefits to the use of online learning:

- online learning creates greater opportunities for collaborations and the exchange of information amongst learners (Barak, 2001; Collis *et al.*, 1999; McVay Lynch, 2002)

- online learning allows learners to access courseware off the Internet, in one location, anywhere and anytime (Lafee, 2001; McVay Lynch, 2002)

- online learning allows expert instruction to be provided to a very large audience in a cost-effective fashion (Barak, 2001; English, 2001)

- online learning also enables those who reside in remote locations or who are physically confined to receive varied educational programming of high quality (Barak, 2001; English, 2001; Lafee, 2001; McVay Lynch, 2002)

- online learning, as part of the World Wide Web, allows access to multiple types of media, and enables the use of multimedia to make courseware interesting and interactive (Barak, 2001; McVay Lynch, 2002)

- online learning allows rapid communication between learners and instructors, and enables 'classroom discussions' among physically isolated learners (Barak, 2001; Collis *et al.*, 1999; McVay Lynch, 2002)

- the use of online learning improves performance and productivity as learning material is available on demand with instant access via the Internet (McVay Lynch, 2002)

- the use of online learning allows learners to adjust to a learning context similar to that of the post-school business environment (McVay Lynch, 2002)

- online learning allows different styles of learning to be addressed in the courseware and method, and allows quieter learners to be more involved in online discussions as they feel less threatened than in classroom situations (McVay Lynch, 2002)

- online learning fosters an attitude of active learning amongst learners as learners interact with many types and sources of information (McVay Lynch, 2002)

- most younger learners are computer-literate or interested in computer technology, and online learning therefore interests and motivates learners (McVay Lynch, 2002).

Literature indicates the following as educational disadvantages and criticisms to the use of online learning:

- there is the assumption that all learners have an ability to use the Internet; different levels of ability could have a confounding effect on the learning process (Forsyth, 2001; Lafee, 2001)

- a team is required to maintain the educational web sites which is time consuming and costly (Forsyth, 2001)

- online learning brings with it a lack of the traditional face-to-face social interaction characteristic of classroom-based teaching (Benest, 1997; Brabazon, 2000; Lafee, 2001)

- the cost of e-learning in terms of loss of teaching jobs through the greater implementation of technology is concerning (Benest, 1997)

- the use of online learning raises issues of equity as not everyone has access to a computer and not everyone is literate (Lafee, 2001)

- information on the Internet predominantly is not designed to cater for a wide range of cultures or learning styles, but geared for a few, mainstream, global cultures (Lafee, 2001)

- metaphorical bases for user interfaces are subject to cultural-based interpretations, and courseware therefore cannot be universally culturally relevant (Benest, 1997; Marcus *et al.*, 2000)

- security and confidentiality on the Internet is a challenge to maintain (Forsyth, 2001)

- not all learners' computer systems have the facilities to effectively display courseware, and technical limitations such as computer power, screen size or the ability of the operating system to cope become problematic for effective delivery (Forsyth, 2001)

- online learning can increase teachers' workloads in administration, preparation and assisting learners in irrelevant activities such as computer queries (Brabazon, 2000; Lafee, 2001)

- despite many advantages, research does not convincingly demonstrate the effectiveness of online educational delivery (McCabe *et al.*, 2003)

- learners may suffer social isolation and alienation from spending more time behind computers and less time interacting in classroom settings (Lafee, 2001).

2.2.4 **THE LEVELS OF CAL USE**

2.2.4.1 Levels of CAL

The literature differentiates between distinct levels of CAL, based on differences in the level of involvement the computer and user have in the educational process. Though sources differ in the structure and terminology used to describe different levels of CAL use, there is general agreement that a continuum exists where learner involvement is low and computer involvement high in the instructional process at one end, and learner involvement is high and computer involvement low on the other end of the scale.

Valdez *et al.* introduced a three phase approach to the levels of CAL use, and matched these to the purposes of the prescribed educational outcomes. Valdez *et al.* (2004) list these phases as follows:

- Phase One instruction that predominantly relies on the principles of behavioural learning theory, where focus is placed on rote memorisation tasks delivered by drill and practise software used to teach fragmented factual content or develop basic skills

- Phase Two, where computers are used as tools for learner centred activities rather than for the delivery of educational content, moving from individualised and isolated learning to group related computer applications for completing educational outcomes

- Phase Three, where computers are used more intensely for data driven activities, and both teachers and learners have access to data that is actively gathered and applied in the educational context.

Heide *et al.*, 2001 distinguish between five categories of computer use in classrooms. These authors base these categories specifically on tasks and classroom scenarios, which include the following (Heide *et al.*, 2001):

- computers and large groups, where computers are used to promote discussions, for demonstration purposes and to direct group exploration activities

- computers and small groups, where computers are used to introduce, instruct and practise skills in small groups or partners, or perform co-operative learning tasks

- computers as a lecture tool, where computers are used for instructional purposes such as those in traditional lessons, through the use of Web based lessons

- computers as learning centers, where computers are used for direct and specific explorations, rote memory and drill and practise exercises, and to access information resources

- computers as secretaries, where more geared for teachers, computers are used for record keeping, planning and assessments and to create administrative documents such as worksheets and letters.

Alessi *et al.* (2001) describe a four phase model for the use of CAL at different instructional levels. Distinguished by teaching stages and the level of involvement of computers; the stages are (Alessi *et al.*, 2001):

- Phase One, where computers are only used to provide initial information for learners, whom then receive guidance from teachers and do practise work in paper workbooks

- Phase Two, where computers are used to instruct and guide learners, who then do practise work in paper workbooks

- Phase Three, where after receiving initial information and guidance from lectures or other forms of instruction, learners use computer software, such as drill and practise software, to perform examples to develop fluency in specified subject matter

- Phase Four, where after receiving initial information and guidance from lectures or other forms of instruction and having practised and studied specified subject matter, computers are used to test and assess learners' level of understanding and knowledge acquisition.

Multiple or single phases are used in educational settings, and all phases combined create a scenario where the computer is responsible for the total instructional process (Alessi *et al.*, 2001).

2.2.4.2 The Structure of CAL in Schools

Research findings are positive and negative regarding the effectiveness of the use of CAL versus traditional instructional methods (Ortega *et al.*, 2001). Despite much research to support the use of educational technologies in schools, the structure of educational technologies in schools has proven to be influential in the extent that CAL is integrated and used effectively in schools (Ortega *et al.*, 2001). The structure of CAL in schools refers to the layout of computer educational technologies that influence when, where and how learners interact with the technology.

The common structure of educational technologies in schools is the use of a computer room (separate from classrooms) where learners congregate at specific times to make use of computers (DOE, 2001a).

Computers are usually neatly organised in rows, and each learner sits in front of their own workstation (DOE, 2001a). A system where computers are located in a computer room usually only allows limited time per learner in a school week to use the facilities, and use is usually limited to operational and shorter educational activities (Johnson, 2003).

Another common structure is the location of computers in classrooms, where computer use is more integral in daily educational activities (Hobson *et al.*, 1998). Computers in classrooms are used for demonstration and facilitative purposes in larger groups, collaborative working and project construction in smaller groups, individual drill and information search work as well as for administrative centres for teachers (Heide *et al.*, 2001; Hobson *et al.*, 1998). However, studies show that technology introduced as an extra addition into an unchanged classroom setting, as systems that are required to change usually do so with a degree of resistance, are usually not integrated successfully, and require structural changes to classroom settings to be successfully integrated into classroom educational activities (Ortega *et al.*, 2001).

A step up from computers located in the classroom is the distribution of a personal computer for each learner to use in the classroom (Hobson *et al.*, 1998; Loschert, 2003; Owen *et al.*, 1998). These would typically be portable laptop computers, computer notebooks or hand held computer systems that are used throughout the day (Hobson *et al.*, 1998; Loschert, 2003; Owen *et al.*, 1998). The computer is regarded as an extension of learners, and technology is used as a tool that can communicate ideas and enlarge the scope, nature and place of learning, as well as act a personal administrative assistant (Owen *et al.*, 1998). The use of personal technology also helps learners improve their writing, thinking, problem-solving, learning and communicating skills by providing immediate access to technology when required (Hobson *et al.*, 1998; Loschert, 2003). The use of personal technology also allows learners to complete work at home, providing continuity to the learning process outside the classroom (Loschert, 2003).

In a virtual classroom, each learner also has personal access to technology, but learners do not meet face to face in a traditional classroom. Information is distributed via web pages and learners are able to receive these from home or any location that allows them access to the Internet (McVay Lynch, 2002). Course information is managed by Course Management System software allowing learner and teacher file management (McVay Lynch, 2002). Learners are also able to communicate with teachers and other learners via e-mail, discussion and bulletin boards and chat rooms (McVay Lynch, 2002). As learners are to log onto the Course Management System that requires user authentication such as a password, teachers are able to track student attendance, activity and performance (McVay Lynch, 2002). Studies have found the following positive effects in the use of virtual classrooms in comparison to their traditional alternatives:

- a much lower absentee rate (Stinson *et al.*, 2000)
- more punctual time management (Stinson *et al.*, 2000)
- higher overall performance (Stinson *et al.*, 2000)
- better overall attitudes to courses (Stinson *et al.*, 2000)
- a more creative learning environment (Stinson *et al.*, 2000)
- an opportunity for learners and teacher for increased and spontaneous communication (Stinson *et al.*, 2000)
- more flexible access to learning materials with regard to time and place of access (Richards *et al.*, 1997)
- learners are able to pace their own learning (Richards *et al.*, 1997)
- information and instruction is standardised across learners (French *et al.*, 1999)
- learners tend to spend more time on class work (French *et al.*, 1999)

- learners spend more time collaborating and communicating with each other (French *et al.*, 1999).

However, drawbacks to such a learning system have been identified as:

- learners differ in their ability to use computers (Forsyth, 2001; Lafee, 2001)

- a lack of face-to-face social interaction prevents the spontaneous flexibility to provide practical on-hand subject support as is common in traditional classrooms (Benest, 1997; Brabazon, 2000; Lafee, 2001; Richards *et al.*, 1997)

- learners may suffer social isolation interacting technologically for extended periods of time (Lafee, 2001)

- teachers are only able to moderate learners through what is tracked on the Course Management System, and therefore may miss the opportunities where learners require remedial interaction (Richards *et al.*, 1997).

2.2.5 **THE ADVANTAGES AND DISADVANTAGES OF CAL USE**

2.2.5.1 **INTRODUCTION**

2.2.5.1.1 The Lack of Research

Literature indicates that schools are under pressure not to be left behind technologically and large budgets are being designated for the implementation of information computer technologies in educational institutions, where their potential at times are not being fulfilled (Hitchcock, 2000; Hobson *et al.*, 1998). Although a large number of research studies have been carried out to determine what factors contribute to good teaching practice in the traditional teaching setting, little research has been done to determine whether or how the use of computers in educational settings helps to improve the quality of education delivered compared to its traditional alternative (Baillie *et al.*, 2000; Hitchcock, 2000; Housego *et al.*, 2000; Robinson *et al.*, 2003; Valdez *et al.,* 2004).

The major reason stated in literature for a lack of research is that the fast rate of technological change renders some studies outdated before the findings have been published, leaving the information to be irrelevant (Valdez *et al.,* 2004). The development of educational computing systems and software therefore tends to rely more on the innovative developments in information technology rather than the basis of instructional research and learning theories (Boles *et al.*, 1999).

2.2.5.1.2 Measuring the Computer as the Key Variable

Research studies performed to determine the effect of computers in education have been criticised as regards to their internal validity (Cousins *et al.*, 1993; Mayer, 2000; McCabe *et al.*, 2003; Reyna *et al.*, 2001; Valdez *et al.,* 2004). The multiple variables that influence the learning situation have proven it very difficult to isolate the role technology plays in a causal relationship as demonstrated in experiments (Cousins *et al.*, 1993; Mayer, 2000; McCabe *et al.*, 2003; Reyna *et al.*, 2001; Valdez *et al.,* 2004). Literature suggests that strict methodological controls are needed to rule out novelty effects, as social factors such as motivation, expectancy and working in small groups are believed to impact studies of educational computing (Cousins *et al.*, 1993; Reyna *et al.*, 2001).

2.2.5.1.3 Inadequate Research

Literature states that in general research performed on the impact and effectiveness of educational technology is of a low standard (Lai, 1996; Valdez *et al.,* 2004), and that more accurate evaluations of conventional versus technological teaching and learning are required (Baillie *et al.*, 2000). Challenges to the inadequacy of educational technology research are indicated as follows in the literature:

- in general, educational benefits are challenging to quantify (Baillie *et al.*, 2000)

- many studies do not report or describe the data collected, or do not report when data is of unreliable quality, leaving the findings unsupported (Cousins *et al.*, 1993)

- a majority of research focuses on lower order thinking skills such as memory retention and the recall of facts, at the expense of higher order thinking skills which has a greater impact pedagogically (Cousins *et al.*, 1993)

- not much research has been conducted in the study of attitudes and individual background characteristics as foundations for achievement in computer use (Cousins *et al.*, 1993)

- studies on the effects of educational computing have predominantly occurred at primary or junior school levels, and little is known of these same affects at a higher school level (Cousins *et al.*, 1993)

- computer use is more prominent in subject areas such as Mathematics and Science, and research has therefore been biased to these subjects, but other subjects offer much opportunity to develop critical thinking and higher order thinking skills through the use of educational computing (Cousins *et al.*, 1993)

- insufficient research has been conducted investigating the comparisons between the use of complex multifunction software and task specific software (Cousins *et al.*, 1993)

- studies are not performed in numerous disciplines or on diverse samples of students and therefore can not be generalised across all contexts (Reyna *et al.*, 2001)

- at a conceptual level, researchers have diverse opinions of the correct concepts and terminology associated with educational computing and therefore effect the theoretical associations that can be made between various research studies (Anderson, 2001).

2.2.5.1.4 Mixed and Conflicting Findings

Many perspectives and opinions expressed in research studies on the effectiveness and benefits of the use of educational technology are essentially mixed (Brabazon, 2000; Lai, 1996). The low levels of consensus indicate the need for more intensive and accurate scrutiny in areas of theoretical conflict (Brabazon, 2000; Lai, 1996). Researchers tend to agree, however, that the use of computers in education differ in instructional effectiveness between various educational tasks (Bussey *et al.*, 2000).

2.2.5.2 **THE ADVANTAGES OF CAL USE**

In general, research studies have proven that the use of CAL by school age level children to develop learner skills effectively (Hitchcock, 2000) and improve achievement (NCETDE, 1998). It is also evident that the use of instructional software increases learner motivation and productivity and enhances learning (Bloom *et al.*, 2002).

Literature shows, however, that many variables impact the study of the effectiveness and benefits of the use of technology in educational contexts (McCabe *et al.*, 2003). Levels of teacher involvement in educational technology tend to influence the levels of effectiveness amongst learners, as a higher level of involvement shows a return of greater success (McCabe *et al.*, 2003). Other variables, such as socio-economic status, tend to be as influential in determining success in the use of educational technology

(McCabe *et al.*, 2003). The levels of organisation and educational objectives of schools also determine the extent that success is achieved in the use of CAL in schools (MacArthur *et al.*, 2003). Also, individual differences between learners and school contexts determine the extent of success achieved in the use of educational technologies (Wilson *et al.*, 2001).

A deeper exploration into the advantages of CAL use follows, structured under the following main headings:

- Pedagogical Benefits
- Logistical Benefits
- Cognitive Benefits
- Social Benefits.

2.2.5.2.1 Pedagogical Benefits

2.2.5.2.1.1 Learner Centred Education

2.2.5.2.1.1.1 Student Centred Learning

The use of CAL creates a more student centred learning environment, where learners participate actively in taking responsibility for their own learning, and teachers move from being ‘the sage on the stage’ to being ‘the guide on the side’ (Bloom *et al.*, 2002). Learners using CAL:

- are able to work at their own pace (Baillie *et al.*, 2000; Christensen *et al.*, 1998; Lelouche, 1998)
- have more choice in the time, setting, content and method of presentation of courseware (Christensen *et al.*, 1998; Lelouche, 1998)

- have more control of the learning process (Hitchcock, 2000; Merrill *et al.*, 1996; Owen *et al.*, 1998; Valdez *et al.,* 2004).

2.2.5.2.1.1.2 Individualised Instruction

CAL systems allow the flexibility to individualise instruction to accommodate the individual differences between, and the individual needs of, learners (Bloom *et al.*, 2002). CAL is used to individualise instruction in the following ways:

- the method of presentation of information can be customised to meet learners' preferences and needs (Christensen *et al.*, 1998; Eom *et al.*, 2000; Wiley *et al.*, 2001)

- the depths and level of content can be customised to suit each learner's level of knowledge or educational goals (Christensen *et al.*, 1998; Forsyth, 2001; Hitchcock, 2000)

- some CAL software is able to give immediate, individualised feedback, to guide learners through instructional content (Merrill *et al.*, 1996).

2.2.5.2.1.1.3 Different Learning Styles

As instructional multimedia provides stimulation in many different audiovisual formats, it appeals to a greater audience and therefore caters for the many diverse learning styles of learners (Bloom *et al.*, 2002). Varieties of CAL software are also able to evaluate learners' abilities and learning styles, provide styles of lessons to suit learners' learning styles, change lessons to suit each learner or address the learner in a level of language that would ease learning (Baillie *et al.*, 2000; Christensen *et al.*, 1998; Lelouche, 1998).

2.2.5.2.1.2 Interactive Learning

2.2.5.2.1.2.1 Technological Interactivity

2.2.5.2.1.2.1.1 Interactive Learning Experience

The use of CAL promotes higher levels of interactivity between learners and the computer medium in the following ways:

- varieties of CAL software are able to provide feedback on learning progress, and adapt learning material to suit the ability and preferences of each learner based on ongoing assessments of learners' progress (Christensen, 1998)

- some CAL systems have the capability to provide real-life simulations and interactive tutorials that provide learners the opportunity to experience and interact with real-world environments prior to entering these situations in reality (Baillie *et al.*, 2000; Forsyth, 2001)

- as learners are more active in their learning activities when using CAL systems, they are able to navigate through information and resources on their own initiative and direct their own lessons based on the content and tasks that best suit their level of understanding and interest (Lelouche, 1998; Wiley *et al.*, 2001).

2.2.5.2.1.2.1.2 The Use of Multimedia

Varieties of CAL that use multimedia create appealing and interesting environments for learning and investigating to take place (Bloom *et al.*, 2002). The use of multimedia creates a shift from the over-reliance on verbal communication, and present an expanded sensory learning experience through the use of audio-visual learning components (Baillie *et al.*, 2000; Bloom *et al.*, 2002; Owen *et al.*, 1998; Wiley 2001). The use of hypertext and hypermedia allow for non-linear and dynamic exploration of educational content and add depth and interactivity to student-centred learning situations

(Bloom *et al.*, 2002; Valdez *et al.,* 2004). As learners become more active in their learning, the use of multimedia helps to communicate abstract principles to learners in a realistic and expanded way (Wiley, 2001).

2.2.5.2.1.2.1.3 Access to Information

The use of educational technologies allows rapid, easy and increased access to a wide variety of information resources (Baillie *et al.*, 2000; Lelouche, 1998; Valdez *et al.,* 2004; Wiley 2001) that learners are able to navigate and extract according to relevance to the subject matter (Wiley, 2001). Information collected can be stored locally and adjusted to suit particular educational needs (Lelouche, 1998) and sorted or organized as required (Valdez *et al.,* 2004). Increased access to information allows for quicker and more valid synthesis and analysis of information (Baillie *et al.*, 2000; Valdez *et al.,* 2004).

2.2.5.2.1.2.2 Social Interactivity

2.2.5.2.1.2.2.1 An Electronic Learning Community

The use of CAL helps to create a peer supported learning community that promotes collaborative learning and participation in educational activities amongst learners (Lai, 1996; Owen *et al.*, 1998; Schrum *et al.*, 1997; Valdez *et al.,* 2004). Learners are found to be more interactive and the levels of integration and communication between learners of different abilities increase (Owen *et al.*, 1998; Valdez *et al.,* 2004).

The levels of interaction also improve between teachers and learners as learners become more interested in, and motivated to use, CAL systems in the classroom (Valdez *et al.,* 2004).

The use of CAL systems also allow learners access to the world beyond school walls and as learners interact with people outside of the school context and explore other cultures and experiences, they become active members in their local and in international communities (Lai, 1996; Schrum *et al.*, 1997).

2.2.5.2.1.2.2.2 Improved Communication

Active participation in CAL systems encourages more communication between learners, and the quality of communication therefore tends to improve (Baillie *et al.*, 2000). The levels of interaction and quality of communication between teachers and learners also tend to improve as interfacing becomes more specific and goal directed (Stinson *et al.*, 2000; Valdez *et al.,* 2004). Thus learners communicate more spontaneously and shy learners feel less threatened to interact in virtual environments (Stinson *et al.*, 2000; Valdez *et al.,* 2004).

2.2.5.2.1.3 Teaching Benefits

2.2.5.2.1.3.1 Positive Effect on Curriculum Delivery

Educational technology creates a greater range and availability of educational methods (Pieters, 2001). Teachers are able to provide learners with a variety of learning settings and methods used to reach the same educational objectives (Pieters, 2001). The impact of CAL frees learners from text based curricula and allows teachers to teach subjects with greater intensity and complexity, therefore enhancing the ways learners learn, and how teachers teach (Pieters, 2001).

2.2.5.2.1.3.2 Solutions Based Teaching Orientation

The use of CAL promotes a solutions based teaching style, promoting creative and problem solving skills in learners as learners are frequently required to correct or solve problems through learning by trial and error and experimentation (Baillie *et al.*, 2000; Lelouche, 1998). The problem-solving process then becomes part of the educational sphere, and focus is placed on educational understanding and mastery than merely providing correct answers (Baillie *et al.*, 2000).

2.2.5.2.1.3.3 Effectiveness Specific to Subjects

The use of CAL has been shown to be effective specifically in the instruction of the following subjects:

- Mathematics (Hitchcock, 2000; McCabe *et al.*, 2003; Pieters, 2001; Swan *et al.*, 1990; Valdez *et al.,* 2004)

- English, and more specifically reading (Hitchcock, 2000; McCabe *et al.*, 2003; Swan *et al.*, 1990)

- Science (Hitchcock, 2000; Pieters, 2001; Valdez *et al.,* 2004)

- Art (Hitchcock, 2000).

Studies show that high levels of effectiveness are displayed at preschool, primary school and secondary school levels, as well as in special education contexts (Hitchcock, 2000). Research also shows that improvements due to using CAL over traditional methods, although occurring for all the subjects listed above, tend to be larger in the instruction of Mathematics (McCabe *et al.*, 2003; Swan *et al.*, 1990).

Some studies, however, indicate that the assertion that the use of CAL improves learners' skills in specific subjects remains inconclusive (Balajthy, 2000). The use of CAL is often assessed by teachers as being inappropriate for the subject they teach (Baillie *et al.*, 2000) and studies measuring effectiveness usually study isolated cases that cannot be generalized to larger populations (Valdez *et al.,* 2004).

2.2.5.2.1.4 Advantages for Teachers

The use of educational technologies have the following advantages for teachers:

- the use of educational technologies frees up teachers' time by automating tasks that would usually be manual and teachers are therefore able to spend more time interacting and providing more individual more individual attention to learners, communicating with parents and recording and reporting learners' progress (Baillie *et al.*, 2000; Hitchcock, 2000; Johnson, 2003; Valdez *et al.,* 2004)

- the use of CAL helps change the traditional role of teachers and teachers are able to shift from merely being providers of knowledge to being able to integrate various resources, methods and content to move towards new learner centred educational objectives for teaching and learning (Baillie *et al.*, 2000; Johnson, 2003)

- the use of CAL increases the productivity and efficiency for both teachers and learners, as teachers are able to administrate, prepare, teach and assess learners and learners are also able to complete tasks at a faster rate and at a higher standard (Housego *et al.*, 2000; Johnson, 2003; Valdez *et al.,* 2004)

- teachers have the opportunity to create more comprehensive and accurate record keeping methods through the use of administrative CAL software, and CAL allows for the quick and professional creation of work sheets, class documents and study guides for class use (Johnson, 2003; Pieters, 2001)

- the use of CAL allows learners to spend more independent time doing practice and reinforcement exercises and teachers are able to spend more time, and provide greater depth and complexity, to the learning and instructional process (Alessi *et al.*, 2001; Hitchcock, 2000)

- it is asserted that the use of CAL improves levels of learning more than traditional methods and therefore provides a more successful and motivated atmosphere within to work (Alessi, 2001).

2.2.5.2.2 Logistical Benefits

The use of CAL provides standardised education that can be created, replicated, updated and distributed quickly and at a low cost (Alessi *et al.*, 2001; Christensen *et al.*, 1998; Wiley, 2001). CAL courseware and information originating from a central source means that the content versions are minimised; quality is controllable; and reporting, evaluation and record keeping may be facilitated centrally (Forsyth, 2001). Methods of CAL delivery are flexible and therefore also allow flexibility in the scheduling of instruction timeframes (Baillie *et al.*, 2000; Merrill *et al.*, 1996).

The use of CAL allows learners to access educational material wherever and whenever computers are available (Alessi *et al.*, 2001; Bloom *et al.*, 2002). The use of online learning facilities also allow learners to access courseware, that is delivered via the Internet, from home or any location that provides access to the Internet (Alessi *et al.*, 2001; Bloom *et al.*, 2002). The use of CAL can also link learners and teachers who are separated by large distances (Valdez *et al.,* 2004).

Despite the initial high cost of CAL implementation, the improvements in learning levels, reductions in learning time and higher pass rates make educational technology cost effective over time and the cost of instruction in complex and resource intensive training may be lowered immediately by switching to CAL delivery systems (Alessi *et al.*, 2001).

2.2.5.2.3 Cognitive Benefits

The following cognitive benefits to the use of CAL are documented in the literature:

- the use of CAL contributes to an accelerated learning rate (Alessi *et al.*, 2001)

- education technology use improves the retention of lesson content (Baillie *et al.*, 2000) and improves learner achievement (Farnsworth *et al.*, 2002; Valdez *et al.,* 2004)

- the use of CAL significantly reduces the time spent learning (Alessi *et al.*, 2001)

- CAL systems tends to attract and maintain high levels of learner interest (Christensen *et al.*, 1998)

- as educational technology is more interactive and learner centred, learners tend to have more positive attitudes to learning (Valdez *et al.,* 2004)

- most CAL systems require learners to be more active in the learning process by gathering, processing, synthesizing and analyzing information, while learning is enhanced and occurs at a greater level of complexity than traditional textbook based methods (Cousins *et al.*, 1993).

2.2.5.2.4 Social Benefits

2.2.5.2.4.1 Positive Social Effects

Some CAL delivery systems, such as simulations, provide realistic and interactive learning experiences that are based on real world associations (Bloom *et al.*, 2002; Valdez *et al.,* 2004). Simulation software is also used when content is potentially harmful and threatening to learn in real life situations, providing a safer but realistic environment in which to learn these skills (Alessi *et al.*, 2001).

The structured nature of CAL materials gives learners the view of content, methods and technological tools as professionals would view it, therefore preparing learners to live in a technological society and work in a technological workplace (Bloom *et al.*, 2002; Forsyth, 2001; Heide *et al.*, 2001; Merrill *et al.*, 1996). Not only do CAL systems help learners develop basic technological skills, but in doing so improve learners' employability after school (Baillie *et al.*, 2000; Heide *et al.*, 2001).

A large consensus in the literature indicates that as the use of multimedia applications make CAL delivery systems more appealing and interesting to use; learners are much more motivated, not only to learn, but to learn content more intently and deeply (Alessi *et al.*, 2001; Baillie *et al.*, 2000; Bloom *et al.*, 2002; Heide *et al.*, 2001; Hitchcock, 2000; Lelouche, 1998; Owen *et al.*, 1998; Schofield, 1995; Valdez *et al.,* 2004; Wiley *et al.*, 2001). However, computer users, especially users of the Internet, are known to become addicted to computer usage by spending large amounts of time on the computer systems that could have effects that are detrimental to health (Wiley *et al.*, 2001).

In general, CAL systems provide learners with a learning environment that they experience as fun and learners that have not succeeded in traditional learning environments often improve when learning on educational technology systems (Bloom *et al.*, 2002; Christensen *et al.*, 1998). Learners usually find themselves more stimulated when using CAL systems and therefore tend to find their work more satisfactory and have more positive attitudes to learning (Forsyth, 2001; Lelouche, 1998; Owen *et al.*, 1998).

2.2.5.2.4.2 Equity

Computer use in classroom contexts create an atmosphere that is less judgemental with less pressure on correct versus incorrect answers and greater focus on functional activities (Owen *et al.*, 1998). Learners using computers individually make errors in private and computer software works patiently at a rate that is comfortable for each learner (Baillie *et al.*, 2000; Merrill *et al.*, 1996).

CAL systems are known to work effectively and help improve learners who have learning and physical disabilities (Alessi *et al.*, 2001; Baillie *et al.*, 2000). The following technological facilities have been created to help learners with visual impairment (Merrill *et al.*, 1996):

- reading machines process electronic data, such as a text passage, and plays the data out loud through speech synthesizers for the user to hear

- voice recognition software and speech synthesisers transfer spoken words into electronic data that is automatically recorded in an required format, such as being typed up as a document

- screen reader software gives a user an indication of what is occurring on a computer screen, in response to the user's navigation and movement, by giving the user feedback through the use of electronic speech

- Braille embossers and translators help Braille users read and generate documents.

The use of educational technology is documented as beneficial for learners with learning and educational disabilities in the following way (Swan *et al.*, 1990):

- the use of CAL is less threatening than traditional teaching contexts that require learners to recite information in class

- CAL software, specifically drill and practise software, provide the opportunity for learners to do extensive practise work

- CAL software are also able to provide feedback and diagnostic information on learner performance and therefore benefit learners who need specific remedial intervention

- CAL systems provide various forms and resources of instructional materials and assist learners who need extra academic support.

However, the difficulty selecting and finding appropriate software for specific special education cases and the lack of appropriate training and classroom management issues has shown to be challenging in the integration of CAL systems for use in special education (MacArthur *et al.*, 2003).

Studies document that learners from economically disadvantaged backgrounds, despite limited access to educational technologies, tend to show the greatest gains from using CAL systems and have shown the ability to successfully learn how to use systems from independent trial and error learning processes (McCabe *et al.*, 2003).

2.2.5.3 **THE DISADVANTAGES OF CAL USE**

2.2.5.3.1 Pedagogical Disadvantages

2.2.5.3.1.1 The Learner

2.2.5.3.1.1.1 Learning Style of the learner

There are a number of limitations when implementing CAL systems (Boles *et al.*, 1999; Brabazon, 2000). CAL systems that provide large degrees of independence may not be suitable to learners who require higher degrees of structure and guidance (Boles *et al.*, 1999; Brabazon, 2000). Another limitation is that students who benefit from traditional and directive methods of instruction may also find CAL instructive systems challenging and unsuited (Rosenberg, 1997). Along with increased pressure to perform on new media, learners' attitudes toward learning are affected along with a general decline in performance (Bussey *et al.*, 2000).

Not all learners have the meta-cognitive ability to assimilate information from a wide variety of sources and to integrate it into existing knowledge (Forsyth, 2001), while the provision of large volumes of information is often assumed incorrectly as the transmission of knowledge (Boyle, 1997).

Criticism aimed at the use of CAL systems in education indicates that the structure of educational technology systems does not suit the properties of human learning, memory and perception (Reyna *et al.*, 2001). It is also not representative of the social and personality features of all learners, creating disparities between the individual characteristics of users and the properties of technology itself (Reyna *et al.*, 2001).

2.2.5.3.1.1.2 The Computer Ability of the Learner

Research suggests that learners who have better computer skills tend to perform better on CAL systems than those who are less experienced (Desai, 2000). Therefore, learners would require developing general computer literacy before engaging in CAL (Bitter *et al.*, 1993). Learners who are inexperienced in using computer systems tend to prefer and perform more successfully when using traditional instructive methods (Wiley, 2001). Thus the learners would find it difficult to accept or master electronic learning methods (Brewer *et al.*, 2001). Literature suggests that learners be exposed to greater degrees of complexity on CAL systems as they become more experienced and learn to see the relevance of technology skills in modern society (Addison *et al.*, 1997).

2.2.5.3.1.2 The Teaching Process

2.2.5.3.1.2.1 Complications in the Teaching Process

Objections to the use of CAL systems in educational contexts specify that technologies are not able to effectively support school curricula which are often changed or amended to fit into the structure and methodology of educational technology, while research still does not comprehensively support that the use of technology enhances student learning (Bloom *et al.*, 2002; Valdez *et al.,* 2004).

The use of computers in technology change the way that learners physically and intellectually orientate to information and instruction, and some learners tend to be more successful that others in adapting to the new learning environments (Valdez *et al.,* 2004). Other research shows that the educational technology learning environment itself is not conducive to a natural learning process (Valdez *et al.,* 2004).

2.2.5.3.1.2.2 A Disruptive Learning Process

The implementation of educational technology in classrooms may be disruptive to the educational flow in the curricula, as learners can easily become distracted from educational tasks by the computers themselves (Cousins *et al.*, 1993) and the use of the technology in itself therefore becomes a special event (Heide *et al.*, 2001). The distraction is increased by the large amount of information and freedom of navigation characteristic of CAL systems and learners often dedicate time to resources that are not relevant to the educational tasks at hand (Brown, 1997).

2.2.5.3.1.2.3 Issues Regarding Assessment

As the implementation of CAL systems are generally costly, schools and educational institutions often feel pressured to find ways to demonstrate its effectiveness to show a positive return on the investment made (Brewer *et al.*, 2001). However, literature suggests that a common perception error made in evaluating the usefulness of CAL systems is the perception that increased productivity implies an increased quality of education, yet research refutes this hypothesis (Mayer, 2000).

Despite assumptions regarding the quality of education, research suggests that it may be problematic to accurately measure learners' performance on tests that are conducted on computers as the scores attained cannot solely be attributed to learners' levels of knowledge (Alessi *et al.*, 2001; Christensen *et al.*, 1998; Johnson, 2003). Many technological and social variables impact on the testing situation, such as individual computer ability and thus have a direct influence on test performance (Alessi *et al.*, 2001; Christensen *et al.*, 1998; Johnson, 2003). As computer software lacks the perception that teachers use when assessing tests, it is unable to provide a holistic and rational evaluative process, particularly to the assessment of essays and large passages of text (Bitter *et al.*, 1993; Johnson, 1993).

2.2.5.3.2 Social Disadvantages

2.2.5.3.2.1 Limited Interactivity

The increased use of computers in the educational context reduces the close interaction between teachers and learners characteristic of conventional teaching methods (Bloom *et al.*, 2002; Cousins *et al.*, 1993). Consequently, the need for individual support, question and answer interaction and for the student group to chat amongst themselves is not always fulfilled in the CAL context (Forsyth, 2001). A lack of interaction often leads to a lack of interest and thus limits the effectiveness of the teaching situation (Forsyth, 2001).

2.2.5.3.2.2 Cultural Implications

In 1994 a South African study into the effectiveness of a newly developed computer-based language-training programme on Zulu-speaking learners provided insight into cultural responses to computer based instructional media (Andrews, 1995). The researchers found that the teaching system and inequalities of the apartheid years had an exceptional impact on many Black adults who were consequently illiterate. Their illiteracy played an influential part in their responses to CAL (Andrews, 1995).

In terms of visual literacy, illiterate respondents struggled to understand images and symbols in two-dimensions, as well as conventional signage, such as no-smoking signs (Andrews, 1995). Specific cultural differences in visual literacy were found when interpreting the meanings of icons and cartoon images on the screen (Andrews, 1995).

The use of high and pure Zulu language that did not take into account the different regional dialects of the learners and the lack of equivalent computer terminology in Zulu made technical explanation difficult (Andrews, 1995).

Despite difficulties at local levels, English which is viewed by many as the predominant language of institutionalised use internationally, generally tends to dominate as the main language of medium in instructional software (McVay Lynch, 2002). Second language users tend to find themselves at a disadvantage when having to learn in their non-mother tongue (McVay Lynch, 2002). Also, most software is produced in the United States of America and Europe, and therefore present foreign-based themes, such as Thanksgiving, that are not understood and irrelevant in outside cultures (Andrews, 1995).

Another study in the cross-cultural impact of learning technologies on Aboriginal people in Australia highlighted the following findings (Hülsmann, 2002):

- the potential for disengagement from the Aboriginal way of life through exposure to educational technologies
- the opportunity of using the Internet to encourage understanding of Aboriginal cultures and develop networks among first world nations' people
- the need for research that identifies Aboriginal learning preferences and solutions for Aboriginal problems.

A research study done on the cultural dimensions of the computer and user inter-face found Geert Hofstede's Dimensions of Culture to be an explanatory base for their findings (Marcus *et al.*, 2000), and echoed the studies discussed above. Hofstede's five dimensions are:

- power-distance
- collectivism versus individualism
- femininity versus masculinity
- uncertainty avoidance
- long versus short-term orientation.

On the bases of these five dimensions the researchers found that considerable differences in the cultural responses to computer interface design do exist, specifically in the use of metaphors and graphics and consequently the interaction between respondent and computer (Marcus *et al.*, 2000).

2.2.5.3.2.3 Implications for Teachers

Studies show that the lack of teacher training in computer literacy is one of the key elements that hinder the successful integration of CAL into schools (NCETDE, 1998). Therefore, as CAL systems are implemented into the school context, teachers will require extra time and effort in learning how to effectively use the new systems (Brown *et al.*, 1996; Cousins *et al.*, 1993; Johnson, 2003). Above computer proficiency, teachers will be required to adopt a new and integrated approach to lesson execution, planning how to use CAL to deliver the educational objectives set out in the teaching curricula (Brown *et al.*, 1996); spend extra time creating additional study units that are meaningful for learners, relevant and require the use of higher level thinking skills (Johnson, 2003).

However, there are widespread predictions that the mass introduction of educational technologies into schools and educational institutions will result in the downsizing of teaching staff, as teaching processes become more automated on computer systems (Mayer, 2000; Rosenberg, 1997).

2.2.5.3.2.4 Censorship Issues

When learners have access to the Internet, teachers are unable to censor material that is available to users and learners are able to have access to questionable and harmful elements, such as pornography (Brown *et al.*, 1996; Rosenberg, 1997).

2.2.5.3.2.5 Copyright Issues

Internet users have access to a vast range of articles, reports and books many of which has been illegally scanned and placed on the Internet (Brown *et al.*, 1996). As users are able to gather references off the Internet, they could be using illegal documentation without knowing it (Brown *et al.*, 1996). However, users also have the freedom to use documentation off the Internet and claim it as their own work, which is challenging for teachers to verify due to the vast nature of the Internet (Brown *et al.*, 1996).

2.2.5.3.2.6 Equity

As affluent schools tend to have more computers and educational technology resources, learners in less affluent and poorer schools find themselves at a disadvantage as they do not develop the skills or benefit from the use of CAL systems thereby receiving an education of lower quality (Brown *et al.*, 1996; Rosenberg, 1997; Schofield, 1995). After school, learners who have had no exposure to using computer related activities also find themselves disadvantaged when finding work or attending tertiary education institutions (Brabazon, 2000; Hobson *et al.*, 1998).

2.2.5.3.3 Cognitive Disadvantages

The belief that the introduction and availability of computers themselves automatically translate to educational benefits is an unfounded error in perception, and similarly, it is often assumed that allowing learners access to vast amounts of information itself would provide educational benefits (Boyle, 1997; McVay Lynch, 2002). However, research studies indicate that regardless of the medium used, the learning objective and therefore the learning activity is the more substantial predictor of educational success (Housego *et al.*, 2000).

Learners often have to spend time on inappropriate and needless material while engaging in CAL activities, and the provision of too much information often leads to misinterpretation, misunderstandings or learning out of scope of the educational objectives (Boyle, 1997).

2.2.5.3.4 Regarding Information Technology

2.2.5.3.4.1 Information Technology Progress

The field of ICTs progresses at a rapid rate, and systems become outdated and eventually obsolete in short periods of time (Richard, 2003). Schools are thus unable to keep their technologies updated due to a lack of funding (Richard, 2003).

Also, due to the progressive nature of ICTs, researchers are unable to evaluate the effectiveness of CAL systems in time for their implementation as systems change before research is completed (Mayer, 2000). As a result, CAL systems in schools generally tend to be outdated (Mayer, 2000).

2.2.5.3.4.2 Computer Use as a Tool

Criticism aimed at the use of CAL, claims that the use of technology involves the substitution of impressive graphics and presentations in place of sound teaching strategies and thought, and though intended to attract the attention of learners, often means that learners are distracted by the ‘bells and whistles’ of CAL software (Christensen *et al.*, 1998; Cousins *et al.*, 1993; Mayer, 2000). Learners tend to wander off task as the parameters of computer use extend beyond the tasks at hand, and the distractions often cause setbacks in learning (Christensen *et al.*, 1998; Cousins *et al.*, 1993).

Instructional software usually rewards learners who perform activities correctly with some form of entertaining graphics and animations (Bloom *et al.*, 2002; Loschert, 2003). Critics feel that this process has no educational benefit and equates to merely watching images on screen, such as watching television or reading comic books (Bloom *et al.*, 2002; Loschert, 2003). As a result, learners tend to focus on the computer itself rather than the educational content and learners are at risk of having lower levels of knowledge retention (Hobson *et al.*, 1998). Also, such CAL systems dedicate more focus to teaching basic skills at the expense of higher order thinking skills (Bloom *et al.*, 2002). Critics term the implementation of such forms of educational technology in schools as 'computer delusion', as research remains unconvincing regarding its effectiveness despite the widespread belief that it is so (Balajthy, 2000).

2.2.5.3.4.3 Computer Software and Hardware

In general, there is a lack of appropriate educational software as there is a shortage of people skilled in both the fields of education and information technology to create effective and relevant software (Alessi *et al.*, 2001; Baillie *et al.*, 2000). Software is usually not developed with the teacher in mind, but is marketed to teachers as being based on sound pedagogy (Alessi *et al.*, 2001).

Criticism aimed at software developers highlights that software is usually not developed based on sound and coherent educational theories, or developed and researched to suit the abilities and characteristics of the intended users, but developed from the basis of little and usually inadequate research (Christensen *et al.*, 1998). The result is an operational incompatibility between users and educational software (Reyna *et al.*, 2001).

Software that is programmed with pre-determined and directive navigation has been challenged as ineffective teaching tools, as merely following set sequences in rote fashion does little to promote creativity, independent thinking and learning skills (Hobson *et al.*, 1998; Morrison *et al.*, 1999). Linear approaches in educational software also make no compromise for learners' individual learning preferences, styles and level of understanding (Lelouche, 1998).

Research performed on the effectiveness of multimedia applications in educational technology show little convincing evidence, yet literature claims to support the integration of multimedia in educational software (Alessi *et al.*, 2001; Mayer, 2000; Reyna *et al.*, 2001). Software developers do not necessarily match the correct tool to the appropriate educational outcome and the use of colour and other multimedia have become common to replicate tasks where textbooks and conventional media remained just as effective in black and white (Bloom *et al.*, 2002; Christensen *et al.*, 1998).

2.2.5.3.5 Logistical Disadvantages

2.2.5.3.5.1 Computer Implementation

Both teachers and learners have limited access to computers in the school context. Because of budget constraints there are limited numbers of computers in schools, which, when divided by the number of pupils, usually allow on average around 20 minutes of weekly individual computer use per learner in schools with moderate computer facilities (Johnson, 2003; Loschert, 2003). Educational tasks therefore become dependent on the availability and access of computers and teachers are forced to compromise opportunities to achieve both the educational and technological benefits for learners, often to the detriment of the educational objectives (Brown *et al.*, 1996).

As computers are usually set out in separate computer labs (as opposed to in classrooms) computers also have a lesser chance of being integrated into the educational process (Bitter *et al.*, 1993). Therefore the active and exploratory learning styles proposed by CAL theories therefore cannot emerge in school systems where learners become passive respondents in limited and rigid computer access opportunities (Addison *et al.*, 1997).

There is general disagreement on how computers should be implemented in schools (Alessi *et al.*, 2001). However, research shows that schools tend to implement educational technology practises before investigating whether and how the technology will be used to its full capacity, or what the human and educational impact would be on learners and teachers (Hobson *et al.*, 1998; Hugo, 2002; McCabe *et al.*, 2003). Schools usually are persuaded by impressive sales presentations, and implement educational technology systems before giving thought to the consequences, while systems often consequently remain unused (Christensen *et al.*, 1998; Schofield, 1995).

2.2.5.3.5.2 Logistical Issues

In general, the use of computer technologies in the educational context is considered to be a time consuming exercise, as technical problems, lower levels of computer ability and complex operational software cause constraints in available teaching time (Baillie *et al.*, 2000; Bloom *et al.*, 2002; Mayer, 2000; Richard, 2003).

The implementation of CAL systems are costly and concerns whether the benefits of CAL implementation weigh up to the financial investment required are indicated in the literature (Draper *et al.*, 2002; Mayer, 2000). Costs involve purchasing computer hardware and software and often include securing telephone lines, modems, Internet service providers and time spent online when adding the use of the Internet into the CAL resource bank (Brown *et al.*, 1996). In some cases, the cost of individual tuition may be increased as learners bear the financial burden for heavy technology related costs (Brabazon, 2000).

Schools often implement systems before considering whether the availability of technical support and the school infrastructure are able sustain and maintain the ongoing operations of the computer systems (Baillie *et al.*, 2000). With insufficient technical support, faulty equipment will often remain so for long periods of time as schools generally do not have staff who are able to provide such a service, and outsourcing is be costly (Heide *et al.*, 2001; Richard, 2003).

2.2.6 CAL VS TRADITIONAL TEACHING METHODS

At a structural level, traditional classrooms tend to have desks or tables set out in rows that face a chalkboard or white board at the front of the classroom (Stinson *et al.*, 2000). In electronic classrooms, tables tend to be spread out with computers systematically setout, allowing an individual user, or a small group of users to sit in front of each work station (Stinson *et al.*, 2000). A teacher's work station is usually located at the front of the class and computers are usually connected by networking systems (Stinson *et al.*, 2000). Other media available in electronic classrooms are stereo sound systems, CD players, microphones, scanners, laptops, video and data projectors and digital cameras (Stinson *et al.*, 2000). However, budget constraints usually do not allow schools to purchase more computer equipment than is required and systems tend to be basic and often outdated (Franklin *et al.*, 2002).

CAL methods usually propose an open learning approach to education, developing learners' problem-solving and higher order thinking skills through explorative, experimental and discovery learning (Kotze *et al.*, 1996). Tasks performed on CAL systems vary from highly didactic instructional software that evaluates learners in an ongoing fashion to direct the instructional content appropriately, to very open ended discovery learning methods where learners are able to choose and direct their own educational navigations through content and courseware and have more control in the instructive process (Kotze *et al.*, 1996). However, learners require regular access to computer systems and traditional methods tend to be used due to the cost and complexity of integrating technology into the educational context (Heide *et al.*, 2001). Traditional teaching approaches tend to be linear and directive and learners are dependent on teachers and instructors for guidance and direction (Kotze *et al.*, 1996). Traditional teaching methods focus on the systematic acquisition and ultimately retention of pre-defined knowledge and skills (Kotze *et al.*, 1996). Learners display proficiency in levels of understanding of taught material, are evaluated at regular intervals to display levels of performance, and are usually directed educationally based on overall performance (Kotze *et al.*, 1996).

Most studies comparing the efficiency of CAL and traditional teaching methods produce unreliable results, as researchers usually do not experimentally provide control for all impacting design variables (Hitchcock, 2000). However, results of the research studies performed show varied stances on the educational effectiveness of both computerised and conventional education. Computerised education is shown to be as effective as traditional classroom education and learners tend to demonstrate similar test scores when tested in each context (Brewer *et al.*, 2001; Franklin *et al.*, 2002). Evidence also does not support or negate the proposition that face to face education is the optimal teaching method (Brewer *et al.*, 2001). However, other studies show that levels of educational efficiency improve by four times when learning with educational technology (Andrews, 1995). Literature indicates the following aspects where CAL tend to show improvements in levels of efficiency over traditional teaching methods:

- in general, motivation and attitudes toward learning improve (Desai, 2000; Hitchcock, 2000)

- learners using educational technologies often demonstrate a deeper understanding of the lesson content, and tend to grasp abstract and theoretical concepts more easily (Baillie *et al.*, 2000)

- learners experience more retention of information when using educational technologies (Baillie *et al.*, 2000)

- learners are able to continue their studies and instruction out of school wherever they have access to computer systems, and the Internet when required, that increases their scope of inquiry (Pieters, 2001)

- learners develop the ability to effectively work both independently and collaboratively when using education technologies (Pieters, 2001)

- interacting with CAL systems is shown to improve higher order thinking skills, creativity and problem solving skills (Owen *et al.*, 1998)

- the use of CAL provides learners with more practical experiences than traditional teaching methods (Baillie *et al.*, 2000)

- CAL systems improve the productivity of teachers and learners (Heide *et al.*, 2001)

- the use of CAL systems enhance the development of literacy and mathematical skills (Owen *et al.*, 1998).

Literature, however, indicate the following ways that traditional teaching methods tend to be more efficient than CAL methods:

- traditional teaching methods tend to be more targeted to achieving concrete educational gains as set out by educational objectives (Balajthy, 2000)

- teachers using CAL methods tend to do little planning for lessons (Balajthy, 2000)

- CAL methods tend to focus on the completion of tasks and often do not suit the lesson content or educational objectives (Balajthy, 2000)

- computers are often used for their motivational value that have no relevance to the educational outcomes (Balajthy, 2000)

- CAL methods are costly to implement and usually are not used to their full capacity (Franklin *et al.*, 2002)

- CAL systems are often not governed by the same educational theories as educational objectives and teaching tasks require (Overbaugh, 1994)

- learners require high levels of computer literacy to make effective use of CAL systems (Baillie *et al.*, 2000)

- it takes time to develop CAL based materials and there is known to be a lack of effective and appropriate CAL software in the educational technology field (Baillie *et al.*, 2000).

Research indicates that, despite the extensive literature on the benefits of traditional education and CAL learning systems, in reality the use of both methods in an integrated format tends to be the ideal for making the best of both worlds (Desai, 2000). In the traditional educational structure, the three entities of the learner, teacher and domain of knowledge interact in various forms in the instructional context (Kotze *et al.*, 1996). In the electronic educational structure, the computer mediates between the three entities, facilitating various educational tasks such as instruction, testing and assessment at different levels of involvement (Kotze *et al.*, 1996). The use of information technologies in the educational context therefore can automate and enhance certain educational tasks that benefit the learning experience, providing access to facilities that would be logistically impossible to utilise from classrooms (Alessi *et al.*, 2001).

However, despite the impact of technology on the teaching situation, learners usually prefer the presence of a teacher or instructor in the classroom (Desai, 2000). Also, the use of CAL systems that incorporate the structural benefits of traditional teaching methods, tend to provide the most success in the educational context (Overbaugh, 1994).

2.2.7 **THE FUTURE OF CAL**

2.2.7.1 The Progression of Computer Technology

As society becomes more dependent on information technology, the skills that the job market require from learners, university graduates and educational curricula, has changed (Johnson, 2003). The ability to actively solve problems, work collaboratively, assess and utilise information from a variety of resources and communicate effectively (above the rote acquisition and retention of knowledge) have become the skills that will enable learners to succeed in the work environment after school (Johnson, 2003).

Literature suggests that as computer systems become integrated into the field of education, learners and teachers will become more reliant on the resources and communication abilities made available through the use of ICTs (Bloom *et al.*, 2002). The media traditionally used for instructional purposes will evolve, as computers become increasingly available in schools, and schools become more dependent on technology (Johnson, 2003).

However, the degree of implementation and use of computers is affected by the levels of wealth of individual schools or educational institutions, between highly populated urban areas and geographically isolated rural areas, and at a broader level between affluent developed countries and developing countries (Ishaq, 2001). It therefore becomes apparent, as technology continues to progress more rapidly, that learners who are not exposed to educational technology are at a disadvantage compared to learners who have high levels of computer literacy and who tend to adapt better in tertiary institutions and in work environments (Ishaq, 2001). As schools, rural areas or entire countries lag behind technologically, levels of poverty and lack of development may continue or worsen as the world becomes more reliant on technology (Ishaq, 2001).

2.2.7.2 The Future of CAL in Schools

As teachers and instructors become more pivotal in integrating educational technology into schools and classrooms, teacher training will become more technology oriented (Opitz *et al.*, 1998). Teachers who have already received teacher training, and who are not computer literate will require intensive and ongoing training if all teachers are to use technology in delivering curricula (Opitz *et al.*, 1998).

As teachers make use of technology, they will require increased access to greater varieties of information than in traditional education (Johnson, 2003). Teachers' traditional lesson planning and development roles will therefore become more complex as teachers become proficient in the varieties of electronic media become available for instructional use as teachers constantly evaluate, manage and utilize information used and included in lesson content (Johnson, 2003). Also, as educational technologies allow learners to become more autonomous, independent and responsible in their learning, teachers' roles will become less directive as characteristic in traditional teaching and more facilitative through providing guidance and assistance (Lelouche, 1998).

The ways that schools are administrated will also evolve, as schools are urged to be accountable for and keep detailed electronic records of school marks, student achievement, attendance records, personnel records, budgeting and expenditure (Johnson, 2003). Also, as schools become more competitive, the active use of information, multimedia and Internet capabilities provide schools with the facilitative and communications tools to manage the schools and deliver curricula more professionally (Johnson, 2003).

Finally, the congregational nature of schools will become less necessary for instruction as Internet capabilities allow learners to increasingly access information and courseware at a time and place that suits them (Lafee, 2001). Learners will congregate at institutions to avoid the isolation of learning through technology and from long distances and take part in facilitative and group activities that require face to face contact (Lafee, 2001).

2.3 CAL, LEARNERS AND TEACHERS

2.3.1 THE RATIONALES FOR USING COMPUTERS IN SCHOOLS

Hawkridge (Cousins *et al*., 1993) suggests four rationales for the use of computers in schools:

- the social rationale; with the aim of familiarising learners with the use of computers due to the perceived importance of computer use in society
- the vocational rationale; implying the need to prepare learners with computer literacy and skills for the purpose of finding employment after school
- the pedagogical rationale; with the purpose of improving the delivery of education and assisting the learning process through the use of computers
- the catalytic rationale; supporting the perception that computer usage enhances the overall performance of schools in the facets of teaching, learning, administration and management.

Literature, however, indicates that schools tend to use computers more in administration and management capacities, than for teaching purposes (NCETDE, 1998). Although there have been attempts to integrate the use of computers into the teaching curriculum in South Africa, the focus of computer use in a teaching capacity has been reserved to the transference of computer literacy and skills, where computers are secluded in computer labs (NCETDE, 1998). However, the use of computers, specifically in the subject areas of Mathematics, Science and Technology, are believed to provide an opportunity to transform the way that teaching and learning takes place within the classroom context (Pieters, 2001). The use of computers in schools allows users access to vast learning resources through the Internet and other commercial networks (Schrum *et al*., 1997). This allows schools that are isolated to benefit equally from electronic resources despite geographical and socio-economic challenges (Schrum *et al.*, 1997). Schools generally are also beginning to understand the potential of computers as tools for accomplishing varied educational and pedagogical ends as opposed to delivery devices or objects of study (Hobson *et al.*, 1998; Schofield, 1995). Taylor (Cousins *et al.*, 1993) suggests the following three features of the use of the computer as a tool to fully realise its potential:

- state resurrection, that implies the ability to swiftly revise existing documents

- time compression, that refers to the ability of the user to complete tasks quickly that were usually manual and tedious

- the graphical representation of information that enhances the level of visual stimulation and interpretation from the user's perspective.

Taylor purports that such an interaction not only speeds up the learning situation, but allows the user to spend more time creating new knowledge, rather than stagnate at accessing prior knowledge (Cousins *et al.*, 1993). Computers also provide the facility to use specific cues to assist in maintaining learner attention and improving memorisation through the use of graphics, sound and other multimedia, while using mnemonics to assist in problem-solving and critical thinking (Overbaugh, 1994). The use of computers as tools are also known to reduce anxiety of learners toward technology as a whole, while the use of personalisation functions helps to maintain learners' interest and motivation in the learning situation (Overbaugh, 1994).

Within the context of educational management, computers provide automation to routine procedures such as creating class lists, work scheduling and record keeping, removing the tediousness and time-consuming practises of doing so manually (NCETDE, 1998). This allows educators to use their time more productively and helps schools to keep their costs at a minimum. Computers, however, can only enhance an existing successful management practise, and cannot substitute a management and administrative practise that is malfunctioning (NCETDE, 1998). Computers also allow educators to communicate and share resources over long distances with other schools and teachers, local communities and parents, as well as other professionals in relevant study fields via facilities such as e-mail (Schrum *et al.*, 1997).This therefore creates social networks to prevent the isolation associated with teaching (Schrum *et al.*, 1997).

2.3.2 **THEORIES OF EDUCATIONAL PROGRAMMING**

The underlying beliefs of how instruction should occur are demonstrated in the documented learning theories, and reflect the way that educational technologies are designed and developed (Semple, 2000). The unique learning theories are the foundations for the development of instructional theories are documented as being the behavioural learning theory, the cognitive learning theory and the constructivist learning theory (Christensen *et al.*, 1998). These theories stem from pedagogical bases of behaviourism, cognitivism and constructivism respectively (Christensen *et al.*, 1998). The latent learning theories of instructional and educational technologies determine:

- the extent that focus is placed on either the individual cognitive structures or the homogenous social structures among learners (Christensen *et al.*, 1998)

- the extent to which control has been allocated to the learner versus the software (Semple, 2000)

- the level of complexity of the software content and processes (Semple, 2000)

- the range of activities that need to be performed (Semple, 2000)
- the intrinsic rewards offered to learners when tasks are completed successfully (Semple, 2000)
- whether learning occurs from the actions of performing certain required tasks or from the understanding of underlying reasons and concepts of educational material (Kotze *et al.*, 1996).

Literature suggests, however, that the advanced level of knowledge regarding learning processes mostly remain absent from educational software, while attempts to translate learning theories accurately and relevantly into instructional methods usually result in inaccurate variations of the original theories (Christensen *et al.*, 1998). This is because various sub disciplines continue to disagree on the emphasis of learning theories, while learners and users who stand to benefit for instructional theories usually remain absent from the developmental process (Christensen *et al.*, 1998). The ideal attempt to match learners' individual cognitive learning styles to the style and format of instructional material has often proven to be successful (Boles *et al.*, 1999).

The following suggestions are therefore made to improve the levels of integration of learning theories into the development of educational software (Christensen *et al.*, 1998):

- the active exploration and recognition of the varieties of ways that instructional components can be developed
- basing the development of educational technologies on established learning theories
- collaborating with experts who have experience in learning and instructional theories when designing educational technologies

- networking with other instructional software developers to explore and share alternate methods and ideas.

2.3.2.1 Computer Instructional Theories

2.3.2.1.1 Behavioural Learning Theory

On their basic premises, Behaviourist Theories are based on the psychological theory of behaviourism whose major proponent was B.F. Skinner (Alessi *et al.*, 2001; Valdez *et al.,* 2004). The study of behavioural psychology maintains that learning is explained by changes in the observable behaviour of learnt subjects that occur as a function of specific events and situational factors in the environment (Alessi *et al.*, 2001). With reductionism as its central feature, behaviourism focuses on the study of observable behaviour, bound by operationally defined behavioural targets and sees cognition as a by product of learning rather than as an explanation as to why learning occurs (Boyle, 1997; Kotze *et al.*, 1996).

In the educational context, the behavioural learning theory involves controlling the behaviour of learners to control the amount and complexity of learning levels (Brown, 1997), and therefore involves the following process:

- the pairing of learner responses to specific instructional stimuli (Brown, 1997; Kotze *et al.*, 1996)

- repetitive behavioural processes (Kotze *et al.*, 1996)

- frequent and consistent feedback on learning progress (Kotze *et al.*, 1996)

- the reinforcement and extrinsic reward of desired behaviours (Kotze *et al.*, 1996)

- the achievement of learning success when the desired observable changes in behaviour have occurred (Kotze *et al.*, 1996).

The use of drill and practise software and branching software are most characteristic of behavioural based educational computing systems that include the use of positive and negative feedback to learners who progressively master simpler tasks before more complex ones and who are able to work at their own pace (Alessi *et al.*, 2001; Kotze *et al.*, 1996).

2.3.2.1.2 Cognitive Learning Theory

Cognitive educational theories propose that learning is viewed as making symbolic, mental constructions involving active mental processing on the part of the learner (Boyle, 1997). While our senses provide us with information regarding the environment, learning occurs in the rational structures of the brain that enable learners to acquire knowledge by making sense of the world around them (Boyle, 1997). Cognitive learning theory, therefore, focuses on latent thought processes (Kotze *et al.*, 1996). This theory views learning as the ability of learners to perform internal cognitive processes such as thinking, remembering, conceptualising, classifying and problem solving, while emphasis is placed on relative concepts rather than individual facts (Kotze *et al.*, 1996).

The aspects of cognitive learning most relevant to the development of cognitive based educational technologies include:

- perception and attention (Alessi *et al.*, 2001; Kotze *et al.*, 1996)
- the encoding and structuring of information (Alessi *et al.*, 2001)
- memorisation and memory (Alessi *et al.*, 2001; Kotze *et al.*, 1996)
- comprehension (Alessi *et al.*, 2001; Kotze *et al.*, 1996)

- active learning and locus of control (Alessi *et al.*, 2001; Kotze *et al.*, 1996)

- motivation (Alessi *et al.*, 2001; Kotze *et al.*, 1996)

- metacognition and mental models (Alessi *et al.*, 2001)

- the transfer of learning (Alessi *et al.*, 2001; Kotze *et al.*, 1996)

- individual and unique differences (Alessi *et al.*, 2001; Kotze *et al.*, 1996).

The learning activities of discovery, the use of prior knowledge, relative instructional content and active learning are therefore seen as relevant cognitive learning activities (Kotze *et al.*, 1996).

Computers are thus seen as cognitive learning tools that magnify human psychological abilities, such as memory, rather than as media of instruction (Semple, 2000). Activities performed on a computer are considered as ‘inauthentic labour’, while the learner invests the extra available energy into vital mental processes, referred to as ‘authentic labour’ (Semple, 2000). The learner is thus able to think deeply about the content studied on the computer, while learning through the use of similar processing methods as the computer (Semple, 2000).

Cognitive computer functions include (Semple, 2000):

- the use of databases, that systematically store information, and can be manipulated in required ways

- the use of word processors, that can manoeuvre text and graphics

- data logging software that can store meaningful information over time.

The relationship between the learner and a computer is active; the locus of control being more with the user than the programme and the learner is able to express his or her thinking and organise information and knowledge through the use of computer related tools (Semple, 2000). Learners therefore construct their own knowledge individually and merely present their own models of understanding by working and rearranging the conceptual models on the computer (Semple, 2000).

Different approaches to cognitive based learning are demonstrated in literature (Schar *et al.*, 2000). An explicit learning mode involves rational thought, selective and conscious attention and learners are required to observe, evaluate and explain the relative movements between a numbers of variables in the learning environment (Schar *et al.*, 2000). This is characteristic of problem solving learning (Schar *et al.*, 2000). On the other end, an implicit learning mode involves an unconscious learning process that conveys abstract knowledge, where learners have the freedom to explore a group of variables in the learning environment creating patterns and similarities between variables (Schar *et al.*, 2000). This is characteristic of trial and error learning (Schar *et al.*, 2000). Surface approaches involve the short term retention of learnt facts, while deep approaches involve a change in a learner's level of understanding in some significant way (Housego *et al.*, 2000).

2.3.2.1.3 Constructivist Learning Theory

Constructivist theories find their origin in Piaget's theory of cognitive development (Semple, 2000). Piaget proposed that when learning, children construct their own knowledge (Semple, 2000). Although Piaget's theory came under criticism, it still had an influence on educational thinking and the development of educational software (Semple, 2000).

On its basic premise, constructivism declares that knowledge is constructed by learners, involving the use of their existing knowledge, attitudes and levels of understanding (Alessi *et al.*, 2001; Brown, 1997). More specifically, literature defines constructivism as involving (Brown, 1997: 5):

"... the belief that knowledge is personally constructed from internal representations by individuals using their experience as foundation…[while]

knowledge is based upon individual constructions that are not tied to any external reality, but rather to the knower's interaction with the external world…[and therefore] reality is to a degree whatever the knower conceives it to be."

Constructivism therefore proposes that, it is not only the existing knowledge and learning that children carry when learning, but the individual characteristics of the learner who influences the learning situation (Semple, 2000). Individual characteristics include (Semple, 2000):

- cultural and social background
- values and beliefs
- motivation and expectations
- environmental influences
- computer based skills
- learning styles.

The characteristics of constructivist learning are summarised as follows (Semple, 2000):

- knowledge is constructed from the learner's experience and therefore resides in the mind of the learner as opposed to an external entity (French *et al.*, 1999; Semple, 2000)
- learners' personal beliefs and values influence their interpretation of the world around them (Semple, 2000)
- the act of learning is active in that meaning is made from experience and involves a process of reflection and elaboration (French *et al.*, 1999; Kotze *et al.*, 1996; Semple, 2000)

- the context of learning influences the knowledge gained from learning (Semple, 2000)

- multiple perspectives collectively influence the learning process and debate and exploration is encouraged (French *et al.*, 1999; Semple, 2000)

- constructivist learning techniques give emphasis to the thoughts, actions and autonomy of learners rather than that of teachers; encourage learners to develop and construct information and projects and highlight learner preference and orientation to goals, plans, and assessment methods (Alessi *et al.*, 2001; French *et al.*, 1999)

- constructivist learning techniques use collaborative learning activities that are personally relevant to learners and provide authentic learning activities that are representative of real world experiences (Alessi *et al.*, 2001; French *et al.*, 1999; Kotze *et al.*, 1996)

- constructivist learning techniques support learner reflection, promote learner enquiry and allow time for thought and argument development before responding to queries (Alessi *et al.*, 2001; French *et al.*, 1999; Kotze *et al.*, 1996)

- cognitive learning techniques motivate learners to actively reduce the incongruency between what they observe and what they know, reducing cognitive dissonance by actively seeking greater understanding (Alessi *et al.*, 2001; Kotze *et al.*, 1996; Morrison *et al.*, 1999).

Literature indicates that two approaches to the educational presentation of constructivist learning techniques exist, influencing the development of educational processing, namely (Brown, 1997):

- BIG, meaning ‘beyond the information given’, where learners respond to tasks and instructional problems, having access to information, by working through available information according to their own levels of understanding, after which they are compelled to apply, generalise and refine their levels of understanding

- WIG, meaning ‘without the information given’, learners are not directed according to specific tasks or study problems, but rather investigate various phenomena, while being encouraged to create intuitive hypotheses regarding their investigations, would then explore anomalies and develop a clear understanding without teachers providing direct answers.

In the early to mid 1990s the constructivist learning approach had become influential in the design of educational multimedia, as designers began to focus on learning environments that promoted the construction rather than the instruction of knowledge (Alessi *et al.*, 2001). The computer applications most suited to a constructivist learning approach include:

- Word processing software (Brown, 1997)

- Databases (Brown, 1997)

- Spreadsheet software (Brown, 1997)

- Graphics programmes (Brown, 1997)

- General multimedia authoring tools that integrate images, graphics, text passages, animations, audio features and video clips (Semple, 2001)

- the use of electronic communication such as e-mail (Semple, 2001)

- the use of hypertext systems, such as that on the World Wide Web (Boyle, 1997).

In terms of the benefits of using constructivist learning systems, literature indicates that the use of constructivist learning systems help engage and motivate learners as they become more involved in active learning activities, such as exploring and inquiring, while participating at higher levels in the instructional and learning process (Valdez *et al.,* 2004). The use of constructivist learning tools also allow for open ended learning, while allowing for the creation of new learning materials in the learning process and creating greater opportunities for collaborative learning (Valdez *et al.,* 2004). Constructivist learning systems also allow greater opportunities for thinking and reasoning, reflection, analysis and synthesis, process and critical writing and general communication (Semple, 2001).

Regarding the limitations of using constructivist learning systems, literature suggests that as most teachers were trained to teach in more directive and prescriptive methods (rather than facilitative) and may be challenging to implement on a large scale without some formal training (Brown, 1997). More specific to the approach itself, learners who are educated in a constructivist teaching system are difficult to assess as focus is placed on the individual construction of knowledge, rather than the acquisition of objective knowledge, and has to be performed through observational and dialogue based assessment methods (Brown, 1997; French *et al.*, 1999). There is also insufficient research available on how the brain functions to support that a constructivist method is the most suitable and relevant method to educate learners (Brown, 1997).

2.3.2.1.4 Eclectic Approaches

It is evident that a paradigm shift in teaching and learning is occurring as a result of higher levels of integration of technologies into the education field (Forsyth, 2001). This shift has enabled teachers and learners to effectively utilise technology and access greater amounts and varieties of information (Forsyth, 2001). However, as computer instructional paradigms have evolved, various opinions and general disagreement still prevails regarding the effectiveness and relevance of behavioural, cognitive and constructivist learning methods (Alessi *et al.*, 2001):

- Behaviourists classify cognitive and constructivist learning methods as unscientific as their effects are difficult to observe and measure
- Cognitivists indicate that constructivism is largely based on philosophical principles that remain mostly unproven
- Radical constructivists assert that the use of behavioural and cognitive learning methods remain outdated and ineffective in educational contexts.

Despite various opinions, developers tend to use an eclectic approach to developing instructional software that utilise aspects from all learning paradigms that are matched to relevant instructional objectives and activities (Alessi *et al.*, 2001).

Modern developments in technological learning paradigms have also shown a reversion away from the traditional learning theories, with the rise of theories such as the ontological transaction (Christensen *et al.*, 1998), epistemological (Christensen *et al.*, 1998) and minimalist approaches (Boyle, 1997) to computer instructional design.

Ontological transaction theories rely on the educational objectives to determine how educational material is developed, using the study of entities, activities and processes, in specific sequences and at different levels, to develop instructional material (Christensen *et al.*, 1998). Epistemological theories account for a more integrated and holistic view of learning (Christensen *et al.*, 1998). Epistemological theories, based on philosophical theories of knowledge, claim to create learning material that have a more coherent epistemological basis than traditionally instructive and constructivist approaches. Epistemological theories integrate elaborate philosophical accounts of: the nature of being a person, of knowing something, of learning something, and the meaning of supporting learning, to understand how people develop knowledge from information that is created for a variety of purposes (Christensen *et al.*, 1998). The minimalist approach supports a user centred approach to instructional design, but minimises the amount of overt instructional material to create a more natural pattern of learning by focusing the users' actual natural sense-making tendencies (Boyle, 1997). Learners retain a degree of freedom in accessing learning materials, but learning material is reserved to a modular structure of smaller self contained learning units (Boyle, 1997).

2.3.2.2 Frameworks for Courseware Development

Robert Gagné's book, *The Conditions of Learning*, provided the initial formalisation of learning theory into a computer instructional theory, laying out a highly disciplined procedure to instructional design (Boyle, 1997). Gagné claimed that nine events had to occur in the learning process for successful learning to occur (Brown, 1997; Overbaugh, 1994). In the first domain of learning, referred to as the 'Instructional Set', the following steps occur (Brown, 1997; Overbaugh, 1994):

- Gaining the attention of the learner, which is intended to make learners aware of the lesson's purpose, and is achieved by methods such as presenting some relevant audiovisual stimuli that represent the lesson content, while motivating learners to continue

- Informing the learner of the lesson objective, which is achieved by using a variety of techniques, such as pre-questions, at the beginning of a lesson to create an association between the information to be presented and prior learning and knowledge

- The stimulation and recall of previous learning, which is intended to create a frame of reference in which to acquire new knowledge and to assess whether sufficient prior knowledge exists before moving onto the new learning material.

The second domain of the learning process, known as 'Teaching Strategies', is where the teaching process begins, and is documented as having the following steps (Brown, 1997; Overbaugh, 1994):

- Presenting learners with stimuli that have characteristically distinct features, that involves presenting learners with the pedagogical components of the lesson through the display of the lesson material in a way that maintains the learners' interest, while learners are also presented with the technical component of the lesson that includes the use of visually stimulating and colourful graphics, sound and text that attract and direct the attention of the learner

- Guiding the learning process, is where the system developer presents subsequent information to guide the learner in a systematic and ordered way through the learning material, using contextual elaboration, inquiry and discovery learning techniques to keep learners engaged in the learning process, while systems allow opportunity after learning exposure to practice and review the learning material prior to assessment.

The third domain of the learning process, known as 'Student Performance', is where the assessment process occurs and is documented as having the following steps (Brown, 1997; Overbaugh, 1994):

- Extracting and evaluating learning performance, where learners are electronically questioned throughout the learning process, and responses are judged to make an evaluation of the quality and levels of learning achieved

- Providing feedback that is informative and instructive, aimed at facilitating the learning performance of learners by providing feedback to the evaluation responses that is positive and informative; responses are generally conveyed in simple "yes / no" answers, brief correct answer feedback, lengthy explanatory or bug related identification and logic error formats

- Formally assessing performance levels, that involve final and formal assessments for record and administration purposes

- Enhancing levels of retention and learner transfer, where learners are exposed to learning material of greater complexity and difficulty when returning to learn on the same system, based on the prior formal assessment levels attained.

The benefits to the use of Gagné's behavioural instructional designs include (Kotze *et al.*, 1996):

- the moulding of educational content into the prescriptive method remains relatively straightforward and allows for easy development of educational material

- the learning situation is not complicated by complex cognitive characteristics

- greater reliance is placed on the process of teaching and instruction and more control is exerted by teachers who educate learners in a strictly didactic fashion, ensuring that learning occurs in a controlled situation.

The limitations to Gagné's behavioural learning computer instructional developments are documented as follows:

- the material and content is presented in an unrelated and disjointed fashion and learners are often not able to have a holistic overview of themes and complex material (Brown, 1997)

- the instructional method has a limited range of activities and scope for knowledge acquisition (Brown, 1997)

- the instructional format requires that learners learn in a predominantly passive rather than interactive orientation (Brown, 1997)

- the learner does not experience autonomy and growth when learning in the prescriptive learning context, where the locus of control resides in the computer rather than the learner (Valdez *et al.,* 2004).

Modern instructional models have been created to reflect the changing instructional paradigms that have occurred with the introduction of multimedia systems and the World Wide Web and are characteristic of the constructivist learning theory (Alessi *et al.*, 2001). The general format of modern instructional designs is less complex than, but yet still reflect, Gagné's original design, and are presented in the following process (Alessi *et al.*, 2001):

- Presenting Information, when an initial media centred process that involves the presentation of various forms of information, whether verbal, textual or pictorial, from various sources, usually under the control of the learner

- Guiding the learner, when an interactive process where the learner is guided, either through independent pursuits or by teachers, to refine and isolate specific learning activities to attain the desired learning outcomes

- Practising, where a learner centred approach where the learner is required to demonstrate the level of understanding of information learnt, which places a greater focus on learner practise activity and feedback from teachers is in the form of short corrective statements

- Assessing learning, which involves the assessment of learners through the use of tests and rubrics, to provide information on the levels of learning attained by learners, the quality of the instructional process as well as to identify the future instructional needs

- Presenting Information, involves the recurrence of the process, whether in response to levels of learning attained, or involving new learning material.

Modern trends, however, suggest that while educational theorists tend to support detailed instructional design formats, practitioners operate at less complex theoretical levels that are accepted with a wider audience (Christensen *et al.*, 1998).

2.3.2.3 Educational Programming Procedures

2.3.2.3.1 Design

Instructional design, which is the first stage of educational software development, tends to be the most time intensive, meticulous and thorough process of the development as a whole (Overbaugh, 1994). The success of the educational software relies heavily on whether the design created matches the intended educational goal and therefore whether the software design and the instructional methods presented are compatible (Valdez *et al.,* 2004). In general, the literature lists the following factors as influential to the design period of educational software development:

- the decision on the content of the design and the levels of interactivity that are to be made available to users as well as to what extent they influence the completion of the educational objectives (Overbaugh, 1994; Schar *et al.*, 2000)

- whether the software developers have ethnographic information of the intended software users available and to what extent the software design will create user friendly learning environments that reflect no cultural bias (Hugo, 2002)

- the extent that the developers cater for a fair delegation of textual and graphic representations of information, as research indicates that learners tend to be split between those who are cognitively compatible with textual and verbally presented information, known as verbalizers, and those who are cognitively compatible and learn better from graphically presented forms of information, referred to as imagers (Boles *et al.*, 1999)

- the degree that developers provide learning systems that accommodate learners who have both wholist and analytic cognitive orientations to organizing and integrating information, as learners who are considered as wholists tend to organize information into undefined clusters of information to construct an overall understanding of the information provided, while analytics tend to create clear and specific conceptual groupings of information, focusing on and processing a single information cluster at a time (Boles *et al.*, 1999)

- to what degree developers provide learning systems that cater for learners who have both field dependence and field independence styles of learning, as these, to an extent determine presentation and interface preferences; learners who have a field dependence cognitive style of learning tend to focus on external references, concentrate on the individual aspects of objects and approach problem solving in an intuitive, common sense and trial and error approach, while learners who have a field independence cognitive style of learning focus more on internal references, concentrate on objects in their totality and tend to define and explain problem situations in relation to underlying causal relationships (Chuang, 1999)

- the decision on the use of theoretical based computer interfaces, such as the perceptual, the information processing and / or the constructivist approach, as well as the use of user centred design principles, as the theoretical based approaches have shown to significantly improve learning but have been deemed not user friendly and therefore less accessible to a larger audience, while the user centred approach has a wider spread amongst learners as their levels of complexity is lower but have been shown to demonstrate smaller levels of learning improvement (Schar *et al.*, 2000)

- the decision on the style of feedback content to include in the educational technology systems would effect the programme design, and methods are documented as follows (Schar *et al.*, 2000):

    - verbal feedback, that involves direct communication messages regarding lesson and answer content

    - response feedback, that evaluates the suitability and correctness of an action

    - approach feedback, that evaluates and responds top the task solving strategy chosen

    - motivation feedback, that is aimed at enhancing the levels of effort dedicated to learning activities

    - cognitive feedback, used in a context where learners are able to observe the results and consequences of their orientation and navigations in educational software

- the objectives of the learning tasks determine the system navigation strategy required in educational software, as free structured systems that allow for larger degrees of browsing, such as those characteristic of the hypertext environment of the World Wide Web, and allow for implicit learning methods, while systems that have more structured and nonbrowsing configuration allow for limited manoeuvrability and therefore a more explicit learning orientation (Schar *et al.*, 2000).

2.3.2.3.2 Pre-programming Development

In general, pre-programming development involves three basic steps, namely (Overbaugh, 1994):

- the creation of flow charts and story boards to aid and guide the programming sequence and content

- creating all the initial technical support and instructional materials for the courseware

- reviewing and evaluating the support and instructional material before the programming procedures can begin.

2.3.2.3.3 Programming

The final stage of educational software development involves the actual programming procedures and is considered the most straightforward of the entire development procedure (Overbaugh, 1994). Other design and pre-programming procedures are more involved processes that create very clear guidelines to direct the programming process (Overbaugh, 1994). However, educators without in-depth programming skills are able to develop their own software using authoring systems that minimize the complexity of programming procedures and incorporate user friendly operations (Overbaugh, 1994).

2.3.3 THE LEARNER AND CAL

2.3.3.1 Pedagogical Aspects

2.3.3.1.1 Learner Controlled and Programme Controlled Learning

Literature asserts that, the difference between learner controlled and programme controlled learning is referred to as (Brown, 1997: 1):

> “allowing the learner some control in an individualised lesson… the learner may control lesson pace, sequence, content, or feedback…this is in contrast to program control of Computer Based Instruction, where the computer program controls the flow of the lesson".

Studies on the effects of higher levels of learner control indicate that learners tend to benefit more from the use of educational technologies when they can control the pace, duration, frequency and levels of difficulty of computer instructional material (Brown, 1997; Overbaugh, 1994; Yang, 1993). Studies also show that higher levels of learner control generally motivate learners to have continued levels of engagement with computer instructional material (Brown, 1997; Eom *et al.*, 2000; Yang, 1993). However, although studies report that learners who learn on systems that allow higher levels of learner control show higher levels of achievement, studies still remain undecided and some studies show higher levels of learning under programme controlled learning conditions (Eom *et al.*, 2000; Overbaugh, 1994). Learners who learn successfully on learner control systems tend to have higher degrees of strategic knowledge, while learners with higher levels of intellectual ability and lower levels of strategic knowledge may achieve lower learning results on learner control systems (Yang, 1993).

The following variables affect learning on learning systems that require higher levels of learner control:

- learners who have sufficient prior knowledge of the educational content tend to learn more successfully with higher levels of learner control

(Brown, 1997; Yang, 1993), otherwise the nature of the learning content itself affects the learning situation (Eom, *et al.*, 2000)

- the intellectual levels of the learners affect the learning success on systems with high learner control (Yang, 1993)

- the use of learning contexts that require higher levels of learner control are found to be successful and relevant when learners have the relevant metacognitive abilities to access and evaluate their own learning progress and the cognitive strategies to apply their own experience and knowledge to learning situations (Brown, 1997; Eom, *et al.*, 2000)

- the nature of the software navigation options and more specifically the inappropriate dedication of learner control to learning situations, have an impact on the success of learning systems with higher levels of learner control (Yang, 1993)

- the individual characteristics and differences between learners, such as age levels, computer abilities, levels of motivation and preferences for locus of control, have an impact on learners' abilities to successfully orientate and master higher levels of learner control (Eom *et al.*, 2000; Yang, 1993)

- research studies suggest that the use of strategic knowledge, such as self management skills, study skills and adaptive cognitive strategies, tend to ensure greater levels of success on higher learner control systems than levels of content knowledge (Yang, 1993)

- learners who learn in high learner control contexts tend to take more time to complete educational tasks, while learners in programme controlled learning contexts usually have more directed and concise learning experiences (Overbaugh, 1994)

- the lack of clearly defined prescriptive learning parameters in higher learner control learning environments is shown to leave learners at a logistical disadvantage, as lower level learners who tend to have poor judgement of their own educational needs tend to do naturally do less educational activities, while higher level learners tend to exceed the required learning objectives, often avoiding work already covered (Overbaugh, 1994)

- learners who are able to exert greater control over their own learning experiences tend to have more positive attitudes to learning and therefore more positive learning experiences (Overbaugh, 1994).

2.3.3.1.2 Traditional Teaching and CAL

Research studies have shown that learners demonstrate similar levels of mastery in learning subjects and areas when educational material is traditionally classroom based or delivered through educational technology media, though diverse individual learner differences make the generalization of these research findings less feasible (Christensen *et al.*, 1998).

Though all learners are able to process both verbal and image based sources of information, studies demonstrate that learners tend to have preferences between the two types of information and therefore tend to learn more successfully when focusing on the type of information of preference (Anderson, 2001). Learners who have greater preferences for image based types of information tend to be more successful in using educational technologies while learners who have preferences for verbal types of information tend to orient toward traditional text based teaching contexts (Anderson, 2001).

Learners also differ with regard to their orientations regarding their locus of control, which refers to learners' individual beliefs as to the internal or external causality of their own life experiences, successes and failures (Anderson, 2001; Wolfe, 2001). Learners who have an internal locus of control have been documented to have higher levels of academic performance as they tend to have a deeper approach to learning, thinking actively about the structures of information by viewing educational content as total and interconnected modules of information (Anderson, 2001). Learners who have an internal locus of control are also shown to (Anderson, 2001):

- take more responsibility to find and utilise information from beyond the bounds of educational materials provided
- have better study habits
- make better use of, and respond more positively to, instruction that is not teacher based
- tend to have better time management skills
- have more positive attitudes toward learning content.

Learners who have an external locus of control tend to perform better in teacher controlled and traditional learning contexts (Anderson, 2001). Learners who have an external locus of control have a greater orientation and success rate in the use of educational technologies and are shown to have a higher frequency of task interaction and more refined abilities to navigate in unstructured and exploratory information environments (Anderson, 2001; Wolfe, 2001).

Despite the differences in learners' individual characteristics, the following suggestions are documented in literature to ensure a balanced and successful integration of educational technologies into the traditional teaching curriculum (NCETDE, 1998):

- use educational material that is representative of real world experiences and relevant to real world problems as learners tend to have more responsibility in the learning process when they are able to understand the relevance of the content

- dedicate enough time for learners to explore and play with technology, as the use of technology is usually reserved to the completion of educational tasks, and computer skills usually do not develop sufficiently with limited interaction

- ensure that all learners have the sufficient computer skills to effectively use the computer technologies, and that all have equal access to all electronic information and material required

- allow all learners to be involved in classroom decision-making with regard to the direction and use of technology for each educational objective, as learners feel more responsible with greater levels of involvement and also feel more comfortable with higher levels of computer integration when in agreement regarding its use

- use systems of continuous and consistent assessment and allow learners to become evaluators of their own progress against clear success criteria

- make certain that teachers remind and guide learners to be aware of the content they are learning to avoid the potentially distracting effects of computer use.

2.3.3.1.3 Individual Responses to CAL Content and Style

Studies indicate that the level of personal access to technologies such as television, learners' capabilities in using technologies, the levels of proficiency in the major delivery languages on technologies and the understanding of cultural symbols influence to what extent learners respond and successfully orientate to learning technologies (DOE, 2000). Higher level learners often do not engage with learning material that is at less sophisticated levels, while learners who do not understand information presented tend to lose attention (DOE, 2000). However, despite differences in the levels of intellectual ability, studies indicate that higher levels of self efficacy and the self belief in the ability to perform at successful levels assist in the successful adaptation and use of educational technologies (Anderson, 2001).

2.3.3.2 Social Aspects

2.3.3.2.1 Attitudes to CAL

Literature demonstrates that learners who have less involvement and control in the learning process tend to have more negative attitudes to the use of educational technologies (Brown, 1997). However, other studies indicate that learners who have more positive attitudes toward the use of computers tend to perform better than learners who have negative attitudes (Anderson, 2001; Cousins *et al.*, 1993; Mayer, 2000). Other research indicates that while levels of personal ability are more influential amongst younger learners, attitudes and motivational factors contribute to greater levels of success among older learners (Anderson, 2001). While educational technologies themselves motivate learners, learners who have higher levels of motivation tend to achieve higher performance levels (Christensen *et al.*, 1998).

2.3.3.2.2 Social Responses to CAL

Some learners who are inexperienced or intimidated by the use of educational technologies tend to experience higher levels of anxiety, while studies indicate that a correlation exists between anxiety and performance, where higher levels of anxiety result in lower performance levels and lower anxiety levels result in higher performance levels (Anderson, 2001). Other learners who are not intimidated by, but have little experience in the use of, educational technologies tend to experience higher levels of frustration, especially due to a lack of technical support (Christensen *et al.*, 1998; McVay Lynch, 2002). In general, inconsistent, unclear and vague teacher support also leads to higher levels of learner frustration (McVay Lynch, 2002).

The use of educational technologies that are unstructured or exploratory in nature require a higher level of ambiguity tolerance amongst users (Wolfe, 2001) and learners who have lower tolerance levels of ambiguous situations, indicated as situations where there are unfamiliar, contrasting or unintelligible signs or cues, tend to find these learning platforms frustrating and experience higher levels of discomfort (Anderson, 2001).

2.3.3.2.3 Effects on Socialisation

The use of educational technologies has been documented to have effects on the interaction patterns of learners (Reyna *et al.*, 2001; Schofield, 1995). The predominant view expressed in the literature has been that the greater use of educational technologies has resulted in limited interaction between teachers and learners (Reyna *et al.*, 2001; Schofield, 1995). Although demonstrated to be true for introvert learners who generally withdraw from social situations, literature has suggested that introverted learners tend to find communicating via computer less threatening and the amount and quality of social interactions between learners generally increase in technological learning environments (Reyna *et al.*, 2001). More specifically, research has indicated that learners tend to rely on each other for technical support, collaborate and co-operate at higher levels and spend more time and with increased focus on task related activities (Schofield, 1995).

2.3.3.3 Cognitive Aspects

2.3.3.3.1 Cognitive Style

The levels of cognition of learning processes achieved through the use of educational technologies are noted from the lowest to highest degrees of complexity (Brewer *et al.*, 2001):

- knowledge, referring to the process of receiving and memorizing information

- comprehension, referring to the higher level understanding of the meanings of information

- application, referring to the practical imitation and demonstration of information learnt

- analysis, referring to the separating of whole pieces of information into smaller parts and determining the cause and effect relationships of information modules

- synthesis, referring to the combining of smaller information modules from various sources to provider a comprehensive understanding of an overall topic

- evaluation, referring to the process of determining the relevance, strengths and weaknesses of various phenomena.

The literature however demonstrates that learners differ in their own cognitive styles and that the variations in cognitive style influence to what extent learners succeed in the use of educational technologies (McVay Lynch, 2002). Cognitive styles refer to the cognitive, emotional and physical behaviours that accurately prescribe how learners perceive and interact with the learning environment (Boles *et al.*, 1999). Various theories regarding the variations of cognitive styles are documented in the literature.

Riding and Cheema indicate that two primary cognitive style groups exist and can be expressed on the wholistic-analytic (WA) and the verbal-imagery (VI) continuums (Boles *et al.*, 1999). The WA continuum refers to whether learners process information in totality or in parts, while the VI dimension provides an indication to whether learners have a preference for processing information that is verbal and textual based, or graphic and image based.

Learners who fall in the verbal dimension, referred to as verbalizers, have a preference for information that is presented in word or text format that provides various word associations (Boles *et al.*, 1999; Wolfe, 2001). Learners, who fall in the image dimension, referred to as imagers, have a preference for information that presents or allows learners to represent information in picture format (Boles *et al.*, 1999; Wolfe, 2001). Verbalizers experience better levels of understanding and memorisation from passages of text or prose, while imagers experience better learning levels from passages of information that are more descriptive and illustrative (Boles *et al.*, 1999). Therefore in educational software, the extensive use of icons and graphics may well cater for imagers, while verbalizers prefer word command facilities (Boles *et al.*, 1999). However, studies indicate that there is a tendency to present information in educational technologies to learners in a way that do not suit human perceptual skills in general, creating a mismatch in information presentation and human perception (Reyna *et al.*, 2001).

Learners who fall in the wholistic dimension, referred to as wholists, tend to categorise and organise passages of information into wholes to create an overall understanding of the information provided (Boles *et al.*, 1999). Learners who fall in the analytic dimension, referred to as analytics, have tendencies to process information in clearly defined conceptual clusters and focus on a single cluster at a time to eventually construct an overall picture of the information provided (Boles *et al.*, 1999).

Riding and Cheema indicate that learners can have a single or bimodal cognitive style (Boles *et al.*, 1999). Bimodal cognitive styles therefore include the following (Boles *et al.*, 1999):

- Wholist-verbalizer (WV)
- Wholist-imager (WI)
- Analytic-verbalizer (AV)
- Analytic-imager (AI).

Other theories focus on learners' depths of cognitive processing, described in a deep-surface continuum (Anderson, 2001). Learners who adopt a deep approach to cognitive processing tend to show greater interest and enjoyment in academic tasks and demonstrate greater tendencies to concentrate on and theorise about information and its relationship to prior knowledge (Anderson, 2001). Learners who adopt a surface approach to cognitive processing tend to show less enjoyment in completing academic tasks, rely on rote memorisation of factual information and concentrate on detached task components that are unrelated to other educational tasks and prior knowledge (Anderson, 2001). However, results on the effectiveness of cognitive processing approaches show inconclusive results for both methods (Anderson, 2001).

The cognitive concept of metacognition refers to learners' knowledge of their own cognitive processes and the active evaluation and regulation of these cognitive processes in relation and response to learnt educational information or phenomena (Anderson, 2001). Three components of metacognition exist, namely self knowledge, knowledge about cognitive tasks and strategy knowledge (Anderson, 2001). Studies suggest that greater levels of metacognition lead to higher levels of academic performance and that greater levels of metacognition are more influential in achieving learner success on educational technology systems than higher degrees of effort or intelligence (Anderson, 2001).

2.3.3.3.2 Learning Style

Literature suggests that learners have their own individual tendencies or styles of perceiving, expressing and structuring information for the purposes of learning (Boles *et al.*, 1999). Educational technologies are also known to be adaptable to accommodate the different learning styles of the learning population (Boles *et al.*, 1999; Christensen *et al.*, 1998). It is documented also that higher levels of consistency between educational software structure and learners' learning styles ensure greater levels of learning success (Boles *et al.*, 1999; Christensen *et al.*, 1998).

It is suggested in the literature that learners are split between having field dependent or independent styles of learning (Anderson, 2001; Chuang, 1999; Wolfe, 2001). In general, field independent learners have the following characteristic learning tendencies:

- an impersonal but self-referent orientation, with clear understanding of personal values and standards (Anderson, 2001)

- a logical, organised and analytical approach in approaching educational activities (Anderson, 2001)

- an ability to demonstrate higher levels of self directed learning (Anderson, 2001)

- a greater reliance on internal references (Chuang, 1999)

- a wholistic and overall preference when perceiving objects (Chuang, 1999)

- a tendency to approach problem situations by reducing and determining causal relationships between various manageable factors (Chuang, 1999).

Field dependent learners, however, have the following characteristic learning tendencies:

- a global, altruistic and interpersonal orientation, and a tendency to be highly influenced by their social and physical backgrounds (Anderson, 2001)

- lower capabilities of maintaining direction, organizing learning activities and relying on own judgements (Anderson, 2001)

- a greater reliance on external references (Chuang, 1999)

- a preference to focus on the individual smaller parts of an object and not the picture as a whole (Chuang, 1999)

- a problem solving strategy that involves the use of common sense, intuition and trial and error efforts (Chuang, 1999).

Studies conclude therefore, that as field independent learners prefer to impose their own structure on information, they tend to be compatible with less structured technological learning environments such as those characteristic of the inferential and covert structured hypertext and hypermedia platforms demonstrated on the World Wide Web (Anderson, 2001; Wolfe, 2001). Field dependent learners are more compatible with technological learning environments that are slower paced, more directive, programme controlled, generate fewer and more defined concepts and require the recall and memorisation of fewer concepts at a time (Anderson, 2001).

Other studies indicate that learners differ with regard to levels of self regulation and that levels of self regulation affect the extent that learners are compatible with various learning situations (Eom *et al.*, 2000). In general, the literature indicates that high self regulatory learners:

- rely on inner resources to manage their own learning process (Anderson, 2001)

- have greater convictions regarding a field of study (Anderson, 2001)

- have greater awareness about what cognitive and motivational approaches best suit the educational objectives and outcomes (Anderson, 2001; Eom *et al.*, 2000)

- have clearer understandings regarding the level of input required, and the amount of personal resources available, to master specific tasks (Anderson, 2001; Brown, 1997; Eom *et al.*, 2000)

- have a proactive approach to seeking out information, and active cognitive and behavioural approaches to learning in general (Anderson, 2001; Eom *et al.*, 2000)

- demonstrate higher levels of self efficacy and intrinsic task interest and satisfaction (Anderson, 2001)

- are capable of self instruction, self reinforcement and self evaluation in learning processes (Anderson, 2001; Eom *et al.*, 2000).

Studies suggest that high regulatory learners are able to learn at high levels in both programme controlled and learner controlled technological platforms, while low self regulatory learners are not sufficiently skilled to learn from learner controlled technological educational platforms and remain compatible with directive programme controlled systems (Eom *et al.*, 2000). Other research results suggest that active learners in general out perform learners with passive learning styles in less structured technological learning environments such as the hypertext and hypermedia World Wide Web platforms (Anderson, 2001).

2.3.4.2.3 Learning Rate

Literature indicates that learners who utilise educational technologies in learning environments tend to progressively improve their individual technology skills and are therefore able to access, retrieve and store information and educational material at a faster rate (McVay Lynch, 2002). Learners have also been noted to acquire more specific subject knowledge in shorter time periods, as they are able to research, organise, manipulate and analyse information and educational material at a quicker rate than conventional methods (McVay Lynch, 2002). Learners also tend to develop their own individual learning strategies that improve their information gathering and processing times (McVay Lynch, 2002).

However, literature indicates that though learners are able to access information at a faster rate, the information gathering process itself is often mistaken for the learning process and learners then show lower levels of learning achievement despite large amounts of effort (McVay Lynch, 2002).

2.3.3.4 Experience in Information Technology

Literature suggests that learners with higher levels of computer skills and prior access to computers, Internet and e-mail facilities are shown to demonstrate higher rates of learning success when learning through the medium of educational technologies (Reyna *et al.*, 2001). However, studies indicate that levels and rates of self-reported computer use are unrelated to learner achievement in the use of educational technologies (Cousins *et al.*, 1993).

2.3.5 **THE TEACHER AND CAL**

2.3.4.1 Changing Roles

Hugo (2002) indicates that work related performance problems generally tend to occur in the workplace when excessive demands are placed on workers' capacities, without the provision of the adequate tools and resources to complete the required activities adequately. The following factors contribute to work related performance problems (Hugo, 2002):

- the consistent need for more progressive and complex knowledge, skills and information
- the complexity of modern work procedures and processes
- the mental and physical demands required to perform tasks
- the social structures and environmental circumstances at the workplace
- the levels of resources available for task and activity support
- the status and capabilities of systems and tools available in the workplace

- the relevance and effectiveness of job and work related training
- the efficiency of communication in the workplace.

Hugo indicates that the creation and implementation of complex and irrelevant computer systems in the workplace often intensify performance problems in the work context and that workers often experience information overload and lack of accurate and consistent technical support that leads to high levels of frustration and helplessness (Hugo, 2002). Discrepancies between computer systems and the required functioning needed in the workplace are often the cause of technologically exacerbated performance problems (Hugo, 2002). Hugo (2002) further indicates that the creation of the Human Computer Task Allocation Model has aimed to create an optimal division of labour between humans and computer technologies in work environments to alleviate human and technological mismatches. The model places various tasks along a continuum, with place the tasks that are suited to computers on the one end, and those that are suited to humans on the other (Hugo, 2002). Research indicates that people are proficient at creative tasks, have intuitive approaches to problem solving, behave in imprecise and adaptable orientations, have advanced and complex cognitive processing skills and are able to progressively learn and acquire new skills (Hugo, 2002). Computers, however, are demonstrated to be proficient at repetitive task functioning, highly mathematical and logical problem solving, possess very high levels of precision, systematic and rigid checking processes and the storage of large amounts of information and data (Hugo, 2002). The purpose of the model, and therefore of effective workplaces, is to create an optimal balance between using the benefits of technology where humans show levels of inability or repetitive and unnecessary tasking, while relying on human resources where human factors prove to be the prevalent task requirement (Hugo, 2002).

Teachers are therefore, expected to perform a varied range of new tasks and functions to ensure that learners receive a comprehensive set of up to date skills (NCETDE, 1998). While the widespread implementation of educational technologies create new opportunities for the teaching community, the increased progressive change and pace creates greater levels of pressure on educators (NCETDE, 1998). Teachers, no longer the sole providers of subject knowledge, are required in modern educational contexts to integrate the use of educational technologies into the school curricula in ways that promote research and information synthesis and analysis skills (NCETDE, 1998). Literature indicates that teachers' roles therefore, become less dominant and determinant in educational settings as the levels of technology integration in educational contexts increase (Lafee, 2001). As educational technologies develop more independent learners, teachers become facilitators in classroom settings, guiding learners appropriately as they learn independently (Lafee, 2001). Research, however, indicates that in reality most teachers are unaware of how to optimise the use of educational technologies and that the use of ICTs is usually reserved to more directive and less complex drill and practise systems, usually in the initial development period as teachers and learners become accustomed to using educational technologies (NCETDE, 1998).

However, opinions in literature indicate that despite the advancements made in the use of educational technologies, that the act of teaching itself, (whether through the medium of textbooks or through modern technological methods) should always be a priority rather than the teaching media and tools utilised for the delivery of educational material (Loschert, 2003). Despite the modern advancements, a variety of both traditional and modern media are best suited to various educational activities (Loschert, 2003). Finally, opinions in the literature suggest that the role of teachers cannot be replaced by educational media, as teachers tend to drive and support the use of educational technologies in schools and educational institutions, while providing adaptive, flexible, responsive, observational, and deeper levels of interaction and guidance in educational settings that computers are unable to provide (Brown, 1997; Loschert, 2003).

2.3.4.2 Teacher Attitudes to CAL

In the literature the term 'attitude' has been defined as (Koszalka, 2001; 2):

"an evaluation disposition toward some object based upon cognitions, affective reactions, behavioral intentions, and past behaviors…[and therefore] is an informed predisposition to respond and is comprised of beliefs, feelings and an intent for action".

Research studies performed on teachers to determine their attitudes toward the teaching profession in general generated the following findings, indicating that teachers (DOE, 2000):

- in general experience negativity from local communities, where teachers were once revered, teachers feel they are undervalued and unappreciated though they still believe that they fulfil a very important role in society
- feel that there is a pervasive lack of security for themselves and school property in general
- feel that there is an extensive lack of interest and financial and emotional support from parents in the community, who believe that providing resources to schools is the responsibility of the government
- feel that many black children are not prepared enough when they start school compared to white learners, and that development problems that black children experience create difficulties and challenges for teachers
- find that larger classes and the multi-lingual nature of learners male it difficult to provide stimulation and individual attention to learners
- feel that they receive too little in service training, despite constant changes to school curricula and methods
- indicate that in general they have insufficient access to teaching media and equipment

- feel that they do not receive sufficient communication from the DOE regarding widespread curricula and methods changes, and that the media proves to be more informative than the formal departmental structures

- feel negative toward the implementation of the School Bill, particularly with regard to levels of parental involvement and redeployment, while teachers in general lack awareness of the implications of the new labour Relations Act

- have a low awareness, but a basic understanding of the concepts of the National Qualifications Framework[9], Integrated Education and Outcomes Based Education[10].

Literature indicates that teacher morale in South Africa is at a low as teachers feel anxious and uncertain regarding teacher rationalisation and redeployment (NCETDE, 1998). There are also high levels of teacher and learner absenteeism and a lack of discipline from both colleagues and learners (NCETDE, 1998). Although teachers are required to have a senior certificate and three years of post school training to be adequately qualified to teach, many teachers in the country remain under qualified (NCETDE, 1998).
Curricula changes and the implementation of educational technologies also create a greater amount of distress for less skilled teachers (NCETDE, 1998).

With regard to educational technologies, literature suggests that people generally respond to computer technologies in two extreme ways (NCETDE, 1998):

- at one end people respond with an optimistic and exhilarated view that aims to embrace all the potential proposed benefits of computer technologies

[7] NQF
[8] OBE

- at the other end people respond with a pessimistic view of computer technologies, believing that they aggravate inequality, further divide society and that technology rules the world.

The literature indicates that more realistically, the majority of people's feelings toward computer technology tend to fall on a continuum between the two extreme responses (NCETDE, 1998). Opinions in literature also claim that technology has progressed to an extent where people can no longer avoid technology, as the majority of social structures are totally dependent on the use of technology (Hugo, 2000). Literature indicates that to a greater extent the increased levels of access to technologies and the modern links between television, radio, general communications and computers are changing the information seeking and communication habits of the general population (Hugo, 2000). It is identified, however, that people's attitudes toward new technologies tend to change as they identify and discover the new benefits that the technologies provide (Hugo, 2000).

With regard to educational technologies, literature indicates that a positive attitude is required to adopt a new innovation, and that understanding teachers' attitudes to CAL systems is a useful measure in determining to what extent the systems will be accepted and optimised (Koszalka, 2001; MacArthur *et al.*, 2003). Research studies extensively document that teachers in general feel positive about the use of educational technologies and the value that the use of computers provide to schools (MacArthur *et al.*, 2003; NCETDE, 1998; Valdez *et al.,* 2004). Studies also indicate that teachers generally value the use of computers for the motivational, developmental, informational and global benefits that they provide, rather than specific academic and educational outcomes (MacArthur *et al.*, 2003; Valdez *et al.,* 2004). It is also noted that positive attitudes to the use of educational technologies amongst teachers tend to be exaggerated among teachers who are less or totally inexperienced in the use of educational technologies, who have the following beliefs that the literature indicates to be inflated or unproven (Balajthy, 2000):

- the use of computers in education will serve to enhance conventional instruction methods

- the increased availability of computers alone will ensure greater learner success at schools

- the change in teaching methods brought about by the implantation of educational technologies in schools will guarantee greater learner success at schools

- in the future the nature of literacy will have evolved with the greater use of technology and will no longer resemble traditional literacy

- learners will develop the capability to critically comprehend and evaluate complex socio-cultural issues as they gain increased levels of access and proficiency in the use of information technologies.

The following reasons for teachers having negative attitudes towards the use of educational technologies in schools are documented in literature:

- most teachers were educated and trained before computers were an integral part of everyday work and are therefore suspicious of its benefits (Schofield, 1995)

- schools are often under funded for sufficient technology implementation in schools and teachers are not exposed enough to technologies, remaining inexperienced (Schofield, 1995)

- teachers often do not receive adequate training (Schofield, 1995)

- inexperienced teachers tend to feel that their learners are more competent in technology use than they are and believe that computers in classrooms would challenge their authority (Schofield, 1995)

- some teachers may generally not have the mental readiness to accept and adopt new innovations (Koszalka, 2001)

- teachers often do not have the opportunities to collaborate in using educational technologies, and therefore feel negative due to the lack of a peer support structure in schools (Koszalka, 2001; Schofield, 1995)

- teachers who have lower levels of computer use and are therefore more inexperienced, tend to have more negative feelings toward the use of educational technologies (NCETDE, 1998)

- in schools where there are more barriers to the implementation and effective use of educational technologies, such as a lack of funds or lack of adequate training, teachers tend to have more negative attitudes toward the use of educational technologies (NCETDE, 1998).

Research conducted in South African schools found that the greatest negative attitudes were directed toward the idea that schools could collaborate on projects and communicate digitally through e-mail and Internet platforms (NCETDE, 1998). In general, findings pointed to positive attitude majority, and teachers felt most positive regarding the following (NCETDE, 1998):

- computer skills present learners with better job opportunities

- computers help and allow learners to work and think independently

- computers are helpful to teachers in lesson preparation and administrative tasks

- teachers are not concerned regarding extra teacher training that would be required or the extra teacher workload through the implementation of CAL systems in schools

- computers help learners prepare themselves for a technological future
- support is also shown by teachers to use CAL for the delivery of the curricula of all learning subjects at school, as well as the general teaching of computer skills.

2.3.4.3 Teacher Training

Studies suggest that despite the availability, access and attendance of both pre-service and ongoing computer training courses, teachers still overwhelmingly indicate that they are unaware of how to integrate computer technology into teaching practice (Firek, 2003; Newhouse, 1999; Robinson *et al.*, 2003). Literature also indicates that despite the implementation of educational technologies in schools, the majority of teachers indicate that they feel unprepared in effectively using the technological media (Loschert, 2003). Though teachers currently receive formal computer training in the pre-service training programmes, the literature suggests that teachers remain unprepared in using educational technologies when starting their teaching careers, as the training focus seems to be on the development of technical competencies rather than the development of computer curricula integration and preparatory skills (NCETDE, 1998). It is largely demonstrated in literature that the training of how to integrate computers into learning situations remains overlooked in teacher computer training content (Brabazon, 2000; MacArthur *et al.*, 2003; Semple, 2000). However, studies on the effects of training have indicated that learners whose teachers have had some formal computer training tend to perform better than learners whose teachers have little or no computer training, which therefore indicates the need for both sufficient training and confidence in computer use amongst teachers (Valdez *et al.,* 2004).

In general, low teacher productivity is seen as the reason for poor academic performance in South African schools (DOE, 2003a). Poor training is identified as the main driver for poor teacher productivity in the country, as most teachers have received their training in poor conditions during the apartheid years (DOE, 2003a). The government's response in democratic

South Africa has been the implementation of in-service training programmes that have reached only a smaller part of the teaching population, who have seen the training as inadequate or irrelevant (DOE, 2003a). The regulations for ongoing in-service training for South African teachers is that teachers are to receive 80 hours of training per year, but the Government is currently unable to reach the more than 300 000 teachers that are spread over the country and calls for the implementation of distance learning capabilities delivered via an Internet based platform to enable a greater reach (DOE, 2001a). However, the teaching population is shown to vary with regard to the level of teacher training received, the level of content knowledge and the level of orientation to C2005 that makes the training situation more complex (DOE, 2001a). The government therefore, sees the implementation of computer technologies in schools as an important component in the career development and performance of teachers, and that well trained, well prepared, motivated and highly knowledgeable teachers would improve the quality of education in the country as a whole (DOE, 2001a). Research studies conducted in South African schools however, indicate very high rates of computer training amongst teachers at tertiary universities or technikons, private colleges or learning institutes and government education departments, though the levels of computer use and integration at schools remain very low (NCETDE, 1998).

Literature indicates that well trained teachers should generally display the following four facets to demonstrate high levels of preparation to teach effectively and at appropriately high standards (Brewer *et al.*, 2001):

- the well trained teacher has a greater theoretical understanding of human behaviour, including the facets of learning, motivation and reinforcement

- the teacher is able to demonstrate positive attitudes toward subject matter and learners in general to promote learning and development

- the teacher is able to demonstrate a greater command in subject knowledge as well as presentation, evaluation and feedback methods

- the sufficiently trained teacher is able to utilise content and media to create teaching strategies that result in meaningful learning scenarios.

To teach with a greater integration of educational technologies, teachers should also possess the following skills and attributes (Brewer *et al.*, 2001):

- to be capable of communicating in clear and focussed methods
- to provide learners with clear expectations of their responsibilities, as well as the learning outcomes in general
- to be able to cope in the ambiguous and often frustrating learning environment of educational technologies
- being able to create and maintain higher standards of instructional content
- being able to effectively and accurately assess learners' performance
- being able to evaluate and modify their own teaching effectiveness.

The following is documented in the literature as points of focus when training teachers in the use of educational technologies in schools:

- use a grassroots approach when training teachers locally by using school or local premises and equipment and upgrade as the need requires to minimise costs (Anderson, 2003)
- use teachers in school who are proficient to train other teachers, so that the training is within the required context and so that the trainer is always on hand to assist or monitor teacher progress (Anderson, 2003)

- use an ongoing training system that sustains the training and development momentum in schools so that teachers are able to improve consistently and keep up with the latest trends and developments (Anderson, 2003)

- get the buy-in and support from the principal who is able to keep abreast with the developments in other schools as well as official policies (Anderson, 2003)

- use both formal and informal occasions to train teachers, and allow teachers to assist each other (Anderson, 2003)

- allow teachers to practise what they have learnt, and expose teachers to the same computer training that learners receive to maintain parity in training systems (Anderson, 2003)

- having teachers and learners who are trained in building and repairing computers help create systems of technical support and open up extra funds for training (Richard, 2003)

- create courses that are able to instruct teachers of all subject groups (Firek, 2003)

- make sure that the computer training content is relevant to the actual teaching situation and that teachers are not trained on complex software that would not be used in the school context (Firek, 2003)

- make sure that training content includes both theoretical and practical orientations to provide theoretical validation and practical relevance to training material (Firek, 2003)

- create partnerships with other local schools and let schools share resources and progress (Firek, 2003)

- ensure that teachers are trained to have newer notions and strategies for education, greater technical skills, curriculum adaptive skills, greater understanding of educational methodologies, global orientations and perspectives to technology and greater people skills along with the training material in the use of educational technologies (French *et al.*, 1999; Newhouse, 1999).

2.3.4.4 Facilitating CAL

Studies indicate that currently teachers generally do not effectively integrate the use of educational technologies into their teaching practise (Koszalka, 2001). The effects of greater integration of educational technologies into the teaching and learning context has shown that teachers' roles change from directive and dominant disseminators of knowledge to that of facilitators and guides as learners become more independent in their own learning (Lai, 1996; Newhouse, 1999; Pieters, 2001; Schofield, 1995). The greater use of educational technologies have also been demonstrated to change and restructure the educational process with a greater focus on learner centred education, providing more flexible, collaborative and independent learning amongst learners (Lai, 1996; Newhouse, 1999; Schofield, 1995). However, the extreme variations in instructional situations, topics and learner characteristics show that different media such as books, audiovisual materials, computers or hands on field experiences all suit different learning outcomes (Alessi *et al.*, 2001).

Literature suggests that a number of facets need to be explored before CAL systems are integrated into educational scenarios, and list the following as most significant:

- a review of the existing computer equipment, software capabilities and Internet and telecommunications facilities is required before new systems are implemented (Opitz *et al.*, 1998)

- the space, time, electrical and security allocations need to be reviewed to accommodate the new CAL systems (Opitz *et al.*, 1998)

- the levels of computer training and experience and availability of in service training for staff (Opitz *et al.*, 1998)

- a planning of the required educational technologies most relevant to the schools' needs and curricula and an allocation of time for electronic and traditional teaching practice (Balajthy, 2000)

- extra time and facilities are required for system maintenance and logistical integration into daily classroom routine (Balajthy, 2000)

- the exploration of teacher routines and the inclusion of the teaching fraternity in the educational technology planning and decision making process (MacArthur *et al.*, 2003).

Literature demonstrates the following as relevant uses and starting points for CAL implementation in teaching and learning contexts:

- computers can be used to free teachers from repetitious administrative tasks, such as keeping record of test scores, calculating grades, creating reports, keeping track of missing homework and assignments and learner attendance as well as tracking the circulation of borrowed learning materials (Bitter *et al.*, 1993)

- teachers are able to use computers to produce and develop lesson plans and materials, detailed daily schedules and evaluative lesson reports (Bitter *et al.*, 1993)

- teachers use the Internet and other information platforms to gather, synthesise and analyse various forms of information, as well as to communicate via e-mail or Internet based communication structures (Valdez *et al.,* 2004)

- teachers can use CAL systems to provide preliminary or primary instruction to learners, while facilitating learning direction and progress (Desai, 2000)

- teachers are able to use drill and practise and other evaluative systems to understand and assess the ability of learners or levels of knowledge acquisition before or after instruction has occurred (Draper *et al.*, 2002)

- teachers are able to use computer based testing systems that provide less frustrating and anxiety provoking testing conditions and automate grading and assessment procedures (Opitz *et al.*, 1998).

The modern requirements for teacher computer use have become more complex than in previous years, and teachers have required greater computer skills to cope with the integration of more intricate and advanced CAL systems (Loschert, 2003). The following factors are shown in the literature to promote the use of computer and CAL systems amongst teachers:

- the availability and quality of computer equipment resources, as well as sufficient availability of funding for computer systems (Bussey *et al.*, 2000; Valdez *et al.,* 2004)

- the levels of personal computer proficiency (Valdez *et al.,* 2004)

- the pedagogical beliefs and practises of teachers that are compatible with the use of CAL systems (Valdez *et al.,* 2004)

- the availability of adequate training and ongoing professional teacher development (NCETDE, 1998; Valdez *et al.,* 2004)

- access to computer facilities off the school premises (Valdez *et al.,* 2004)
- the younger age of teachers (Valdez *et al.,* 2004)
- a smaller degree of fear and anxiety of technology or change in general (Bussey *et al.*, 2000)
- greater general personal interest in the use of technology (Bussey *et al.*, 2000)
- wider networks of conductivity between teachers, schools and institutions in general (Bussey *et al.*, 2000)
- a greater degree of confidence in using and adopting new technologies (NCETDE, 1998)
- efficient school CAL administration and management systems, as well as clear parameters for CAL integration and use (NCETDE, 1998)
- greater collaboration and sharing among teachers who vary in computer ability and experience (Koszalka, 2001; Robinson *et al.*, 2003).

2.4 CAL Implementation in South African Schools

2.4.1 Computer and Education Policy in South Africa

A number of policies have been implemented since the inception of the democratic government in 1994 that have transformed the education system in South Africa. The National Education Policy Act laid forth a national policy that decreed conditions for fair policy creation on education practise (President's Office, 1996a), while the initiation of the South African Schools Act in 1996 provided a guide toward the way that schools are governed, funded and organised in South Africa (NCETDE, 1998). Actionable responses to the state of South African Education are demonstrated in the Tirisano plan (Asmal, 1999), as well as the Dakar Framework (DOE, 2003a). The primary move in policy development in the South African education system has been the institution of a uniform education system adopted in place of the racially segregated education departments of the previous era (NCETDE, 1998).

However, literature states that in general there is a lack in information technology policy in South Africa (NCETDE, 1998). As demonstrated in the Schools Needs Register (Asmal, 2000), a national audit of the state of schools in South Africa, the lack of basic resources in schools limits the extent that the use of computers can be implemented, most obviously in schools without electricity and other sources of power. It appears that a developmental disparity exists between the ideal of being 'wired or technologically savvy', and the ideal of being 'resourced with provision of all basic needs'. Although each has its advantages developmentally, the decision of where the budget should be spent is pivotal in the way forward. The School Funding Norms policy aims to create equity in the school funding system by allocating more funding to poorer schools who cannot afford basic resources, while at the same time providing high level norm breakdowns of what categories of items should be covered by the finances supplied (DOE, 2003b). The two points of departure include either to allow the pro-poor funding school allocation to help disadvantaged schools to reach standard levels in terms of the quality of buildings and equipment, or allow that each school has a similar point of departure with regard to the supply of moveable assets into schools (DOE, 2003b). The two points of departure are not mutually exclusive, as when schools acquire certain priority moveable assets, their funding structure could change to ensure that schools do not benefit more than what is required from the extra funding (DOE, 2003b). Schools that are unable to effectively manage the allocations of resources themselves will have the resources managed on their behalf by the DOE (DOE, 2003b). Computers are included into the category termed "New moveable assets" and include the likes of: chairs, desks, copiers, laboratory equipment, lawnmowers, photocopiers, textbooks, library books and some stationery such as staplers and more (DOE, 2003b). As technology itself is not treated as its own category, the acquisition of computers in schools may not received priority status in such a category and could be seen as the last resort after a backlog of resources still lacking from inequalities harboured in the Apartheid system. The result is that despite the goal to integrate computers at a large scale into the educational system in South Africa, the lack of physical resources and a funding system that does not see computers as a priority could remain challenges to overcome if the vision is to come to fruition.

2.4.1.1 General Education Policy in South Africa

2.4.1.1.1 Acts

2.4.1.1.1.1 The National Education Policy Act, 1996

The objectives of the National Policy Act are to determine a national education policy in harmony with the Constitution, establish bodies to facilitate consultation in the education system, issue and implement policy as well as screen and evaluate education (President's Office, 1996a).

The policy lays down the stipulations that determine to what extent, and under what conditions, the Minister of Education is to create and forward educational policy in the country. The National Education Policy Act stipulates that national education policy in South Africa may be created for (President's Office, 1996):

- governance and management of the national education system and education management information systems
- resources, finance and development plans for education
- innovation, research and development in education
- institutions of education as well as the professional education and accreditation of educators
- the admission and compulsory school education of students
- the ratio between educators and students, school hours and the school calendar year among provinces
- curriculum frameworks, core syllabuses and education programmes, learning standards, examinations and the certification of qualifications
- language in education
- control and discipline of students at education institutions
- co-operation between the Department, other bodies and international relations in the field of education
- education support services, including health, welfare, career and vocational development, counselling and guidance for education institutions, within the functional responsibility of a department of education.

All education policies initiated must be aimed at (President's Office, 1996):

- ensuring the progression and maintenance of the basic human rights as stipulated in the Constitution
- developing the personal development of each student, as well the country as a whole
- equitable education opportunities
- promoting lifelong learning
- achieving an integrated approach to education and training within a national qualifications framework
- cultivating skills, disciplines and capacities necessary for reconstruction and development
- recognising the aptitudes, abilities, interests, prior knowledge and experience of students
- encouraging independent and critical thought, as well as research and the advancement of knowledge
- promoting a culture of respect for teaching and learning in education institutions
- enhancing the quality of education and educational innovation through systematic research, development, evaluation and training
- broad public participation in the development of education policy
- achieving the cost-effective use of education resources and sustainable implementation of education services

- achieving close co-operation between the national and provincial governments on matters relating to education.

2.4.1.1.1.2 The South African Schools Act, 1996

The aim for the establishment of the South African Schools Act was to (President's Office, 1996b):

- provide for a uniform system for the organisation, governance and funding of schools
- amend and repeal certain laws relating to schools
- combat all forms of unfair discrimination and intolerance
- eradicate poverty and contribute to the economic well-being of society
- preserve the diverse cultures and languages of the country
- uphold the rights of all learners, parents and educators
- promote joint responsibility for the organisation, governance and funding of schools in partnership with the State.

The Act (NCETDE, 1998):

- promotes access to education for all learners

- promotes quality of education
- calls for democratic governance of the schooling system
- makes schooling compulsory for learners aged 7 to 15 years, or until learners reach Grade 9
- provides for both independent and public schools, the latter which are governed democratically by school-governing bodies country wide
- aims to redress poverty through school-funding norms.

2.4.1.1.2 The National School Curriculum in South Africa

The political changes in South Africa after the 1994 democratic elections led to changes in the education system through the development of a new curriculum and educational framework for instructing and learning. OBE, implemented in schools country wide through the outlay of Curriculum 2005[9], has aimed to eradicate the system of racist policies and outdated teaching methods (Mda *et al*., 2000). The new framework has aimed to change and transform traditional teaching methods of previous years (NCETDE, 1998), by providing a set of assessment standards for each learning area, layered at each grade level (DOE, 2001a).

2.4.1.1.2.1 Outcomes Based Education

In relation to the concept of OBE, the concept of an “outcomes” approach refers to the clear definition and specification of what learners are to be able

[9] C2005

to demonstrate after the learning experience and is indicative of learning success (Mda *et al.*, 2000). The concept of the term “based” is understood as the determination of the lesson didactics, direction and organisation as based on or directed by the nature and finality of the final learning result (Mda *et al.*, 2000).

In a document entitled *Qualifications and Assessment Policy Framework: Grades 10-12* scripted by Baloyi (2002), the aim of OBE is presented as striving to enable all learners to reach their full potential, by encouraging a learner-centred and activity-based educational method and setting the outcomes to be achieved at the end of the learning process. The critical outcomes set for grades 10 to 12 require learners to (Baloyi, 2002):

- be able to use critical and creative thinking to be able to recognise and solve challenges, as well as make decisions
- work effectively as participating members of groups in general, within any organisation or community
- be responsible and effective self-management and activities
- be able to critically collect, organise and analyse information
- communicate effectively in visual, symbolic and language skills
- use science and technology successfully
- show responsibility towards the environment and others
- demonstrate an understanding of the interrelated, systemic nature of the world and its implication on problem-solving.

The developmental outcomes set for grades 10 to 12 require learners to be able to (Baloyi, 2002):

- explore many strategies to learn more effectively

- contribute as responsible individuals in the life of local, national and international societies

- be culturally sensitive and aesthetically responsible in various contexts

- explore education and career opportunities

- develop entrepreneurial skills and possibilities.

Van der Horst and McDonald list the following as advantages to developing and implementing an OBE curriculum (Mda *et al.*, 2000):

- learners understand what is expected from them as the outcomes and assessment criteria are clearly stated and they are therefore able to evaluate their own progress

- OBE provides greater learning support to learners than past practises, based on techniques such as co-operative learning, peer and self assessments

- failure is eliminated as learners are granted further opportunities to reach the required standard

- rote learning is reduced, with a focus on critical understanding of content

- focus is placed on the understanding of relevant content, not isolated facts

- focus is placed on real-life situations, emphasising knowledge and skills that improve the learner's ability to deal with life after school, as opposed to classroom activities.

On the contrary, Van der Horst and McDonald list the following as disadvantages to the development and implementation of an OBE curriculum (Mda *et al.*, 2000):

- stated outcomes often tend to be ambiguous, as well as based on attitudes and values rather than learning content

- the attitudes and values expressed in the new curriculum may not be values that are universally accepted

- some believe that schools who work through an OBE system lower their standards to accommodate all learners, as not all learners are able to work at the highest levels

- extra resources and high costs are required to implement OBE, as well as disruptive procedures in retraining staff, revising curricula and creating new standardised assessment procedures

- the differentiation between teachers educated in the 'old method' and those trained in the 'new method' has led to a belief of incompetence amongst staff, that therefore contributes to a general resistance to the implementation of new methods

- some believe that the OBE system leans toward schools with greater resources and will contribute to the widening gap between privileged and underprivileged schools and communities.

2.4.1.1.2.2 Curriculum 2005

The new curriculum lends itself to the ideal of lifelong learning and is a shift from the older curriculum, which has been primarily based on content, to one that focuses on learning outcomes; and therefore aims to establish a nationwide standard of OBE (Mda *et al.*, 2000).

The new curriculum anticipates the following changes (NCETDE, 1998):

- a shift from education that focuses on content to education that is outcomes-based
- having learners who are active in the learning process
- embracing an assessment process that is ongoing, as opposed to being driven by examination events
- changing the rote learning style and moving towards a more critical cognitive involvement which leads to appropriate actions
- a shift to learner-centred education, with the teacher playing the role of educational facilitator that guides the learning environment.

More relative to the implementation of CAL, the widespread implementation of computers is believed to provide logistical support to, and be supportive of; the integration of C2005 into schools nationwide (DOE, 2001a).

2.4.1.1.3 Department of Education Development Actions

2.4.1.1.3.1 Department of Education Priority Budgeting

2.4.1.1.3.2 Tirisano

The Tirisano plan, meaning “working together”, was implemented in 2001 as an actionable response to the state of South African education. The following priorities led to the implementation of the Tirisano plan (Asmal, 1999):

- the need to make provincial systems work by making co-operative government work
- alleviating illiteracy among adults and the youth in a period of five years
- making schools the centre of community life
- ending conditions of physical degradation in South African schools
- developing the professional quality of the teaching force
- ensuring the success of active learning through outcomes–based education
- creating a further education and training system that meets the social and economic needs of the 21st century
- implementing a higher education system that prepares individuals to meet challenges facing South Africans in the 21st century
- dealing with the HIV and AIDS situation in and through the education system.

Positive effects documented after implementation were (DOE, 2003):

- stability in the education system
- improved school functionality

- improved management of human and financial resources
- a focus on delivery
- promoting values and building citizenship
- targeting communities involved in programmes for rural and urban development
- targeting teaching, learning, curriculum development, school development and learner performance
- an increase in involvement in further and higher education
- a greater focus on the Mathematics, Science and Technology learning fields.

2.4.1.1.3.3 The Dakar framework

South Africa is a participant of the Dakar Framework for Action of 2000, which requires a commitment to poverty alleviation through the provision of good quality compulsory education to learners of school-going age, regardless of financial status and capacity (DOE, 2003a). The framework calls for full school attendance in the country by the year 2015.

The goals set out to achieve full access to education are (DOE, 2003a):

- to ensure that all poor schools are sufficiently funded to eliminate the need to charge school fees
- to implement a fee exemptions policy to ensure that no parent need to pay school fees that are too elevated

- to implement a school uniforms policy to prevent price abuse relating to school uniforms.

2.4.1.2 Information Technology Policy related to CAL in South Africa

As South Africa continues to modernise through processes of globalisation and becomes entrenched in international trade and relations, it faces challenges nationally and internationally from the competitive environment perpetuated by an ever changing, and a greater reliance upon, technological development. The 'White Paper on Science and Technology' (Government Communications, 1996) indicates that South Africa currently lacks a national policy to propagate and facilitate the best movement of the country as a whole toward a globally competitive information based society, with no concrete responsibilities or goals clearly outlined. Above that, of the policies that that have been created and implemented in the country, the promotion of technological development still remains lower on the priority list.

Research on the benefits of implementing computers into schools has produced mixed results. Research performed in the United Kingdom, characteristic of industrialised countries, showed evidence of the following gains (DOE, 2001a):

- improved subject learning
- enhanced vocational training across broad ranges of subjects and across the full age range
- a shift towards project focused work and an integrated curriculum
- capacity development in the use of electronic networks to create information access and communication with others.

Research in developing countries has shown that schools that lack resources in general tend to benefit more from the implementation of basic functional computers than schools that are saturated with resources (DOE, 2001a). However, because of a general lack of infrastructure in developing countries, expensive technology implemented into schools tend to be under-used and over-budgeted (DOE, 2001a).

2.4.1.2.1 Policies

2.4.1.2.1.1 The Draft White Paper on e-Education

The general strategy in South Africa is the development of an information society that serves the needs of the country, and benefits individuals, groups and communities at all levels of society (Government Communications, 1996). As opposed to the current model of personal access and increased competition in business and political realms, an ideal of mutual upliftment and co-operation at community level is thought to help redress past indifferences; ensuring that all benefit from technological development (Government Communications, 1996). However, the requirement of funding and resources would heavily always rely on input and support from those in the business sector (DOE, 2003a). At a policy level, because of differences in ICT provision between provinces, there is a need to understand and manage how ICT policy in education at a provincial level relates to national policy of the same nature (DOE, 2003a).

Current national policy has focused on the following issues (NCETDE, 1998):

- a focus on improving ICT infrastructure, as reflected in the White and Green Paper and Tele-communications Act, as well as the Universal Service Agency Working Document

- the establishment of a national standard and regulatory framework for the implementation of ICTs in the country through the creation of the South African Telecommunications Regulatory Authority

- the importance placed on the Mathematics, Science and Technology learning areas as the focus for economic growth in South Africa, as stated in the Science and Technology White Paper

- a focus on the development of information resources at school levels, including basic skills training, information clearing houses and learning sites on the Internet as put forward in the Technology Enhanced Learning Investigation (TELI), performed by the DOE in 1995.

At an educational level, strategies developed around the use of computers in schools are based on the principles outlined in the White Paper for Technology, and are aimed towards (NCETDE, 1998):

- the access to education that is of a high quality, as upheld in the Bill of Rights

- the development of the full potential of South African citizens, through the complete participation in, and contribution towards, a democratic and economically sound country

- the creation of new strategies for efficient and flexible provision of education, through equal distribution of technological and other resources

- the implementation of learner-centred and outcomes-based educational processes at prescribed national standards

- the ongoing process of, and success in, life-long learning

- a creative solutions-oriented environment that supports the widespread use of new technologies

- integrating technology into all spheres of South Africa’s goals of advancement, to improve the country’s development in the use of new technologies.

Currently, a computer related learning policy is in the process of finalisation, and addresses the country’s needs in this regard. The Draft White Paper on e-Education was compiled in September 2003, and called for any input from public and private structures for amendments or general input towards the content thereof. The goal of the e-Education policy is stated as follows (DOE, 2003c: 10):

> “Every South African learner in the general and further education and training bands will be ICT (Information and Communications Technology) capable (that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community) by 2013”.

At the highest level, the Education Ministries seek the following outcomes for an e-Education policy (DOE, 2001a):

- all schools are to have possession of a means of telecommunication, whether it is cellular or landline based

- all schools are to have at least one Internet-linked computer for administration and support purposes

- schools are to have access to Internet-linked computing facilities for learner and teacher use

- after the foundation education phase, all learners must have used computers for the development of their numeracy and language skills

- all learners and teachers are to have basic competence in the use of word processing, spreadsheet, flat database, e-mail and web browser applications

- learners and teachers will have used a number of computer interfaces, comprising of keyboards, touch pads and other devices

- where possible, the school and wider community will make use of the computer facilities after school hours, with cost-recovery when appropriate

- all educational software is to comply with the assessment standards indicated in the C2005

- Thutong, the DOE portal, is to provide access to curriculum and various education related support material.

To reach these goals, the government proposes the creation of e-Schools, which are establishments that are intended to have (DOE, 2003c):

- learners who use ICTs to enhance the learning process

- qualified leaders and management who use ICTs for planning management and administration

- qualified teachers who use ICTs to enhance the education process

- access to resources and information through the use of ICTs that help the delivery of curriculum

- connections to a networked ICT infrastructure

- access to ICT resources for surrounding communities after school hours

- relationships with businesses who fund or assist in computer and general ICT maintenance

- allocated venues for ongoing workshops to train members of local communities in general computer and computer repair skills.

The development of e-schools will also aim to provide service to immediate communities by (DOE, 2003c):

- permitting members of the community to make use of computer facilities after school hours

- receiving various levels of support from community structures and the local business sector to assist in the repair and sustainability of computer equipment

- allowing schools to be used as venues for business consultancies and community training venues for local community computer repair businesses.

Teachers and learners will be required to function across three dimensions in e-schools (DOE, 2003c):

- teachers and learners would need to be able to function across an operational dimension, where skills are developed that allow users to efficiently operate ICTs

- the cultural dimension, where teachers and learners develop the custom of using ICTs for educational purposes, despite the personal level of computer literacy

- the critical dimension requires teachers and learners to consistently question and challenge the levels of success demonstrated by the use of ICTs in education, to refine and improve systems on an ongoing basis.

More specifically for teachers and training, more emphasis is to be placed on pre-service and in-service training, while standards are to be created with accreditation as required by the National Qualifications Framework (NQF) (DOE, 2003c). Each school is to have a teacher that will be required to manage and develop the ICT structure within the school (DOE, 2003c). The standards and progression of teacher professional competencies in the use of ICTs are considered in the policy document to be at the following levels (DOE, 2003c):

- entry level, where teachers have basic computer literacy, are able to use and teach the basic use of computers

- the adoption level, where teachers are able to use computer technologies as support to the traditional teaching, learning, administration and management processes

- the adaptation level, where teachers are able to use computer technologies to enhance the teaching curriculum, and integrate technology into their management and administration practices

- the appropriation level, where teachers are capable of integrating technology into all instructional and learning levels, and integrate the use of computer technologies for administration and management in the context of local communities

- the innovation level, where teachers have the capability to create new learning environments using technologies as flexible tools, creating learning contexts that are collaborative and interactive.

As the computer and CAL implementation process continues, teachers will be managed under an incentive encouragement scheme to integrate the use of ICTs into their teaching and administrative tasks, and the use of technology in schools will become part of the Development Appraisal System, and part of school evaluations (DOE, 2003c). However, the DOE is still to determine what ICT tools a school requires to qualify as an e-School (DOE, 2003c).

Private businesses, non-profit organisations and funding bodies also contribute not only funding and resources, but also to policy creation. The NEPAD E-Schools initiative, launched at the World Economic Forum's Africa Economic Summit, aims to bridge the digital divide on the African continent to provide the skills to thrive in the 21st century (World Economic Forum, 2003a). The initiative aims to provide each African school-leaver with the basic skills to function effectively in the knowledge and information society, while focusing on the youth sector for high intervention aimed at bridging the digital divide and providing the foundations for a more just Global Information Society. It is intended that every NEPAD E-school has a basic information and communications technology (ICT) laboratory, equipped with tools to educate students to function effectively in a knowledge economy, while thousands of teachers are trained in several countries allowing for the pooling of resources and shared experience (World Economic Forum, 2003a). Research shows, however, that the availability of computers alone do not ensure the successful integration of computers into schools (Lafee, 2001), while successful integration of computers into classrooms occurs with peer collaboration, shared technological challenges and extensive practise with technology (Koszalka, 2001), requiring time and technological experience.

2.4.1.2.1.2 The e-Education Policy framework

On its basic premise therefore, the policy aims to advance the following four facets (DOE, 2003c):

- an equity based system, allowing equal access to, and equal competence levels in using ICTs in the education system

- regular access to a reliable and connected ICT network and infrastructure

- the implementation of ICTs as a central facet in teacher pre-service training, as well as the ongoing development of teachers in a professional capacity

- the establishment of norms and standards in teaching and learning processes to shed light on the responsibilities, requirements of compliance and mechanisms for implementation (DOE, 2003c), and include:

    - standards of teacher development; ensuring that teachers are competent at levels stipulated in the National Qualifications Framework (NQF) and that the lesson content meets the required levels

    - educational soundness standards; ensuring that lesson content is relevant, valid and compatible with the digital resources available

    - inter-operability of content standards; focusing on the geographical accessibility, inter-operability, durability, distribution and flexibility of ICT systems

    - rights management norms; including the establishment and maintenance of equitable licensing systems.

2.4.1.2.2 Implementation Strategies

Literature suggests that the successful use of computers in schools is an ideal that is attained through a basic implementation strategy, namely (Bloom *et al.*, 2002):

- an implementation phase
- an evaluation phase
- a refinement stage based on a set of best practises.

South Africa finds itself predominantly in the implementation phase, although a very small percentage of schools in South Africa have extensive Information Technology related resources. In South Africa, a significant backlog exists of schools without computers and schools without computers tend to lack other media equipment in general, such as Video Cassette Recorders, radios, tape recorders, slide projectors and overhead projectors (NCETDE, 1998). In comparison to the United States, being amongst the countries in the world that lead in the integration of computers into schools, the table below indicates the speed of integration in developed countries with sufficient resources and funding at hand.

Table 3: Percent of Public Schools in the USA with Internet Access From 1994-2001

Year	Percentage
1994	35
1995	50
1996	65
1998	78
1999	95
2000	98
2001	99

Source: (Loschert, 2003)

Literature indicates that the use of ICT clusters in developing countries, particularly in rural areas, work to develop ICT capability and potential (Hugo *et al.*, 2001). However, ICT clusters are traditionally reliant on first world technologies and software that put locals in remote and traditional areas at a disadvantage, and are therefore only usually accessed by small groups of educated people (Hugo *et al.*, 2001). However, the ideal of indigenous ICT clusters provide insight into ways that international technologies may be customised to suit local communities, therefore reaching a greater audience and providing a significant impact on poverty and education levels in poorer and remote areas (Hugo *et al.*, 2001). Also, customisations may find a place in larger international markets and could therefore become institutions that not only generate skills development, but personal revenue that could create significant growth in local communities (Hugo *et al.*, 2001).

More specifically, in order of significance, the factors preventing South African schools from acquiring computers are (NCETDE, 1998):

- no widespread infrastructure to supply electricity
- insufficient funds
- no building space
- Not enough available or trained teaching staff
- poor security measures in place.

Research performed in South African schools with computer resources indicated the following as factors (in order of priority) that would help promote the teaching of computer skills at schools (NCETDE, 1998):

- increased time dedicated to the task of teaching computer skills
- the inclusion of a greater range of computer skills in the curriculum
- an increase in the depth of knowledge of computer skills

- at the least part, an increase in resources at school level.

When schools were asked to indicate what factors prevented schools from implementing computers, the following were indicated most frequently (NCETDE, 1998):

- insufficient funds
- lack of computers
- poor computer literacy among teachers and school staff
- unavailability of subject teachers trained in how to integrate computers into learning areas
- no developed curriculum for teaching computer skills.

When asked to consider in which areas computers would be most useful, being used in administration and management received the most consensus, while being used in the teaching and learning context also received some support (NCETDE, 1998).

While schools that do not have sufficient basic resources usually do not successfully acquire computers, some schools that do have enough resources also fail at successful computer implementation (NCETDE, 1998): South African schools that successfully implement computers usually have the following characteristics (NCETDE, 1998):

- smaller class sizes
- the ability to rely on parents to contribute additional financial costs
- the ability to integrate the use of computers effectively into the normal school routine

- schools have the availability of a dedicated computer teacher at the school

- the tendency to have had computers for a relatively longer period of time.

A larger number of schools in South Africa do not have the most basic infrastructural resources required to implement computers, have larger classes as well as lack of funding and trained computer staff (NCETDE, 1998). Thus these factors are indicative of the challenges that exist when wanting to integrate computers into South African schools

As set out in the Draft White Paper on e-Education, the DOE aims to develop a system-wide approach to the nation wide implementation of computers in schools; opting to develop a system of technology practice that benefits schools as a whole, classrooms, learners and teachers, school management and the local communities (DOE, 2003c). The DOE feels that the experiences of initial small scale implementation have provided enough success to validate a system wide approach to implementation (DOE, 2003c). The DOE therefore plans to adopt a “multi-pronged strategy for the gradual integration of ICTs at all levels of the education and training system” (DOE, 2003c: 29), guided by targets and goals set at national level. Annual insight into the status of progress will alter and modify yearly targets based on (DOE, 2003c):

- the level of readiness of schools to become e-schools

- the number of ICT trained teaching staff

- the type of teaching content available

- the ratio between learners and computers

- the technologies currently used in schools and classrooms

- the level of Internet connectivity nationally.

The policy indicates that the development of a Ministerial e-Education Advisory Council, consisting of key stakeholders from various fields, will consistently monitor and evaluate the progress and success of implementation through regular reviews and the collection and analysis of data, while an e-Education inter-departmental team will manage and administrate the implementation of the e-Education policy (DOE, 2003c).

The planning cycles for the implementation strategy are laid out in a multiyear format of action, consisting of three major phases of integration (DOE, 2003c):

- phase one - enhance system-wide and institutional readiness to use ICTs for learning, teaching and administration (year 2004 to 2007)

- phase two - system-wide integration of ICTs into teaching and learning (year 2007 to 2010)

- phase three - ICTs integrated at all levels of the education system: Management, teaching, learning and administration (year 2010 to 2013).

As provinces differ in the level of ICT integration into schools and in the number of resources available, it is assumed that the time allocated will allow all provinces to plan and determine locally, in a sufficient time frame, what is required to reach the targets set out before them (DOE, 2003c).

At a project level, Schoolnet, whose development was assisted by the DOE, works independently to connect schools to the Internet, but is funded by government departments. The organisation aims to support education through the use of information and communications technology to provide leadership and expertise in the areas of Internet connectivity, human resource development, development of curriculum and marketing (Kwape, 1999).

2.4.1.2.2.1 Phase one: Enhance system-wide and institutional readiness to use ICTs for learning, teaching and administration (year 2004 to 2007)

Phase one consists of the following delineated steps (DOE, 2003c):

- the establishment of an education and training system that supports the integration of ICTs into education practice

- building the confidence of teaching and management staff to use ICTs, by ensuring that each teacher has access to, and training in the use of, computer technologies

- make ICT competency a priority in teacher development at pre-service and ongoing training levels, by ensuring that teachers have access to in service training facilities to train how to integrate the use of ICTs in instructional processes, as well as technical support

- integrate and establish “an ICT presence in schools” (DOE, 2003c: 32) by ensuring that every school has a computer for administration use, that 50% of schools are able to access a networked computer facilities for education purposes, that computer systems are being used effectively and that computers systems are secure in schools

- ensure that the content of educational material is of excellent quality and at parity with the relevant national norms and standards, while having access to databases of content resources available for teacher usage

- having 50% of schools connected to an Educational Network, with access to the Internet and ongoing electronic communications, that allow electronic communication with provincial educational authorities

- allowing communities and local businesses to utilise computer facilities at schools, and in return provide technical and financial support toward the facilities.

2.4.1.2.2.2 Phase two: System-wide integration of ICTs into teaching and learning (year 2007 to 2010)

Phase two involves the following (DOE, 2003c):

- the integration of ICTs into the management process and curriculum by ensuring that:

    - half of all teachers are trained in techniques of ICT integration into educational processes

    - teachers are able to access technical support training

    - 80% of managers actively use ICTs in daily management

    - consistent evaluations and research provide feedback on the progress and status of ICT integration into schools

- the widespread presence of ICTs in schools, pushing the availability of at least a single networked computer facility in schools up to 80%, that ICT systems are safe and in working order and at the same time successfully integrated into the educational context, while an individual at each school is appointed to manage and promote this process

- further ensuring that the content of educational material produced by teachers and schools is of excellent quality, that teachers have access to digital libraries for creating resources and share these resources with other teachers and at the same time are accessing and using the educational resources available on the 'Thutong' educational portal

- having all schools connected to an Educational Network, with access to the Internet and ongoing electronic communications

- ensuring that all schools have community support to maintain, sustain and provide technical support to the computers at schools in local communities.

2.4.1.2.2.3 Phase three: ICTs integrated at all levels of the education system: Management, teaching, learning and administration (year 2010 to 2013)

The final phase aims for the following (DOE, 2003c):

- ICTs are fully integrated into management, administrative, communication and evaluation processes

- all learners and teaching staff are competent in the use of ICTs

- ICTs have been integrated into the educational processes at all schools

- all teaching staff have incorporated the use of ICTs into curriculum delivery

- all schools have access to and make use of at least a single networked computer facility for educational processes

- ensure that all computer software used at schools is of excellent quality

- Ensure that all schools access and utilise the 'Thutong" educational portal to create a learning environment that is based on an OBE approach

- working so that all communities are involved in e-schools

- ICT use and modifications that are driven by research and development.

2.4.2 COMPUTER RESOURCES IN SOUTH AFRICAN SCHOOLS

2.4.2.1 South Africa in the Global Context

Globally, computer and Internet usage is at higher levels in industrialised countries, while populations who are more affluent, or more educated, are more likely to be users of information technology (Ishaq, 2001). The 'digital divide' refers to the technology gap that separates richer and poorer countries; a divide that finds its origins in the period of the Industrial Revolution (Ishaq, 2001). It is unknown whether poorer countries will find themselves thrust into economic prosperity as they adopt a technological predisposition, or whether the digital divide will serve to widen the breach between the haves and have-nots, creating populations that are void of technological wealth that will remain so for a considerable number of years (Ishaq, 2001).

Despite the conceptual feasibility of the development and economic growth that parallels technological progress, the current status of Internet use in Africa and South Africa provides insight into the 'digital divide' and reflects the lack of technological resources, as well as the further factors that restrict access to such media.

2.4.2.1.1 Internet Usage in Africa as a Whole

In general, statistics on Internet use is erratic and varied. Recent statistics (Africa Online, 2002b) indicate a general increase in the number of dial-up Internet subscribers in Africa as a whole. A recent report by Africa Online indicates a rise of 20% over the 2001 to 2002 period, tallying the current figure at 1.7 million dial-up subscribers in total - 1.2 million of whom are based in North Africa and South Africa (Africa Online, 2002b). Of the 770 million people in Africa, one in every 150, or approximately 5.5 million people in total, now use the Internet (Africa Online, 2002b). Another report indicates that there is roughly one Internet user for every 200 people on the African continent, compared to a world average of one user for every 15 people, and a North American and European average of about one in every 2 people (Akst *et al.*, 2001).

Although Africa is becoming increasingly wired, access to the Internet remains limited particularly due to the in abundance of phone lines (Hall,1998) and the poor power supply infrastructure throughout the continent (Akst *et al.*, 2001). The high levels of poverty in Africa, the lack of structured telecommunications and the fact that Africa, particularly Sub Saharan Africa, has the least developed infrastructure in the world, means that Africa remains, at the back of the information technology race in the world (Akst *et al.*, 2001). Although Africa harbours 13% of the world's population, only 2.5% of the world's televisions can be found on the continent, while other research studies claim that the general use of computers is currently reserved to 3 per 1000 people (Akst *et al.*, 2001). More specifically, at the end of 1999 Ghana had eight telephone lines per every 1000 people, compared to Norway that owns the most developed and advanced telecommunications infrastructure in the world, with 712 lines per 1000 people (Accra Mail online, 2001). By 2000, only 25 African countries could supply universities with Internet access (Akst *et al.*, 2001).

However, within the African context Internet use peaks in the Northern and Southern areas of the continent (Akst *et al.*, 2001). Literature indicates that at the time of auditing, North Africa was responsible for 200 000 Internet subscribers, South Africa for 650 000, and the rest of Africa for 150 000 users (Akst *et al.*, 2001). The total users in Africa is estimated at three million, two thirds of whom reside in South Africa, converting to a ratio of one user per 750 people (Akst *et al.*, 2001). This compares to a world average of one user per 35 people and a peak of one user per 3 people in North America and Europe (Akst *et al.*, 2001).

Despite the lack of infrastructural and skills-readiness in the African continent to fully utilise information technology and a lack of research in the assimilation of innovation in Africa, African countries continue to receive large donations of computer technologies for the aim of sustainable development. The World Economic Forum's World Computer Exchange Programme has a mission to (World Economic Forum, 2003b: 1):

> "Act as a partner and ally in bridging the global digital divide for youth, promoting cultural understanding between students in industrialized and least developed countries, and facilitating the use of technology and experiential education in education reform".

It has been responsible for the shipping of 1 540 computers to Benin, Cameroon, India, Nepal and Nigeria with the plan to implement computers in 870 schools, with 323 000 students, in 24 developing countries (World Economic Forum, 2003b). The World Computer Exchange Programme has developed partnerships with 22 teams responsible for sustainable development within each targeted country, based on 42 agreements signed for agreed development, as well as World Computer Exchange teams collecting computers in Boston, New Haven, San Francisco, Stockholm, Sydney, Tokyo and Washington DC (World Economic Forum, 2003b). Since 1997 the World Bank too has been involved in sponsoring a worldwide supported project to train teachers in 261 African schools to use the Internet, with the intention to spread the knowledge at grassroots level to peers and communities (Akst *et al.*, 2001). Research shows, however, that increasing the availability of computers in schools in itself does not guarantee the usage and successful integration thereof and that positive peer collaboration, practise with technology and the sharing of technological understanding serve more to promote technological integration (Koszalka, 2001), particularly challenging in the African context.

However, literature indicates that the future looks positive for technology in Africa. Almost all African countries have state-controlled telecommunications bodies that have the monopoly across the markets, but reports indicate that the communications market is to be opened up across the continent, due to increased pressure from international agencies such as the World Bank, the IMF and other major donor agencies (Hall, 1998). The price of connectivity, and therefore technology itself, is predicted to decrease with increased competitiveness, resulting in further participation in, and emergence of, communications technologies particularly in isolated communities (Hall, 1998).

2.4.2.1.2 Internet usage in South Africa

Literature indicates that South Africa is ranked seventeenth in the world with regard to the number of Internet users, as acknowledged by the national domains and service providers, and has an information technology infrastructure in the financial and business sectors that is at levels currently found in Europe (Hall, 1998). Opposed to the average of the continent as a whole, one in fifteen South Africans had Internet access by the end of 2001, compared to countries leading in Internet use with one Internet user for every two people in America, Canada, Singapore, South Korea and Hong Kong (Africa Online, 2002a). The general contrast with the rest of the continent is also highly significant.

Table 4: Internet Use in Southern Africa

	Population (2003 Est.)	Internet Users Dec 2000	Internet Users, Latest Data	Growth (2000-2003)	% Population (Penetration)	(%) Users
Botswana	1,762,100	15,000	**50,000**	233.30%	2.80%	0.60%
Lesotho	2,523,400	4,000	**5,000**	25.00%	0.20%	0.10%
Mozambique	18,151,100	30,000	**30,000**	0.00%	0.20%	0.40%
Namibia	1,923,800	30,000	**45,000**	50.00%	2.30%	0.60%
South Africa	45,919,200	2,400,000	**3,100,000**	29.20%	6.80%	38.40%
Swaziland	1,068,600	10,000	**20,000**	100.00%	1.90%	0.20%
Zimbabwe	14,300,700	50,000	**500,000**	900.00%	3.50%	6.20%
Angola	13,036,300	30,000	**41,000**	36.70%	0.30%	0.50%
TOTAL AFRICA	**879,855,500**	**4,514,400**	**8,073,500**	**78.80%**	**0.90%**	**100.00%**

Source: Adapted from "Internet Usage Statistics for Africa (Internetworld, 2004)"

Table 4 indicates that within Sub-Saharan Africa, South Africa dominates the levels of Internet Usage with a 38% share of Internet use within the continent as a whole, while Zimbabwe falls at 6%. Within the Sub-Saharan region, each country, with the exception of Mozambique, has shown vast increase in Internet use, most notably so for Zimbabwe and Swaziland who had a 900% and 100% increase respectively in the four year period from 2000 to 2003.

While statistics indicate that subscribers are increasing, access to such technology in South Africa remains divided between the haves and the have-nots in term of access, indicative of the so-called 'digital divide'. Literature stipulates that the majority of those with access are from privileged white minority sectors of the population, based on the telecommunications infrastructure of the country (Akst *et al.*, 2001; Hall, 1998). Research indicates that the average South African using the Internet largely reflects the average person worldwide (Hall, 1998): of male gender, with higher levels of education, aged at thirty five years, residing in urban areas, earning an above average income and able to access the Internet every day. In terms of infrastructure, almost 90% of white people in South Africa have telephones in their homes as opposed to 12% of Africans (Hall, 1998). The major disparity in South Africa is the contrast between the "urban, largely white and increasingly commercial users of information and communications technology, and rural, overwhelmingly African, communities who have partial access to basic telecommunications" (Hall, 1998: 4). In South Africa, the 'digital divide', therefore does not solely fall on a line of social class, but rather a disparity in a variety of factors, including among others race, wealth and geography.

2.4.3.2 The Profile of Information Communications Technologies in South African schools

One of the more dominant trends that affects South Africa's distribution of resources and planning is the globally emerging information society that is distinguished by

> "the globalization of markets, a shift toward service industries in the major economies, and an explosion of information coupled with the means to process this information…[that] impact on all levels of our society, especially in the creation and loss of work opportunities" (DOE, 2001a: 7).

Literature published by the South African Department of Communications indicates that the capacity to fully integrate the use of information, particularly in providing increased access to its citizens, is accepted to be the most important aspect in the competitiveness between countries internationally (Government Communications, 1996). Table 5 shows that in general radios, televisions and telephones remain the most widely used media in South Africa (Nationmaster, 2003). While almost 4 in 10 people have radios in South Africa, only approximately 1 in 10 people have access to televisions and telephones, indicating the extent of the general lack of media resources in South Africa. Less than 1 in 10 people in South Africa use computers and the Internet (Nationmaster, 2003).

Table 5: General Media Use in South Africa

Media	Total in use	Users per 1000 people
Internet users	3.068 million (2002)	70
Personal computers	2.9 million (2000)	66
Radios	17 million (2001)	389
Televisions	6 million (2000)	137
Telephones - main lines in use	More than 5 million (2001)	115
Telephones - mobile cellular	7.06 million (2001)	162
Fax machines	Not supplied.	2

Source: (Nationmaster, 2003)

The same department calls for increased research in the human sciences with specific regard to the processes of innovation in South Africa, and name the following roles that research will play in this context (Government Communications, 1996):

- provide insight into the social responses and challenges as a result of innovation
- assist in suitable technological change in the South African society and economy
- provide accurate information to assist in policy analysis
- be an objective provider of knowledge, allowing accurate evaluation of the country's transformation.

Emerging technologies have been implemented into educational settings to make the process of instruction more effective (Semple, 2000). An array of media have made their entrance into classrooms, with the use of television and video technology, slide projectors, overhead projectors, audio equipment and the like in educational settings to make the process of interaction more engaging. Computers, the recent addition to classrooms worldwide, are responsible for an imminent emergence of technology-assisted education (Schofield, 1995), by providing "an optimal means for storing, searching, and retrieving educational materials, and for composing and editing written work; and permitting self-directed and individualised instruction and feedback in almost any area of interest" (Barak, 2001: 1). The widespread use of the Internet also allows for the possibility of e-learning and distance education opportunities in educational sectors (Barak, 2001).

2.4.2.2.1 Access to Computers in Schools

In 2002 a total of 39.2% of all schools in South Africa were in possession of computers (DOE, 2003c). The growth rate that at which schools acquired computers between the years 2000 and 2002 averaged 59%, and was higher for secondary than primary schools (DOE, 2003c). Predictions show that at the same growth rate, 9 278 schools in South Africa will have computers at the end of 2004 (DOE, 2003c). In 1999, 12.3% of all schools had computers for teaching and learning purposes, while 26.5% claimed the same in 2002, showing a growth of more than 100% (DOE, 2003c).

While the government, the private sector, nongovernmental organisations and various funding bodies have been involved in bridging the digital divide within the educational system as well as the country as a whole (DOE, 2003c), in general, the provinces in South Africa differ with regard to the integration of computers into education. Table 6 below indicates the variances between provinces.

Table 6: Schools with Computers in South Africa by Province in 2002 in Percentages

Provinces	Schools with Computers in %	Schools with computers for teaching and learning in %
Eastern Cape	8.8	4.5
Free State	25.6	12.6
Gauteng	88.5	45.4
KwaZulu-Natal	16.6	10.4
Mpumalanga	22.9	12.4
Northern Cape	76.3	43.3
Limpopo	13.3	4.9
North West	30.5	22.9
Western Cape	82.4	56.8
National	**39.2**	**26.5**

Source: (DOE, 2003c)

In general the schools in Gauteng, the Northern Cape and the Western Cape have better ICT infrastructures. Schools in the Free State, Kwazulu-Natal, Mpumalanga and the North West have an infrastructure that falls in the middle of the continuum, while the Eastern Cape and Limpopo provinces fall at the lower end. Of the schools that had acquired computers by 2002, less than half of the schools in the Free State and Limpopo provinces were using computers for teaching and learning purposes. In the other provinces, more than half were doing so.

Although access to technology has remained the primary issue, the inability of users to effectively resource the technology also remains a national challenge in South Africa, with difficulties in accessing content of acceptable standards, creating own content, communicating and collaborating and the integration of computers into teaching and learning (DOE, 2003c).

2.4.2.2.2 Computer Hardware in Schools

The standard method of organising computers has been to isolate and position the machines in a specified room, referred to as a computer laboratory, requiring users to congregate in the room to access the technology (DOE, 2001a). Although of benefit for the organisation, administration, cost reduction and theft prevention purposes, the computers have remained isolated from the rest of the school system, lowering general productivity by only allowing each user about 30 minutes of access per week (DOE, 2001a).

Research indicates that of schools that have computers, 44% have between 11 and 29 computers, 38% have 30 or more computers, while 20% have 10 or less computers (NCETDE, 1998). In general, secondary and combined schools tend to have more computers than primary schools, while schools that offer Computer Studies as a school subject also tend to have more computers and more up to date equipment than schools who do not offer the same (NCETDE, 1998).

Greater than 40% of all schools who have computers have access to the Internet, while 6 in 10 schools that have computers also have computer networks (NCETDE, 1998). Among secondary schools with computers, 49% have access to the Internet, while 35% of primary schools can claim the same (NCETDE, 1998). In general, urban areas tend to be better connected than peri-urban and rural areas. Although Internet use in schools is becoming more common, due to high telecommunication and connectivity costs, little local content and inadequate local pedagogical and technical support, Internet use for teaching and learning purposes remains very limited (DOE, 2003c).

Nationally in schools that have computers, in order of significance, 56% of learners, 53% of teachers, 43% of management and 27% of administration have personal e-mail addresses (NCETDE, 1998). In 11% of schools with computers, more than 50% of teachers have personal school e-mail addresses (NCETDE, 1998). In general, schools that are well resourced, that started using computers before 1990, and that offer Computer studies as a school subject tend to have higher rates of computer use among teachers (NCETDE, 1998), while schools that began using computers before 1990, that offer Computers Studies as a learning subject and that have more than 30 computers have higher levels of personal access to e-mail facilities for teachers at schools (NCETDE, 1998). Literature indicates that the use of e-mail facilities in schools is predominantly for management and administrative purposes, and for teaching and learning at a much lesser extent (DOE, 2003c).

A small percentage of schools claim that more than half of their students have access to computers at home, 10% of schools indicate that none of their students have access to computers at home while the majority of schools claim that less than half of their students have access (NCETDE, 1998).

2.4.2.2.3 Software Use in Schools

In schools that have computers, 94% use administrative software, 88% use word processing software, 67% use programming languages, and 60% use spreadsheet software (NCETDE, 1998). More than half of schools with computers use electronic information resources in the form of CD-Rom encyclopaedias and information banks, while the use of presentation software is also widespread (NCETDE, 1998). In order of functional priority, computers in schools generally are used more often in descending order for the following (NCETDE, 1998):

- administration and management processes

- as learning tools
- to teach computer skills
- for lesson preparation.

In general, schools that are better resourced tend to have a greater variety of uses for computers in the school context, though levels of resources do not necessarily dictate the efficiency of computer use (NCETDE, 1998).

Generally in schools, emphasis is placed on software that caters for administration and management in schools, the development of basic computer skills and work in drill and practise formats (NCETDE, 1998).

Of all schools studied, 80% indicate that drill and practise software is the most important use for computers in educational computing at schools, as indicative of current usage, though an expanded awareness is expressed to find ways to increase the variety of computer use functions in schools (NCETDE, 1998). More specifically, interviews performed with school teachers reflect criticisms of the tendency of schools to orient more toward drill and practise software than problem and solutions oriented software, leaving the benefit beyond traditional teaching methods, through the medium of textbooks and the like, questionable (NCETDE, 1998). Studies indicate that a traditional dominance of drill and practise software has historically occurred in educational computing at schools, particularly in the Mathematics and Language learning areas (NCETDE, 1998). The use of other computer functions therefore, such as the Internet and e-mail facilities, has and is becoming more common in educational computing (NCETDE, 1998).

2.4.2.2.4 Subjects Taught Through the Use of Computer

Research studies indicate that educational computing features the most in the Languages, Mathematics, Natural Sciences and Technology learning areas, while generally being less prominent in the Humanities and Arts learning areas (NCETDE, 1998). More specifically in secondary schools, greater degrees of computer use for instructional and learning purposes tends to occur predominantly in the Technology learning areas and to a greater degree for Computer Studies (NCETDE, 1998). In schools where Computer Studies is offered as a learning subject, the use of computers in the teaching of Technology and the Natural Sciences tend to be more prominent, while the use of computers for Mathematics and Language instruction tends to be higher in schools that do not offer Computer Studies as a subject (NCETDE, 1998).

With regard to the teaching of computer skills, fundamental computer principles and word processing skills form the bulk of teaching material in both primary and secondary school contexts, but the level of complexity tends to be higher in secondary schools (NCETDE, 1998). However, learners in primary schools on average are able to spend less than one hour per week learning and developing computer skills (NCETDE, 1998). On the other hand, learners in secondary schools are able to spend larger amounts of time using computers if the resident school provides Computer Studies as a subject, usually with the added facility of a larger availability of computers in isolated computer laboratories (NCETDE, 1998).

2.4.3 Factors Influencing CAL Implementation in South Africa

2.4.3.1 Infrastructural Factors

In 1996 and 2000 research audits were conducted of all the schools in the country, performed by The Education Foundation, Council for Scientific and Industrial Research (CSIR) and Markdata. Termed the ‘Schools’ Needs Register (SRN)’, the audits aimed to collect information on the resources and levels of infrastructure of all schools in the country as a whole, and measure levels of progress achieved in the period from 1996 to 2000 (Asmal, 2000). The findings, as demonstrated in the *Brochure for the 2000 School Register of Needs* (Asmal, 2000) provide insight into the successes and challenges that are faced regarding the implementation of basic resources in South African schools. Literature suggests that the lack of electricity and other basic facilities are significant barriers to overcome if the widespread implementation of computers with up to date technologies is the vision in South Africa, while the intention of integrating large scale technologies into the education system could help to improve levels of education as well as correct educational imbalances in the country (Addison *et al.*, 1997).

2.4.3.1.1 National Infrastructure

2.4.4.1.1.1 The Number of Schools

With regard to the number of schools in the country, the Brochure for the 2000 School Register of Needs report identifies that the Eastern Cape and Kwazulu-Natal share the largest number segment of schools in the country, with 23% and 21% respectively (Asmal, 2000). The Northern Province, at a 16% share, is the only other province to have a share of greater than 10%. The Northern Cape has the smallest share of schools at 2% (Asmal, 2000). The vast differences in the number of schools per province, as well as the proportional breakdown of primary, combined and secondary schools would have an influence on the way that budgetary requirements are set for computer technologies and the method of how computers are implemented per region.

Table 7: The Number of schools in South Africa

Region	Combined	Primary	Secondary	Total Schools	% Breakdown of Total Schools
Eastern Cape	2536	2837	880	6260	23
Free State	351	1884	264	2500	9
Gauteng	308	1359	518	2204	8
Kwazulu-Natal	353	3920	1449	5734	21
Mpumalanga	219	1262	328	1810	7
Northern Cape	117	299	66	482	2
Northern Province	129	2711	1392	4261	16
North Western Province	507	1481	309	2304	8
Western Cape	219	1063	307	1593	6
National	4,739	16,816	5,513	27,148	100

Source: (Asmal, 2000).

2.4.3.1.1.2 Human Resources

Regional differences in the total number and proportion of teachers and learners would influence to some extent how computers are implemented in schools. The average national learner to educator ratio has remained unchanged at 32 learners to 1 educator since 1996 (Asmal, 2000). Differences between provinces, however, are mixed (Asmal, 2000):

- the Eastern Cape, the Northern Cape and the Northern Province have experienced downward trends in learner to educator ratio due to an increase in the teaching workforce

- Gauteng, Mpumalanga and the Western Cape have trended upward due to an increase in learner enrolment figures

- the Free State, Kwazulu-Natal and the North Western Province remain unchanged.

There has been a general decline in the number of learners enrolled in schools in most provinces with Gauteng, Kwazulu-Natal and the Western Cape proving the exception (Asmal, 2000). This is a parallel to a national decrease of 1.3% in the number of educators from 1996, dropping from 370 599 to 365 965 educators (Asmal, 2000). This too varies between provinces, with the Eastern Cape increasing their teaching workforce by 3929 educators. However, the DOE (DOE, 2001b) claims that there are shortages of qualified educators in learning areas such as Science, Mathematics and Accounting in the Further Education and Training[10] phase, which results in lower learner uptake into these fields. The General Education and Teaching[11] phase experiences the same shortfall in the Culture, Economic and Management Sciences, and Technology learning areas and is considered serious as these learning areas are compulsory at the GET level (DOE, 2001b). A lack of teachers, if designated a priority as some schools would prefer more

[10] FET
[11] GET

experienced and qualified teachers (Richard, 2003), could mean more budgetary input at the expense of other resources, possibly of computer and educational technologies.

Table 8: The Average Number of Learners per Educator in South Africa (1996 and 2000)

Region	1996	2000
Eastern Cape	35	32
Free State	31	31
Gauteng	27	29
Kwazulu-Natal	34	34
Mpumalanga	36	39
Northern Cape	29	26
Northern Province	33	31
North Western Province	29	29
Western Cape	25	31
National	**32**	**32**

Source: (Asmal, 2000).

2.4.3.1.1.3 Power

In 2000, 53% of all schools had access to either grid, solar or generator forms of power, showing an increase of 13 percentage points from 40% of schools claiming the same in 1996 (Asmal, 2000). Solar power is used nationally in 6.7% of all schools (Asmal, 2000), while a quarter of schools in the Eastern Cape make use of solar power (Asmal, 2000). Lower levels of power not only have significant limitations on the implementation of computer technologies that require power to function, but are also needed for the basic daily functioning of schools in general and could be seen as priority for implementation.

2.4.3.1.1.4 Sanitation and Water

There has been a significant increase in the provision of sanitation in schools in South Africa. In 1996 55% (6.6 million) of learners in schools were without toilet facilities, at a ratio of 42 learners per toilet (Asmal, 2000). In 2000, the number had improved to a lower figure of 16.6% (1.9 million), at a ratio of 38 learners per toilet (Asmal, 2000). However, 15% of toilets were found not to be in working order, especially in schools in the rural areas (Asmal, 2000).

In 1996, 40% of schools nationally had no access to water (Asmal, 2000). In 2000 34% of schools claimed the same, an improvement of 6% (Asmal, 2000). The greatest fluctuations were in the Northern Province at 12%, Mpumalanga at 10% and the Free State at 9% (Asmal, 2000).

Lower levels of sanitation and water are also needed for the basic daily functioning of schools in general, and could be seen as priority for implementation as a basic need over that of technology in schools.

2.4.3.1.1.5 Telecommunications and Access to Technology

In 1996 59% of schools nationally had no access to telephones, while in 2000 34% of schools claimed to have no telecommunications facilities; the improvement is believed to have been driven by a growing cellular phone industry (Asmal, 2000).

Although there has been an increase in access to technology, over 70% of schools in South Africa are without computers (Asmal, 2000). In 1996 2241 schools shared 34483 computers, while 6581 schools reported a total of 59 333 computers in 2000 (Asmal, 2000). The difference between provinces is noteworthy. At the highest end the Eastern Cape had 84% of schools without computers, while only 16% of schools in Gauteng could claim the same (Asmal, 2000).

Table 9: Schools with No Access to Computers for Learning or Administration in South Africa

Region	**Percentage of schools with no access to computers**
Eastern Cape	84
Northern Province	82
Mpumalanga	83
Kwazulu-Natal	78
North Western Province	76
Free State	71
Northern Cape	41
Western Cape	20
Gauteng	16
National	**70**

Source: (Asmal, 2000).

Literature indicates that a disparity exists between the desire for technology in schools, and the suggestion that technology should be the final acquisition in schools after all basic infrastructural needs have been satisfied (Johnson, 2003; Richard, 2003). Although acknowledged as an important tool for teachers to use, a lack of qualified and experienced teachers, schools managers and high levels of education are required to help schools in areas of poverty create a learning context that will help learners opportunity to better their future prospects (Richard, 2003). Maslow's hierarchy of needs, as placed in the educational context, requires that all infrastructural needs of administration and adequate physical and human resources are met before technology related learning systems are implemented, as technology may not have the desired positive effect on learners if their learning environments are under resourced (Johnson, 2003). South African schools vary considerably from well resourced schools that are characteristically reflective of first world affluence and financially supported by wealthier communities, while rural schools on the other hand are poor and receive little support from local communities where a majority of parents are illiterate (DOE, 2003a). A priority for the DOE in South Africa is stated as ensuring that as many poor schools as possible do not have to charge school fees due to inadequate funding, so as to ensure that more children of school going ages as possible attend school (DOE, 2003a). The DOE is also intending to provide school meals in poorer areas as learners are not able to concentrate in learning contexts when under-nourished, while the availability of food at schools is seen as an incentive for poorer parents to bring their children to school on a regular basis (DOE, 2003b). In this context, the decisive split between dedicating budgets for implementing technologies, and continuing to provide opportunities for education for poorer children and providing basic resources for poor schools, may be one that requires much research and debate.

Also, other learning resources have proven to be as effective as computer technologies. The use of textbooks has proven to be effective and is able to reach a greater audience despite a lack of electricity and other basic resources (DOE, 2003b). However, textbooks are shown to require greater funding in South Africa due to the lack of competitive suppliers and low retrieval rates in schools (DOE, 2003b). Literature indicates that access to technology itself does not equate to the implementation of technology in schools, as adequately trained staff, adequate technical support and long term planning are required to ensure the efficient and adequate integration of computer technologies into schools (McCabe *et al.*, 2003; Robinson *et al.*, 2003). The use of other traditional media therefore may be more relevant in the context of South African schools, and the placing of computers into schools may be a resource intensive process that, with poor planning, may prove unsuccessful and unnecessary.

2.4.3.1.2 School Level Infrastructure

2.4.3.1.2.1 School Facilities

In 1996 83% of schools were without media centre facilities, while in 2000 an improvement of 3% meant that 80% claimed the same (Asmal, 2000).

Table 10: Percentage of Schools without Media Centres in South Africa

Region	1996	2000
Eastern Cape	93	91
Free State	89	85
Gauteng	56	48
Kwazulu-Natal	82	80
Mpumalanga	85	85
Northern Cape	67	64
Northern Province	95	92
North Western Province	86	81
Western Cape	48	42
National	**83**	**80**

Source: (Asmal, 2000).

Library facilities are found in 17% of schools in South Africa, while 50% claim to have sufficient resources of textbooks (Asmal, 2000). Of all the schools nationally, 37% report not to have any sports facilities (Asmal, 2000).

The largest deficit is found in the Free State where half of the schools are without sports facilities (Asmal, 2000).

Table 11: The percentage of Schools without Sports' Facilities in South Africa

Region	Percentage of schools without sports facilities
Eastern Cape	38
Mpumalanga	28
North Western Province	31
Northern Cape	33
Gauteng	35
Kwazulu-Natal	35
Western Cape	35
Northern Province	40
Free State	50
National	**37**

Source: (Asmal, 2000).

2.4.3.1.2.2 Conditions of Buildings

The number of schools that are considered to be in excellent or good condition has decreased since 1996, due to less investment toward general maintenance of infrastructure (Asmal, 2000).

Table 12: The Condition of School Buildings in South Africa in Percentages

Year	Excellent	Good	Need repairs	Weak	Very Weak
1996	7	35	41	12	5
2000	4	16	47	27	9

Source: (Asmal, 2000).

The number of school buildings that were being renovated in 2000 also varied by province (Asmal, 2000).

Table 13: The Number of School Buildings Currently Being Renovated in South Africa

Region	Number of schools
Northern Cape	10
Mpumalanga	12
Free State	18
Gauteng	19
North Western Province	26
Northern Province	29
Western Cape	49
Eastern Cape	59
Kwazulu-Natal	92
National	**314**

Source: (Asmal, 2000).

Of particular interest is the external wall structure of school buildings in South Africa, where almost a quarter of schools in the Eastern Cape have school buildings constructed of mud, while the Northern Cape and Western Cape have a significant number of prefab based schools (Asmal, 2000).

Table 14: External Wall Structures of School Buildings in South Africa in Percentages

Region	Brick	Concrete	Mud	Prefab
Eastern Cape	36.0	31.0	23.0	6.0
Free State	72.0	17.0	1.8	3.0
Gauteng	84.0	10.0	0.6	3.0
Kwazulu-Natal	30.0	64.0	3.0	1.0
Mpumalanga	52.0	23.0	2.0	0.0
Northern Cape	73.0	12.0	1.0	10.0
Northern Province	86.0	9.0	0.5	1.0
North Western Province	85.0	10.0	0.6	1.0
Western Cape	76.0	6.0	0.2	15.0
National	**58.0**	**27.0**	**6.0**	**3.0**

Source: (Asmal, 2000).

2.4.3.2 Social Aspects

2.4.3.2.1 Overcrowding

In 2000, 1023 schools used the facilities of other schools for education purposes; a decline from 1264 in 1996 (Asmal, 2000). In 2000, 41% of schools nationally claimed to have classroom shortages; an improvement of 8% from 1996 (Asmal, 2000). The Eastern Cape, the Free State, Gauteng, Kwazulu-Natal, Mpumalanga, the Northern Cape, the Northern Province and the North Western Province had a decrease in classroom shortages, while Gauteng, Mpumalanga and the Western Cape experienced the opposite trend (Asmal, 2000). The Eastern Cape, Mpumalanga, the Northern Cape and Kwazulu-Natal reported the highest rate of classroom shortages (Asmal, 2000). Classroom shortages are calculated based on the assumption that there should be no more than 40 learners per classroom (Asmal, 2000).

Table 15: Percentage of Schools Indicating Classroom Shortages by Province in Percentages

Region	1996	2000
Eastern Cape	65	52
Free State	25	16
Gauteng	24	26
Kwazulu-Natal	61	48
Mpumalanga	49	56
Northern Cape	16	10
Northern Province	66	50
North Western Province	42	28
Western Cape	16	17
National	49	41

Source: (Asmal, 2000).

The national average number of learners per classroom has decreased from 43 learners in 1996, to 38 in 2000 and classrooms have generally become less crowded in all provinces, except for Mpumalanga (Asmal, 2000).

Table 16: The Average Number of Learners per Classroom Across All Provinces in South Africa

Region	1996	2000
Eastern Cape	55	43
Free State	38	33
Gauteng	34	33
Kwazulu-Natal	45	40
Mpumalanga	45	48
Northern Cape	32	26
Northern Province	49	40
North Western Province	40	34
Western Cape	33	31
National	**43**	**38**

Source: (Asmal, 2000).

2.4.3.2.2 Crime at Schools

A total of 31380 criminal incidents were reported by schools in the 2000 Schools Needs Register, at an annual value of 155 million Rands worth of property loss (Asmal, 2000). The Kwazulu-Natal province reported the most criminal incidents, with the highest rate of serious crimes that include rapes, murders, stabbings and the like (Asmal, 2000). Other provinces with higher rates of criminal incidents include the Eastern Cape and the Western Cape. The Free State, Mpumalanga and the Northern Province reported lower rates of criminal incidents (Asmal, 2000). High crime rates have significance when considering the safety of computer and other technological property, especially in high risk areas.

Table 17: Criminal Incidents at Schools in South Africa Including the Social Cost of Crime

Region	Burglaries	Assault Cases	Serious Crimes (Rape, Murder, Stabbings etc.)	Estimated annual value of property lost (R millions)
Eastern Cape	5250	710	270	39.0
Free State	1050	260	70	5.7
Gauteng	2850	630	220	24.8
Kwazulu-Natal	5200	1300	590	27.1
Mpumalanga	1490	330	70	14.6
Northern Cape	600	50	30	2.3
Northern Province	2600	550	200	20.8
North Western Province	2350	310	170	8.2
Western Cape	3150	840	240	12.8
National	**24,540**	**4,980**	**1,860**	**155**

Source: (Asmal, 2000).

2.4.3.2.3 Gender Issues

Literature indicates that noteworthy differences in attitudes toward computers exist between female and male learners at schools and as a result males tend to use computers more regularly than females in the school context (Owen *et al.*, 1998). However, despite high levels of interest and skill acquisition by female learners, male learners are often traditionally directed toward more complex business related computing skills, while female learners are pushed toward traditionally secretarial and clerical level skills (Schofield, 1995).

2.4.3.3 The Quality of Education in South Africa

2.4.3.3.1 The Effects of Apartheid

The after effects of Apartheid were detrimental on the education system in South Africa. A non-governmental report issued in 1990 entitled *The Third Alternative* (Andrews, 1995) provides some research findings that illuminate to what extent the education system infrastructure was damaged at the end of the Apartheid era. Of the general population (Andrews, 1995):

- 24% of black adults had never been to school, and 32% had not finished primary school

- with Grade 8 as a benchmark and cut-off point for functional literacy, then the illiteracy rate in the country was estimated to be at 66%

- 1600000 black children between 6 and 17 were not attending school.

Of those who attended school (Andrews, 1995):

- 70% of black children did not reach Grade 12

- in 1989, 58% of black Grade 12 pupils failed, while 64% failed in 1990

- 2% of black people had higher education.

Regarding teachers (Andrews, 1995):

- 34% of black teachers had not passed Grade 12 themselves

- in 1998 there was a shortage of 6881 teachers, but if all the children were in school that should have been, an additional 78000 teachers would have been needed.

2.4.3.3.2 The Grade 12 Pass Rate

A document entitled *Education Statistics at a Glance in 2001*, compiled by the South Africa DOE (2001b), provides insight into the quality of education in post-apartheid South Africa by documenting the pass rate of Grade 12 learners across the country.

Nationally, the Grade 12 pass rate had risen by 4%, from 58% in 1994 to 62% in 2001(DOE, 2001b). In the interim years, the national pass rate dipped to a low of 47% in 1997 (DOE, 2001b). The Eastern Cape, Kwazulu-

Natal, Mpumalanga, the North West Province and the Western Cape had lower pass rates in 2001 than in 1994 (DOE, 2001b). Less than half of Grade 12 learners passed their final examinations in the Eastern Cape and Mpumalanga in 2001 (DOE, 2001b).

Table 18: The Grade 12 Pass Rate Trend from 1994 to 2001 in South Africa in Percentages

Province	1994	1995	1996	1997	1998	1999	2000	2001
Eastern Cape	57	48	49	46	45	40	50	46
Free State	56	50	51	43	43	42	53	59
Gauteng	61	58	58	52	56	57	68	74
KwaZulu-Natal	68	69	62	54	50	51	57	63
Limpopo	44	38	39	32	35	38	51	60
Mpumalanga	48	38	47	46	53	48	53	47
North West	70	66	70	50	55	52	58	63
Northern Cape	78	75	74	64	65	64	71	84
Western Cape	86	83	80	76	79	79	81	83
National	**58**	**53**	**54**	**47**	**49**	**49**	**58**	**62**

Source: (DOE, 2001b)

Of the Grade 12 learners in 2001, 47% passed with endorsement, while 15% of learners passed without endorsement (DOE, 2001b). The Eastern and Northern Cape had a higher ratio of passes with endorsement to passes without endorsement (DOE, 2001b).

Table 19: The Grade 12 Pass Rate in South Africa in 2001

Province	Number who wrote	Number who failed		Candidates who passed without endorsement		Candidates who passed with endorsement		Total Passed	
	Number	**Number**	**%**	**Number**	**%**	**Number**	**%**	**Number**	**%**
Eastern Cape	63 175	34 350	54	24 692	39	4 133	7	28 825	46
Free State	26 637	10 934	41	11 850	45	3 853	15	15 703	59
Gauteng	64 338	16 970	26	33 671	52	13 697	21	47 368	74
KwaZulu-Natal	93 338	34 718	37	42 923	46	15 697	17	58 620	63
Limpopo	82 242	33 271	41	37 977	46	10 994	13	48 971	60
Mpumalanga	38 691	20 555	53	14 435	37	3 701	10	18 136	47
North West	36 733	13 770	38	17 684	48	5 279	14	22 963	63
Northern Cape	6 619	1 048	16	4 596	69	975	15	5 571	84
Western Cape	37 559	6 510	17	21 671	58	9 378	25	31 049	83
National	**449 332**	**172 126**	**38**	**209 499**	**47**	**67 707**	**15**	**277 206**	**62**

Source: (DOE, 2001b)

The groupings of school pass rates in 2001 also demonstrate interesting and valuable statistics. At the extremes, nationally 1% of schools had 0% pass rate while 7% of schools had a 100% pass rate. Looking at the data trend from 2000 to 2001, a drop in the number of schools with below 40% pass rates has meant a rise in the number of schools with above 40% pass rate, particularly with those who managed a pass rate of 80-99%.

Table 20: Groupings of School Grade 12 Pass Rates in South Africa in Percentages

Region	**0%**		**1-20%**		**21-40%**		**41-60%**		**61-80%**		**81-99%**		**100%**	
	2000	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**	**2000**	**2001**
Eastern Cape	1	2	14	24	33	29	24	20	14	12	15	14	5	4
Free State	0	0	13	7	27	22	19	23	12	21	29	27	8	7
Gauteng	2	1	8	4	19	12	21	20	16	21	37	43	7	10
KwaZulu-Natal	2	1	14	8	25	20	23	25	19	24	19	25	3	5
Limpopo	1	0	9	3	27	17	30	29	22	28	12	24	1	4
Mpumalanga	0	1	5	14	31	33	29	27	20	11	15	15	3	4
North West	1	0	4	1	20	18	33	29	22	27	21	26	4	6
Northern Cape	1	0	3	0	13	3	15	9	22	20	48	68	21	27
Western Cape	0	2	1	3	5	4	12	11	22	22	60	60	18	21
National	**1**	**1**	**10**	**8**	**25**	**19**	**25**	**24**	**19**	**22**	**22**	**28**	**5**	**7**

Source: (DOE, 2001b)

2.4.3.3.3 South Africa Compared to Neighbouring Countries

A document compiled by the DOE in 2003, entitled 'Report to the Minister: Review of the Financing, Resourcing and Costs of Education in Public Schools' (2003b), indicates that the quality of education in South Africa was low, but relative to what South Africa spends on schooling, particularly compared to neighbouring countries (DOE, 2003b). Expenditure on education in South Africa is higher per capita than any other neighbouring country with the exception of Botswana (DOE, 2003b). The document indicates that while South Africa spends more on education than nearly all of sub-Saharan Africa, the level of proficiency in Reading and Mathematics of Grade 6 pupils is lower than its neighbours, with the exception of Lesotho and Namibia (DOE, 2003b). Tanzanian learners scored 50% higher than South African learners, yet Tanzania spends half of what South Africa does on Education (DOE, 2003b).

This is believed to be that Tanzania has had forty years of peace and stability while the majority of South Africans have been victim to suppressive education policies under Apartheid laws (DOE, 2003b).

However, literature prompts that:

> "while it is essential for the state to tackle the serious issues of provision of resources and physical infrastructure, these factors do not, in themselves, provide any guarantee that effective teaching and learning will take place, nor is their absence sufficient explanation for under-achieving schools" (NCETDE, 1998: 62).

2.4.3.4 Diffusion of Computer Technology

2.4.3.4.1 Factors Influencing the Diffusion of Innovation

Rogers identifies five characteristics that influence the rate of innovation adoption amongst people, and are relevant in the following ways for teachers in the school context (Housego *et al.*, 2000):

- competitive advantage, referring to the overt characteristics and benefits displayed by new technologies that suggest to new users that it is more relevant or useful than current methods

- observability, referring to the opportunities that new users have to observe and scrutinise how new technologies are used in school and classroom contexts

- trialability, that refers to the opportunity for teachers to try out and provide feedback on the relevance of new technologies in the classroom context

- compatibility, referring to the provision of adequate resources and time to make new technologies compatible with the existing work content and curricula

- complexibility, that results in 'alignment' when teachers are able to see the benefit of new technologies that match or align with the pre-determined lesson objectives.

Otherwise, literature indicates that although the use of computers has been shown to enhance learning in various contexts, the use of educational technologies has shown to be beneficial for some educational activities, and less beneficial for others (Farnsworth *et al.*, 2002). As a variety of teaching and learning methods are required for curriculum delivery, many educators believe that no single tool is able to cater for a variety of educational tasks, and therefore the use of educational technologies is seen as teaching tools amongst the traditional array of teaching media and not as a replacement for them (Ortega *et al.*, 2001).

It is also demonstrated in the literature that teachers are usually not adequately trained to use educational technology systems (Hobson *et al.*, 1998; Lai, 1996), while teachers do not usually receive enough time to adapt and integrate computer applications to their own specific curricula (Hobson *et al.*, 1998). Studies also show that there is often not sufficient and reliable hardware and software available for teachers to use in instructional contexts and insufficient support is provided to help teachers plan how to integrate technology into the educational context (Lai, 1996).

The ideological devotion to computer use in modern times has led to a tendency to use computer technologies at the expense of other traditionally effective media, such as using the computer to source all information with no consideration for books and other informational resources (Brabazon, 2000). Despite an ideological commitment to the use of computers, literature indicates that a majority of schools do not have structures and a computer culture to encourage the use of computer systems in schools (Lai, 1996).

2.4.3.4.2 Factors Contributing to the Fuller Use of CAL

Literature indicates that the following factors contribute to a more extensive use of CAL systems in schools:

- the development of relevant and specific learning objectives, and a clear indication of how learners are to achieve the learning objectives through the educational computing software (Hughes, 1998; Rosenberg, 1997)

- having a deeper level of commitment from school management, and staff that are computer literate and rewarded for regular and successful orientation to CAL systems (Baillie *et al.*, 2000; Rosenberg, 1997)

- clear strategies for the development of infrastructure in schools, and a change in user mindset to adopt and work towards achieving goals set out by strategies (Baillie *et al.*, 2000)

- the creation of national standards, and information on the developments of CAL systems nationally and internationally (Baillie *et al.*, 2000)

- sufficient budget and computer equipment, and adequate access to computer systems at schools (Baillie *et al.*, 2000; Hughes, 1998; Johnson, 2003; Rosenberg, 1997)

- the use of adequate and relevant software that are fully integrated into school curricula (Hughes, 1998)

- guiding and providing learners with a greater understanding of how to effectively use computer software, how to focus on key areas and how to study on software as opposed to the traditional book based text system (Hughes, 1998)

- the availability of technical support at schools that is non-judgemental, aiming to repair systems, provide software support and alleviating user anxiety (Johnson, 2003; Rosenberg, 1997)

- providing teachers with a degree of choice in deciding whether to use the technology, or in deciding what aspects of the technology to use in different learning contexts (Christensen *et al.*, 1998; Rosenberg, 1997)

- providing teachers with opportunities to work collaboratively, and allowing teachers sufficient time to learn how to effectively integrate computer technology into their instructional and learning activities (Rosenberg, 1997)

- providing ongoing feedback to teachers on their progress in integrating computer systems into the daily educational activities (Christensen *et al.*, 1998)

- ensuring that user privacy is maintained (Johnson, 2003).

2.4.3.5 Pedagogical Aspects

2.4.3.5.1 Implications of CAL for Pedagogics

The widespread implementation of computer technologies in schools is significantly influencing the modes of instruction and learning, and new social structures of learning are being created with no extensive exploration of the consequences on learners' individual styles of learning (Baillie *et al.*, 2000). At the same time, existing useful theories of knowledge and learning are being evaluated, expanded or modified by computer generated alternatives (Brabazon, 2000). However, studies demonstrate that the use of some types of computer technologies in education engage well with natural learning processes, while others do not (Reyna *et al.*, 2001).

In general, teachers tend to teach in linear, directive and teacher centred methods and, despite the theoretical intentions of CAL systems, affect to what extent computer technologies are relevant or useful in educational settings (Semple, 2001). Studies show that despite the variety of computer technologies available, the use of directive drill and practise software have been used to a greater extent in school instructional settings (Owen *et al.*, 1998). Criticisms aimed at the use of CAL in this regard state that the provision of vast amounts of information to learners usually overwhelm rather than motivate, while at the same time, the acquisition of information is often mistaken for the acquisition of knowledge (Baillie *et al.*, 2000). Learners who have higher degrees of self regulation tend to learn better in learning contexts where the learner has more control in the learning situation, while learners who have lower degrees of self regulation tend to learn better under programme controlled learning situations (Brabazon, 2000; Yang, 1993).

2.4.3.5.2 The Lack of Educational Policy and Standards

The 'White Paper on Science and Technology' (Government Communications, 1996) indicates that South Africa currently lacks a national policy to propagate and facilitate the best movement of the country as a whole toward a globally competitive information based society, with no concrete responsibilities or goals clearly outlined. Coupled with that, of the policies that that have been created and implemented in the country, the promotion of technological development still remains lower on the priority list. As the use of educational technologies become more integrated into the educational context, a degree of competency in the use of computers is required to ensure that teachers and learners do not find themselves at a disadvantage when required to learn in a technological environment. The e-Education policy (DOE, 2001a) requires that all learners and teachers are to have basic competence in the use of word processing, spreadsheet, flat database, e-mail, and web browser applications. The availability of computers and levels of integration of educational technology is currently at lower levels in South Africa (Asmal, 2000).

Literature indicates systems developed in other countries have required that teachers are able to demonstrate levels of technology proficiency to achieve certifications; that teachers complete an educational module to receive certification or that teachers attend teacher education programmes to receive the required technology skills (Loschert, 2003). Usually, the levels of capability required are monitored by national licensing and monitoring bodies that set the standards and represent the core technology competency requirements (Loschert, 2003).

2.4.3.6 CAL in the South African Cultural Context

Indigenous socio-economic and cultural factors, such as the 11 registered official languages in South Africa, as well as globalisation processes impose significant influences on South African society (Hugo, 2000a; Hugo, 2002b). As computer users are not homogenous, it is essential that the impact of human factors are understood and acknowledged in the design and development of technologies (Hugo, 2000a; Hugo, 2002b). The customary approach to the design and development of technologies is characterised by the application of engineering principles to technical challenges, yet the absence of culturally relevant factors in technology has shown to result in lower productivity levels, lower user performance, poor application and usability and a greater reliance on user support and training (Hugo, 2002b).

Literature indicates that the lack of attention to cultural factors in the field of Information Technologies in South Africa has had an effect on lower rates of empowerment for disadvantaged groups, poorer rates of education and training and lower levels of economic growth (Hugo, 2002b). To a greater extent, poor levels of technology use in South Africa can be attributed to greater variations of cultural and linguistic diversity (Hugo, 2002b). In developing countries there is a tendency (termed the ‘technological halo effect’), to view the ideals from countries that are more technologically advanced, as superior to those from developing countries, yet culturally it is not plausible to have a ‘one size fits all’ approach to technology that in turn excludes various sectors of society in effective use of technology (Andrews, 1995; Hugo, 2002b; Hugo *et al.*, 2001). On the other end of the continuum, the development of software that tries to over compensate on the inclusion of culturally relevant material often represent cultures in a stereotyped fashion (Hugo, 2002b). This therefore highlights that emphasis should be placed on the user of the technology rather than the ideals and rationales for development, and should determine the structure and development of the technology (Hugo, 2002b).

However, users' attitudes toward technology are changing, as people from all sectors of society become accustomed to different levels of technologies from music players through to computers, particularly from poorer disadvantaged communities (Hugo, 2002b). Research however shows that users have expectations of technology that are influenced by their backgrounds, levels of education, cultural prejudices, levels of income and other variables that are not entirely understood or catered for by the developers of computer technologies (Hugo, 2002b).

2.4 RESEARCH QUESTIONS

The undertaken research study as a whole aims to gauge teachers' attitudes toward the implementation of CAL systems in South African schools. The following research questions aim to provide insight into teachers' attitudes as determined by their patterns of computer and general media use, their perceptions of the benefits and disadvantages of computer use in schools and their perceptions of the needs, priorities and appropriate structures for the implementation of CAL systems. The questions are set out as follows:

1. Teachers' current computer usage precedents in schools

1.1. What are the current teacher usage profiles of media in schools?

1.2. What are the current patterns of teacher computer use in schools?

1.3. What are teachers' general computer abilities?

1.4. What are the reasons for teacher computer use in schools?

2. Teachers' attitudes toward the use of computers in education

2.1. What are teachers' attitudes toward the use of computers?

2.2. What are teachers' perceived benefits of computers in education?

3. The needs and priorities for CAL implementation in South African schools

3.1. What are the factors preventing the implementation of CAL in South African Schools?

3.2. What are priority needs in schools for the Implementation of CAL systems?

4. The structure and layout for CAL implementation in South African schools

4.1. What is the optimal grade for CAL implementation in South African schools?

4.2. What is the optimal structure for CAL implementation in South African schools?

4.3. What is the software most relevant for CAL implementation in South African schools?

5. The levels of CAL most suited to the implementation of CAL in South African schools

5.1. What levels of CAL are most suited for CAL implementation in general?

5.2. What levels of CAL are most suited to the delivery of the Grade 10 Mathematics curriculum?

6. The levels of CAL that teachers foresee as being implemented in the future

6.1. What levels of CAL do teachers perceive to be common in South African schools in five years' time?

2.5 CONCLUSION

CAL is defined as "an all encompassing term to describe any educational use of computers…[and] can be divided into three main groups:

- when the computer is used as a tool (word processor, database, spreadsheet, and graphics application)

- when the student "teaches" the computer, for example, by issuing a set of instructions to the computer through a programming language such as Logo

- when the computer delivers some instructional material" (Brown, 1997: 1).

Several methods of CAL exist (Kotze *et al.*, 1996) that vary on a continuum of involvement from purely instructive and demonstrative on the one end, to exploratory and investigative on the other (Kotze *et al.*, 1996). Instructive software is characteristically systematic and rigid and succeeds when the user has acquired knowledge within the specified cognitive structure (Kotze *et al.*, 1996). Exploratory methods of learning are however, more flexible and based on viewing the computer as a tool used to achieve learner-centred educational outcomes through processes of investigation or discovery (Kotze *et al.*, 1996).

The literature differentiates between distinct levels of CAL, based on differences in the level of involvement the computer and user have in the educational process. Though sources differ in the structure and terminology used to describe different levels of CAL use, there is general agreement that a continuum exists where learner involvement is low and computer involvement high in the instructional process at one end, and learner involvement is high and computer involvement low on the other end of the scale.

Despite much research to support the use of educational technologies in schools, the structure of educational technologies in schools has proven to be influential in the extent that CAL is integrated and used effectively in schools (Ortega *et al.*, 2001). The structure of CAL in schools refers to the layout of computer educational technologies that influence when, where and how learners interact with the technology.

CAL methods usually propose an open learning approach to education, developing learners' problem-solving and higher order thinking skills through explorative, experimental and discovery learning (Kotze *et al.*, 1996). Tasks performed on CAL systems vary from highly didactic instructional software to very open ended discovery learning methods (Kotze *et al.*, 1996). However, learners require regular access to computer systems and traditional methods tend to be used due to the cost and complexity of integrating technology into the educational context (Heide *et al.*, 2001). Traditional teaching approaches tend to be linear and directive and learners are dependent on teachers and instructors for guidance and direction (Kotze *et al.*, 1996). Traditional teaching methods focus on the systematic acquisition and ultimately retention of pre-defined knowledge and skills (Kotze *et al.*, 1996). Learners display proficiency in levels of understanding of the taught material, are evaluated at regular intervals to display levels of performance and are usually directed educationally based on overall performance (Kotze *et al.*, 1996).

The underlying beliefs of how instruction should occur are demonstrated in the documented learning theories, and reflect the way that educational technologies are designed and developed (Semple, 2000). The unique learning theories are the foundations for the development of instructional theories are documented as being the behavioural learning theory, the cognitive learning theory and the constructivist learning theory (Christensen *et al.*, 1998). These theories stem from pedagogical bases of behaviourism, cognitivism and constructivism respectively (Christensen *et al.*, 1998).

Literature states that in general there is a lack in information technology policy in South Africa (NCETDE, 1998). The general strategy in South Africa is the development of an information society that serves the needs of the country, and benefits individuals, groups and communities at all levels of society (Government Communications, 1996). In South Africa, a significant backlog exists of schools without computers and schools without computers tend to lack other media equipment in general, such as Video Cassette Recorders, radios, tape recorders, slide projectors and overhead projectors (NCETDE, 1998). More specifically, in order of significance, the factors preventing South African schools from acquiring computers are (NCETDE, 1998): no widespread infrastructure to supply electricity, insufficient funds, no building space, not enough available or trained teaching staff and poor security measures in place.

The e-Education policy (DOE, 2003c) provides a CAL implementation strategy that consists of three major phases of integration (DOE, 2003c):

- phase one - enhance system-wide and institutional readiness to use ICTs for learning, teaching and administration (year 2004 to 2007)

- phase two - system-wide integration of ICTs into teaching and learning (year 2007 to 2010)

- phase three - ICTs integrated at all levels of the education system: Management, teaching, learning and administration (year 2010 to 2013).

However, the factors influencing CAL implementation in South Africa are demonstrated in the literature as including a lack of: human resources, power, sanitation and water, telecommunications and access to technology and adequate school facilities. Negative social effects, overcrowding, gender issues and the quality of education in South Africa also impact the CAL implementation process.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Research methodology is defined as "the methods, techniques, and procedures that are employed in the process of implementing the research design and plan, as well as the underlying principles and assumptions that underlie their use" (Babbie *et al*., 2001: 647). This section provides a review of the methodological procedures involved in the research study. It firstly clarifies the justification for the research paradigm and methodology adopted for the study. It then expands on the various research procedures involved in the study, including the definition of the universe, the sampling procedures, questionnaire design and administration, data analysis procedures and the limitations to the study. Finally, the ethical considerations adopted in the research study are clarified.

3.2 JUSTIFICATION FOR THE PARADIGM AND METHODOLOGY

A research paradigm refers to the research framework used to observe, record and understand various phenomena and behaviours (Babbie *et al*., 2001). It therefore refers to a comprehensive system of practise and thinking that defines the nature of inquiry to researchers (Terre Blanche *et al.*, 1999). This research study is performed within the quantitative research paradigm, as it focuses on (Babbie *et al.*, 2001):

- the quantification of constructs
- the use of variables in describing and analyzing behaviour or phenomena
- the control for various sources of error in the research process.

In general, however, the research study can be described as both exploratory and descriptive. Exploratory studies are defined as

> "preliminary investigations into relatively unknown areas of research…[and] employ open, flexible and inductive approaches to research as they attempt to look for new insights into phenomena" (Terre Blanche *et al.*, 1999: 39).

Exploratory studies are usually conducted for the following reasons (Babbie *et al.*, 2001):

- the desire for better understanding of phenomena
- to test the viability of performing a more extensive study
- to develop and enhance the methods for subsequent more intensive studies
- to explain the central tenants and concepts of a study
- to highlights areas of priority for future research
- to expand hypotheses about existing phenomena.

An exploratory study is relevant to the topic of research as literature indicates that the use of ICTs in educational contexts currently are disorganized and lack clear and specific direction, and remain challenging to mediate due to a lack of research in this area in South Africa (NCETDE, 1998).

Studies that are descriptive "aim to describe phenomena accurately…[by] measuring relationships [between phenomena]" (Terre Blanche *et al.*, 1999). Descriptive studies "describe or classify specific dimensions or characteristics of individuals, groups, situations, or events by summarizing the commonalities found in discrete observations" (Fawcett, 1999). Descriptive studies yield large masses of data that can be classified by type, frequency or central tendency, and can be analysed for numerous relationships (Miller, 1991). As the study involves the measurement of teacher's attitudes through the use of rating and measurement scales, that measure the frequency distribution of responses, the descriptive research method provides the numerical and descriptive platform to allow for effective and relevant comparative analysis. The descriptive method is also relevant to the study as descriptive studies are required to provide levels of descriptive measurement when little is known about the phenomena in question (Fawcett, 1999). Thus, because there is a lack of relevant research in the topic under study in South Africa, makes this research method relevant.

3.3 RESEARCH PROCEDURES

3.3.1 Defining the Universe

In the context of research, the 'population' is referred to as the "theoretically specified aggregation of study elements" (Babbie *et al.*, 2001: 173). In the context of this study therefore, the population is Grade 10 Mathematics teachers that teach in the city of Port Elizabeth in the Eastern Cape, South Africa. As no existing detailed information was available regarding the current population of Grade 10 Mathematics teachers in the Port Elizabeth city area at the inception of the study, schools were telephoned and a population list was created by the researcher. Therefore, to an extent, only schools that could be contacted were included in the study. The researcher found that many schools, particularly schools in previously disadvantaged areas, were unable to be contacted as telephone calls were repeatedly not answered or telephone numbers had been discontinued. In the context of research, the 'study population' is known as the "aggregation of elements from which the sample is actually selected" (Babbie *et al.*, 2001: 173). In the context of this research, the study population is the Grade 10 Mathematics teachers in the Port Elizabeth city area that teach at schools that were able to be contacted telephonically.

3.3.2 Sampling Procedure

The researcher compiled a population list of all Grade 10 Mathematics teachers in the city of Port Elizabeth, South Africa, as a detailed list of teachers in the Port Elizabeth area was not available for the study. The final list contained a total of 153 Grade 10 Mathematics teachers in the Port Elizabeth city area. As the researcher was not able to collect detailed variable and descriptive information of each teacher, such as gender, demographic breakdown, age and level of qualification, the final list only contained the names of teachers linked to schools in the specific geographical area. As a result, the study focuses on the teacher group as a whole as the primary sample group, but provides analysis breakdowns across other variables collected in the data as exploratory information that provides some insight, though not at significant levels, into the various variables that affect the implementation of CAL into schools.

In performing the pilot of the questionnaire, the researcher experienced a high level of refusals, as teachers reported that they were at a busy period of the year (the fourth term). The researcher therefore decided to sample the entire study population, as the number of the population was relatively low at 153 teachers. It was intended then to receive a number of responses that could provide substantial validation to the study sample, failing which, the researcher would then attempt again to approach teachers and request involvement in the study. Of the 153 teachers, 78 participants successfully completed the survey instruments, returning a high yield of 51% of the total study population. At a confidence level of 95%, the standard error for the achieved sample is determined to be at 7.8%. Therefore, with a high confidence level of 95%, one is able to assume that the findings presented fall within the range of 3.9% above and below the values presented, as stated by probability theory (Babbie *et al.*, 2001).

Table 21: Research Study Sample Description

Universe	Sample	Percentage of Total Universe	Standard Error
153	78	51.0	7.8%

Table 22 demonstrates the breakdown of the various characteristics of the sample group. The sample group is divided into gender, demographic, age group, qualification level and computer use variables.

Table 22: Research Study Sample Variable Breakdown

Subject Breakdown	Subject Group	Totals of Respondents
Total Teacher Group	All Teachers	78
Gender Breakdown	Female Male	41 37
Demographic Breakdown	Black Coloured White	13 25 40
Age Group Breakdown	21 - 30 31 - 40 41 - 50 51 - 60 Over 60	8 32 28 8 2
Level of Qualification	Diploma First Degree Postgraduate Degree	22 40 16
Level of Computer Use	Never Used Used - not for work Used - for work no CAL Used - work and CAL	5 6 39 28

3.3.3 Questionnaire Design

A survey instrument was chosen as the relevant means of collecting data for the study. Survey instruments are able to collect data for populations that are too scattered or vast to observe directly (Babbie *et al.*, 2001). The questionnaire (Appendix A) for this study was developed with the following six sections:

- Section A. QUESTIONNAIRE DETAILS; including information for administrative use only

- Section B. INTERVIEWEE DETAILS; providing a record of the interviewee's biographical information

- Section C. COMPUTER ACCESS AND USE; recording patterns of personal computer use, levels of computer ability and personal opinions regarding various teaching media

- Section D. COMPUTER INFORMATION; recording teachers opinions regarding various scenarios of computer implementation and use in schools

- Section E. ATTITUDES; recording teachers' attitudes toward the use of computers and the benefits and disadvantages of computers

- Section F. COMPUTER ASSISTED LEARNING AND THE MATHEMATICS CURRICULUM; recording teachers' opinions of the relevance of various levels of CAL toward the Grade 10 Mathematics curriculum.

Questionnaire items were constructed in the standard survey format, where respondents were required to select a single response from various options per each item (Babbie *et al.*, 2001). Some questionnaire items were also presented in a matrix question format, where several items have the same set of response and answer categories (Babbie *et al.*, 2001). The survey also made use of contingency questions that direct certain questions to specific respondents based on relevant screening criteria (Babbie *et al.*, 2001). In the survey, contingency questions were used where questions were directed to teachers with various levels of computer use experience.

3.3.4 Administration of Questionnaire

After the questionnaire was constructed, a pilot study was performed on three teachers. After this, various questions' wording and formats were refined. A letter (Appendix B) was then constructed and mailed to principals at all the relevant schools where teachers from the study population were employed and working at the time of surveying in November 2003. The letter informed the principals of the nature of the study and of the selection of teachers at all the various schools that would be approached to be involved in the study.

Courtesy visits were then made to relevant school principals, checking whether letters had been received and requesting permission to approach the Grade 10 Mathematics teachers in the school for involvement in the study. After permission was granted, the relevant teachers were approached for involvement and supplied with surveys that had their identity information included from the study population list constructed initially. The teachers were informed that they were to sign the questionnaire cover consent form (Appendix C) if they accepted to be involved in the study. This ensured respondent confidentiality. Respondents were then informed to leave the completed survey at the school office where the survey would be collected a week later. Following this time period, telephone calls were made to schools to confirm that the surveys were ready for collection. Teachers were also reminded and requested to complete surveys if they had not done so. On completion, surveys were then checked and collected from the various schools.

3.3.5 Data Analysis

The data analysis is performed through the use of descriptive statistics, and data is processed using the methods of frequency distributions and means, that allow for descriptive and comparative analyses (Babbie *et al.*, 2001). Frequency distributions provide a simple indication of how often, or how frequently, specific data items occur within the data set (Walsh, 2001). The mean is the value area where the data is most centred and provides an idea of the average value (Walsh, 2001).

The primary sample of the study, consisting of the total teacher group as a whole regardless of all other variables, provides the only statistically significant analysis breakdown of the study, and therefore can be reported with a high level of confidence. However, as the study is exploratory in nature, various data breakdowns have been performed and reported in the study, providing insight into the factors that influence attitudes toward CAL implementation across diverse variable groups. These breakdowns have been reported as anecdotal and insightful data, and should only be used to direct further studies in the field of CAL. The analysis breakdowns therefore, occur across the following subject groups:

- the total teacher group
- a gender breakdown, including
    - female respondents
    - male respondents
- a demographic breakdown, including
    - respondents who place themselves in the Black demographic group
    - respondents who place themselves in the Coloured demographic group
    - respondents who place themselves in the White demographic group
- an age group breakdown, including
    - teachers from age 21 to and including age 30
    - teachers from age 31 to and including age 40

  - teachers from age 41 to and including age 50
  - teachers from age 51 to and including age 60
  - teachers all ages above age 60
- a breakdown according to the respondents' level of qualifications, including
  - teachers who have a tertiary level diploma as their highest qualification
  - teachers who have a tertiary level degree as their highest qualification
  - teachers who have a tertiary level postgraduate degree as their highest qualification
- a breakdown according to the respondents' levels of computer use, including
  - teachers who have never used a computer
  - teachers who have used a computer, but have never used a computer for work related activity
  - teachers who have used a computer, have used a computer for work related activity, but have never used the computer in a CAL capacity
  - teachers who have used a computer, have used a computer for work related activity and have used the computer in a CAL capacity.

Results are presented in graph and tabular formats across each subject group breakdown, and descriptive analyses and anecdotes are reported throughout the data analysis section of the study. In the conclusion of the research report, a concise summary of research findings are reported.

3.3.6 Limitations

The lack of information regarding teachers in the Grade 10 Mathematics population as a whole was a limitation to the study. The researcher compiled a list of the Grade 10 Mathematics teachers by making telephonic contact with schools in the Port Elizabeth area. However, many teachers, and thus schools, in the previously disadvantaged areas teachers could not be contacted, as telephone numbers had been discontinued with no record of telephonic details available in the local telephone directory or call-in telephone directory databases. Telephones were also repeatedly not answered. Therefore, some teachers may have been omitted, leaving the study population significantly smaller than the population as a whole.

As a record of the teaching population was not available, it is problematic to determine the extent that the characteristics of the sample population represent the characteristics of the total Grade 10 Mathematics population in Port Elizabeth, South Africa. The number of teachers in the sample that fall in the Black demographic group is significantly lower than the number of teachers in the other demographic groups. This could be as a result of the possible omission of teachers in the process of compiling the study population group, as well as a higher refusal rate among teachers in the Black demographic group. This limitation was primarily due to a lack of understanding of the technical nature of the terminology of the survey. It would therefore have been more advantageous if a translated version of the questionnaire was provided to the predominantly Xhosa speaking Black demographic group.

As the nature of the information recorded is subjective in nature, items that recorded teachers' perceptions of their own computer abilities and performance, therefore cannot be construed as finite and would need to be scrutinised under objective performance tests to prove the validity of the findings. A possible limitation could also be that participants conferred with other teachers, which may in turn have interfered with their responses.

The sampling procedure also has its limitations. As the entire study population was approached to complete surveys, and the returned surveys collected combined to fulfil a robust sample of the study population, the sample does not share the statistical benefits of simple random sampling. Simple random sampling, where respondents are randomly selected from the population group, allows each respondent the equal chance of having been selected for involvement in the study (Babbie *et al.*, 2001). However, though each respondent had an equal chance of being involved in the study, the population that did not respond to the survey may have been unable to understand the language or jargon of the survey, or maybe not have understood how to complete the survey. This result is that the sample is not truly random and therefore could be affected by other uncontrolled variables.

3.4 **ETHICAL CONSIDERATIONS**

Ethical considerations refer to the awareness of “the general agreements among researchers about what’s proper and improper in the conduct of scientific inquiry” (Babbie *et al.*, 2001: 520). The purpose of ethical considerations in research is to protect the wellbeing and safety of all those participating in the research process (Terre Blanche *et al.*, 1999). The following ethical considerations were taken into account in the conduct of the research study.

This research study involved the voluntary participation of participants. Participants received information regarding the study and had the choice to participate. Respondents also signed a consent form to validate their willingness to participate.

The research was conducted in a way that put respondents in no danger of physical or psychological harm. Also, information regarding the study was sent to the principals of each relevant school as well as the participants in the study, and therefore alleviates any likelihood of deception regarding the study or its purposes.

Participants were assured that their surveys and individual responses would be held in confidence, and that their personal information and opinions would not be revealed publicly. Respondents received assurance of confidentiality on their consent forms, and signed in acknowledgement.

3.5 CONCLUSION

This research study was undertaken as literature indicates that there is a lack of research in this subject area in South Africa (NCETDE, 1998). Therefore, an exploratory study formed the basis of this research as information is limited regarding the topic of study. Despite using an exploratory paradigm, descriptive statistics were also employed to provide the means for comparative analysis. The universe of this study consisted of Grade 10 Mathematics teachers currently teaching in the Port Elizabeth area in the Eastern Cape. The total population of 153 teachers was sampled, 78 of whom took part in the study and successfully completed surveys. The questionnaire used to gather data was constructed in the standard survey format and consisted of six sections, namely: questionnaire details, interview details, computer access and use, computer information, attitudes, and CAL and Mathematics curriculum. Questionnaires were administered during November 2003, where participants were given one week to complete the survey, after which they were collected by the researcher. The data analysis was performed through the use of descriptive statistics, and data was processed using the methods of frequency distributions and means. The lack of information regarding study population group may have impacted on the representivity of the sample, a limitation to the study. Ethical considerations of informed consent for participation and confidentiality were acknowledged in the study.

CHAPTER 4

ANALYSIS OF DATA

4.1 INTRODUCTION

Quantitative analysis is known as the "numerical representation and manipulation of observations for the purpose of describing and explaining the phenomena that those observations reflect" (Babbie *et al*., 2001: 646). This section therefore provides the meaningful presentation of the collected data by providing tabular and graphic formats of quantitative data presentation, as well as anecdotal commentary. The descriptive statistical method of data analysis has been employed to analyse data, known as "statistical computations describing either the characteristics of a sample or the relationships among variables in the sample…[and] merely summarize a set of sample observations" (Babbie *et al.*, 2001: 641). A concise summary of the research findings can be found in Chapter 5, under the sections 5.2 and 5.3 entitled 'Conclusions About Each Research Question' and 'Conclusions About The Research Problem' respectively.

The analysis is structured into two sections, namely: Computers in the School Context and The Implementation of CAL. The section entitled 'Computers in the School Context' includes the following analysis categories:

- Media Use in Schools
- Teachers and Computers in Schools
- Attitudes to the Use of Computers in Education
- Perceived Benefits of Computers in Education
- Perceived Disadvantages of Computers in Education.

The section entitled 'The Implementation of CAL' includes the following analysis categories:

- Perceived Factors Preventing the Implementation of CAL in South African Schools
- School Priority Needs for the Implementation of CAL
- The Optimum Grade for CAL Implementation
- The Optimum Structure for CAL Implementation in Schools
- The Software Most Suitable for CAL implementation
- The Levels of CAL Most Suited to the Implementation of CAL in South African Schools.

4.2 SUBJECTS

In the context of this research, the population under study is Grade 10 Mathematics teachers that teach in the city of Port Elizabeth, South Africa. Therefore, analyzing across the entire total teacher group sample produces the most significant results with high degrees of certainty.

However, as the study is exploratory in nature, various data breakdowns have been performed and reported in the study, providing insight into the factors that influence attitudes toward CAL implementation across diverse variable groups. Due to a lack of descriptive population information, the researcher is unable to determine the statistical soundness of the samples attained in the various variable groups. These breakdowns therefore have been reported for their anecdotal, insightful and illustrative value, and should only be used to provide guidance and direction for future research in the field of CAL in South Africa. The analysis breakdowns occur across variable groups that include the total teacher group as a whole, a gender breakdown, a demographic breakdown, an age group breakdown, a breakdown according to the respondents' level of qualifications and a breakdown according to the respondents' levels of computer use.

4.2.1 Total Teacher Group

The total teacher group analysis is performed across the entire total teacher group, exclusive of all variables, and consists of a sample of 78 subjects from a total population of 138 Grade 10 Mathematics teachers. The sample's level of confidence at 95% provides a standard error of 7.8%, indicating that scores deviate within 3.9% above or below the displayed values, therefore providing a high degree of certainty in the findings.

4.2.2 Gender Breakdown

The gender breakdown consists of analyses split between the female and male gender groups, regardless of all other variables.

4.2.3 Demographic Breakdown

The demographic breakdown consists of analyses split between the Black, Coloured and White demographic groups, regardless of all other variables. Although other demographic selection options were provided on the questionnaires, the total group of respondents was only characteristic of Black, Coloured and White populations.

4.2.4 Age Groups

The age group breakdown consists of analyses split across five age group intervals regardless of all other variables, namely:

- age 21 to and including age 30
- age 31 to and including age 40

- age 41 to and including age 50
- age 51 to and including age 60
- all ages above age 60.

4.2.5 Level of Qualifications

The Level of Qualifications breakdown consists of analyses split across three levels of qualification groups regardless of all other variables, namely:

- teachers who have a tertiary level diploma as their highest qualification
- teachers who have a tertiary level degree as their highest qualification
- teachers who have a tertiary level postgraduate degree as their highest qualification.

4.2.6 Level of Computer Use

The Level of Computer Use sample groups consist of analyses split across four levels of computer use, regardless of all other variables, that include:

- teachers who have never used a computer
- teachers who have used a computer, but have never used a computer for work related activity
- teachers who have used a computer, have used a computer for work related activity, but have never used the computer in a CAL capacity
- teachers who have used a computer, have used a computer for work related activity and have used the computer in a CAL capacity.

4.3 PRESENTATION OF FINDINGS

Findings are presented in tabular and graph formats. A description has been provided within each section detailing the manner in which the findings have been compiled and arranged. A commentary of relevant highlights within each section provides insight into the salient and appealing data trends and anomalies worthy of further scrutiny.

4.3.1 COMPUTERS IN THE SCHOOL CONTEXT

4.3.1.1 Media Use in Schools

4.3.1.1.1 Use of General Media

In this item, a comparison is made between the expectation that teachers have of the frequency of educational media use among teachers as a group and the frequency that teachers personally use the educational media in reality.

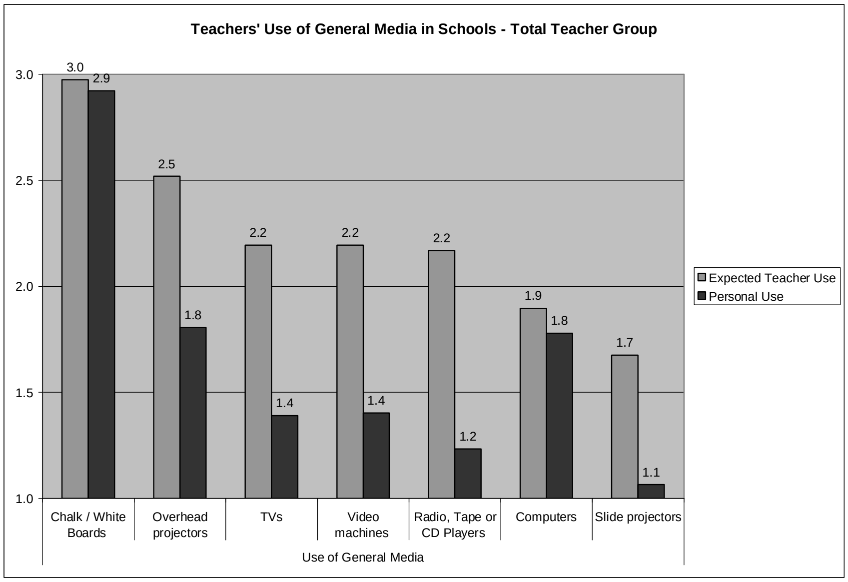
The results are indicated in a proportional percentage breakdown between frequent, seldom or non-use patterns per each teaching media item, presented in a tabular format. A totals section provides a summary of overall use versus non-use patterns.

In addition, a weighted average has been calculated by assigning values to the ratings, from 1 for ‘non-use’ to 3 for ‘frequent use’. Presented in a graph format, an average score in the following category intervals are indicative of the following general levels:

- 1 to 1.67 indicates general non-use
- 1.68 to 2.33 indicates seldom use
- 2.34 to 3 indicates frequent use.

4.3.1.1.1.1 Total Teacher Group

Figure 1



Except for the use of chalk and white boards and to a lesser extent computers, teachers as a whole tend to use media less than what they expect. In general, the levels of expectation of teacher media use is high, with the lowest level of use at 61% for slide projectors, though personal use in reality falls significantly below the expectation. In addition, teachers' use of media is generally at infrequent intervals.

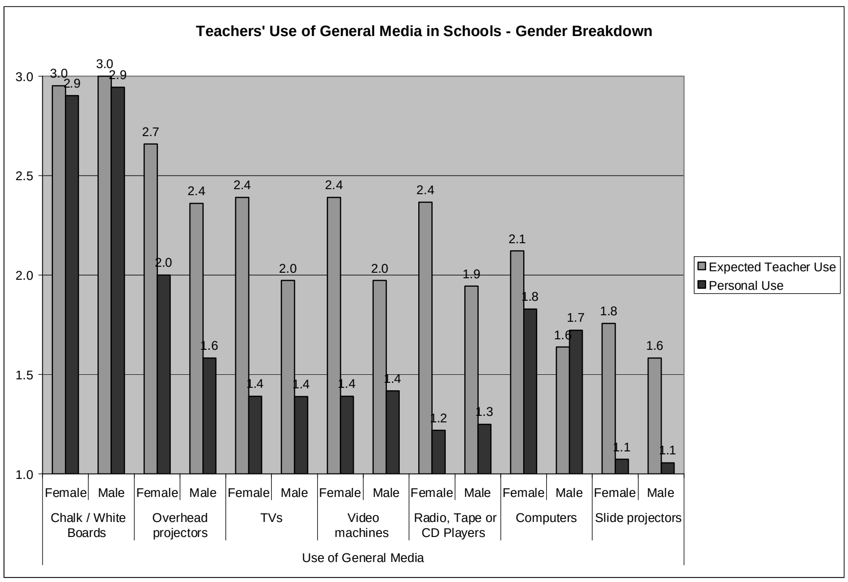
Table 23: Teachers' Use of General Media – Total Teacher Group

		Category Breakdown			Totals	
Media Items	**Media Use**	Frequently	Seldom	Never	Use	Never Use
Chalk / White Boards	Expected Teacher Use	97	3	0	100	0
	Personal Use	95	3	3	97	3
Overhead projectors	Expected Teacher Use	55	43	3	97	3
	Personal Use	25	31	44	56	44
TVs	Expected Teacher Use	36	47	17	83	17
	Personal Use	5	29	66	34	66
Video machines	Expected Teacher Use	34	52	14	86	14
	Personal Use	4	32	64	36	64
Radio, Tape or CD Players	Expected Teacher Use	29	60	12	88	12
	Personal Use	3	18	79	21	79
Computers	Expected Teacher Use	13	64	23	77	23
	Personal Use	16	47	38	62	38
Slide projectors	Expected Teacher Use	6	55	39	61	39
	Personal Use	0	6	94	6	94

As a comparative, the use of chalk and white boards falls the highest for both expectation of use and personal use, showing a very strong integration in, and reliance upon, the traditional teaching method in the educational context. In addition, despite the expectation that teachers tend to have higher levels of use of technological media, teachers' levels of use fall far below expectation. The use of computers, however, shows parity in expectation and use, though both are at lower levels. The use of overhead projectors and computers are highest among the technological educational media.

4.3.1.1.1.2 Gender Breakdown

Figure 2



The results suggest that female teachers tend to have largely higher expectations of the frequency of media use among teachers than do male teachers, yet the patterns of use between the two groups look very similar. However, female teachers tend to make more frequent use of overhead projectors than do their male colleagues.

Table 24: Teachers' Use of General Media – Gender Breakdown

Media Items	Gender Breakdown	Media Use	Category Breakdown: Frequently	Seldom	Never	Totals: Use	Never Use
Chalk / White Boards	Female	Expected Teacher Use	95	5	0	100	0
		Personal Use	93	5	2	98	2
	Male	Expected Teacher Use	100	0	0	100	0
		Personal Use	97	0	3	97	3
Overhead projectors	Female	Expected Teacher Use	66	34	0	100	0
		Personal Use	37	27	37	63	37
	Male	Expected Teacher Use	42	53	6	94	6
		Personal Use	11	36	53	47	53
TVs	Female	Expected Teacher Use	51	37	12	88	12
		Personal Use	7	24	68	32	68
	Male	Expected Teacher Use	19	58	22	78	22
		Personal Use	3	33	64	36	64
Video machines	Female	Expected Teacher Use	49	41	10	90	10
		Personal Use	7	24	68	32	68
	Male	Expected Teacher Use	17	64	19	81	19
		Personal Use	0	42	58	42	58
Radio, Tape or CD Players	Female	Expected Teacher Use	41	54	5	95	5
		Personal Use	2	17	80	20	80
	Male	Expected Teacher Use	14	67	19	81	19
		Personal Use	3	19	78	22	78
Computers	Female	Expected Teacher Use	22	68	10	90	10
		Personal Use	17	49	34	66	34
	Male	Expected Teacher Use	3	58	39	61	39
		Personal Use	14	44	42	58	42
Slide projectors	Female	Expected Teacher Use	10	56	34	66	34
		Personal Use	0	7	93	7	93
	Male	Expected Teacher Use	3	53	44	56	44
		Personal Use	0	6	94	6	94

4.3.1.1.1.3 Demographic Breakdown

Teachers from the White demographic group tend to have higher expectations of the frequency of teacher media use than do the Black and Coloured demographic groups. However, the use of media by the White demographic group is at levels demonstrated by the other demographic groups in study, despite a more frequent use of overhead projectors by White teachers.

Figure 3

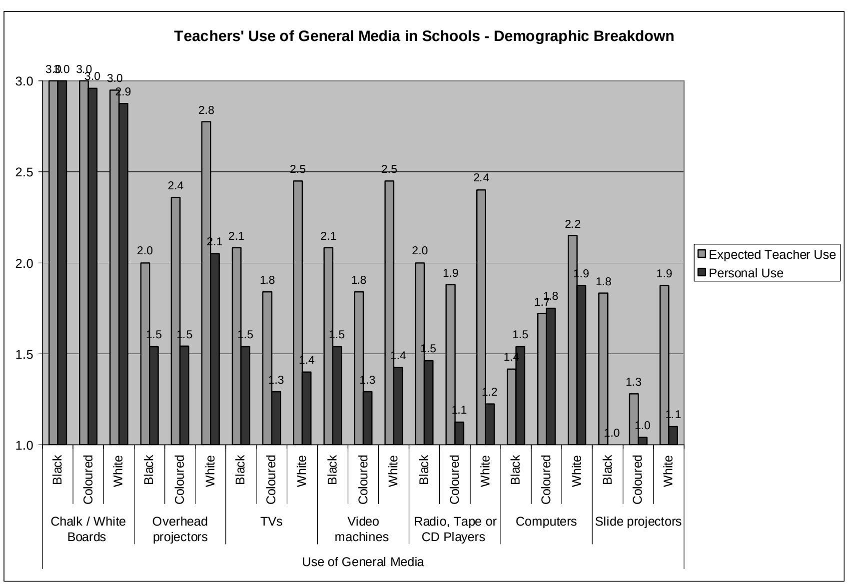


Table 25: Teachers' Use of General Media – Demographic Breakdown

Media Items	Demographic Breakdown	Media Use	Category Breakdown: Frequently	Seldom	Never	Totals: Use	Never Use
Chalk / White Boards	Black	Expected Teacher Use	100	0	0	100	0
		Personal Use	100	0	0	100	0
	Coloured	Expected Teacher Use	100	0	0	100	0
		Personal Use	96	4	0	100	0
	White	Expected Teacher Use	95	5	0	100	0
		Personal Use	93	3	5	95	5
Overhead projectors	Black	Expected Teacher Use	8	83	8	92	8
		Personal Use	8	38	54	46	54
	Coloured	Expected Teacher Use	40	56	4	96	4
		Personal Use	13	29	58	42	58
	White	Expected Teacher Use	78	23	0	100	0
		Personal Use	38	30	33	68	33
TVs	Black	Expected Teacher Use	25	58	17	83	17
		Personal Use	8	38	54	46	54
	Coloured	Expected Teacher Use	8	68	24	76	24
		Personal Use	0	29	71	29	71
	White	Expected Teacher Use	58	30	13	88	13
		Personal Use	8	25	68	33	68
Video machines	Black	Expected Teacher Use	17	75	8	92	8
		Personal Use	0	54	46	54	46
	Coloured	Expected Teacher Use	8	68	24	76	24
		Personal Use	0	29	71	29	71
	White	Expected Teacher Use	55	35	10	90	10
		Personal Use	8	28	65	35	65
Radio, Tape or CD Players	Black	Expected Teacher Use	17	67	17	83	17
		Personal Use	8	31	62	38	62
	Coloured	Expected Teacher Use	8	72	20	80	20
		Personal Use	0	13	88	13	88
	White	Expected Teacher Use	45	50	5	95	5
		Personal Use	3	18	80	20	80
Computers	Black	Expected Teacher Use	0	42	58	42	58
		Personal Use	8	38	54	46	54
	Coloured	Expected Teacher Use	0	72	28	72	28
		Personal Use	17	42	42	58	42
	White	Expected Teacher Use	25	65	10	90	10
		Personal Use	18	53	30	70	30
Slide projectors	Black	Expected Teacher Use	0	83	17	83	17
		Personal Use	0	0	100	0	100
	Coloured	Expected Teacher Use	0	28	72	28	72
		Personal Use	0	4	96	4	96
	White	Expected Teacher Use	13	63	25	75	25
		Personal Use	0	10	90	10	90

The higher expectation of the frequency of media use among the White demographic group may be indicative of the inequalities as a result of Apartheid, as people in the White demographic group historically have had greater levels of access and use of technologies than people of other demographic groups (Hall, 1998). Therefore, as White teachers may have had access to a greater variety of media resources for a longer period they may have higher expectations of use among teachers. However, the indication that the frequency of media use among White teachers is similar to that of Black and Coloured teachers shows some validation for the suggestion in the literature that widespread availability of media itself does not guarantee the extensive use thereof (Christensen *et al.*, 1998; Schofield, 1995).

4.3.1.1.1.4 Age Groups

An interesting trend in the results of the age group breakdown shows that, despite the high showing in the lower age groups for frequent use of overhead projectors, the rise in age group seems to correlate with a higher expectation that teachers use media more frequently. Again, the higher expectation does not actualize into use that is more frequent in reality.

Figure 4

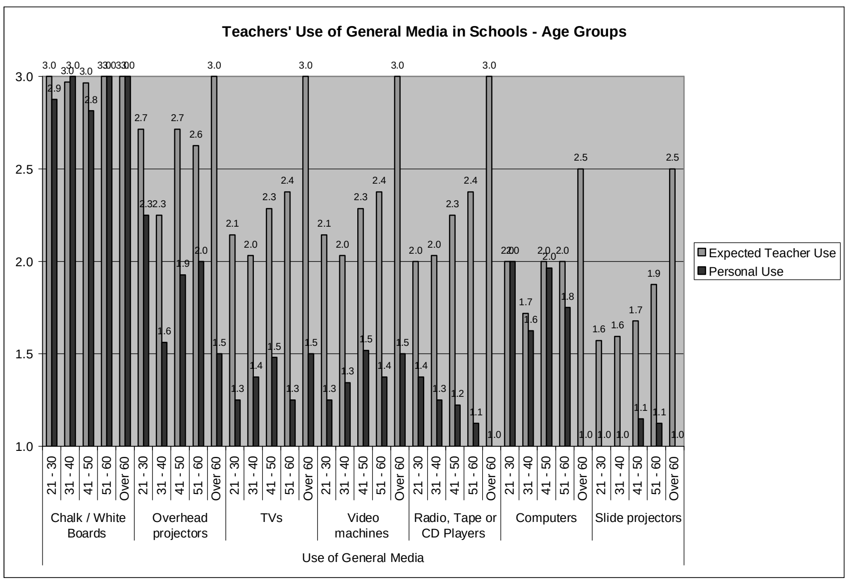


Table 26: Teachers' Use of General Media – Age Group Breakdown

Media Items	Age Groups	Media Use	Category Breakdown			Totals	
			Frequently	Seldom	Never	Use	Never Use
Chalk / White Boards	21 - 30	Expected Teacher Use	100	0	0	100	0
		Personal Use	88	13	0	100	0
	31 - 40	Expected Teacher Use	97	3	0	100	0
		Personal Use	100	0	0	100	0
	41 - 50	Expected Teacher Use	96	4	0	100	0
		Personal Use	89	4	7	93	7
	51 - 60	Expected Teacher Use	100	0	0	100	0
		Personal Use	100	0	0	100	0
	Over 60	Expected Teacher Use	100	0	0	100	0
		Personal Use	100	0	0	100	0
Overhead projectors	21 - 30	Expected Teacher Use	71	29	0	100	0
		Personal Use	38	50	13	88	13
	31 - 40	Expected Teacher Use	31	63	6	94	6
		Personal Use	13	31	56	44	56
	41 - 50	Expected Teacher Use	71	29	0	100	0
		Personal Use	33	26	41	59	41
	51 - 60	Expected Teacher Use	63	38	0	100	0
		Personal Use	38	25	38	63	38
	Over 60	Expected Teacher Use	100	0	0	100	0
		Personal Use	0	50	50	50	50
TVs	21 - 30	Expected Teacher Use	29	57	14	86	14
		Personal Use	0	25	75	25	75
	31 - 40	Expected Teacher Use	22	59	19	81	19
		Personal Use	6	25	69	31	69
	41 - 50	Expected Teacher Use	46	36	18	82	18
		Personal Use	7	33	59	41	59
	51 - 60	Expected Teacher Use	50	38	13	88	13
		Personal Use	0	25	75	25	75
	Over 60	Expected Teacher Use	100	0	0	100	0
		Personal Use	0	50	50	50	50
Video machines	21 - 30	Expected Teacher Use	29	57	14	86	14
		Personal Use	0	25	75	25	75
	31 - 40	Expected Teacher Use	19	66	16	84	16
		Personal Use	3	28	69	31	69
	41 - 50	Expected Teacher Use	43	43	14	86	14
		Personal Use	7	37	56	44	56
	51 - 60	Expected Teacher Use	50	38	13	88	13
		Personal Use	0	38	63	38	63
	Over 60	Expected Teacher Use	100	0	0	100	0
		Personal Use	0	50	50	50	50
Radio, Tape or CD Players	21 - 30	Expected Teacher Use	29	43	29	71	29
		Personal Use	0	38	63	38	63
	31 - 40	Expected Teacher Use	19	66	16	84	16
		Personal Use	3	19	78	22	78
	41 - 50	Expected Teacher Use	32	61	7	93	7
		Personal Use	4	15	81	19	81
	51 - 60	Expected Teacher Use	38	63	0	100	0
		Personal Use	0	13	88	13	88
	Over 60	Expected Teacher Use	100	0	0	100	0
		Personal Use	0	0	100	0	100
Computers	21 - 30	Expected Teacher Use	14	71	14	86	14
		Personal Use	25	50	25	75	25
	31 - 40	Expected Teacher Use	9	53	38	63	38
		Personal Use	16	31	53	47	53
	41 - 50	Expected Teacher Use	18	64	18	82	18
		Personal Use	19	59	22	78	22
	51 - 60	Expected Teacher Use	0	100	0	100	0
		Personal Use	0	75	25	75	25
	Over 60	Expected Teacher Use	50	50	0	100	0
		Personal Use	0	0	100	0	100
Slide projectors	21 - 30	Expected Teacher Use	14	29	57	43	57
		Personal Use	0	0	100	0	100
	31 - 40	Expected Teacher Use	6	47	47	53	47
		Personal Use	0	0	100	0	100
	41 - 50	Expected Teacher Use	4	61	36	64	36
		Personal Use	0	15	85	15	85
	51 - 60	Expected Teacher Use	0	88	13	88	13
		Personal Use	0	13	88	13	88
	Over 60	Expected Teacher Use	50	50	0	100	0
		Personal Use	0	0	100	0	100

4.3.1.1.1.5 Level of Qualifications

In general, the data indicates that teachers with postgraduate degrees make greater use of general media in schools, though their levels of personal use generally do not meet their higher expectations of use. Levels of personal use match or fall within scope of expectations across the board in the use of chalk and whiteboards and computers, though parity at lower levels is indicated in the use of overhead projectors.

Figure 5

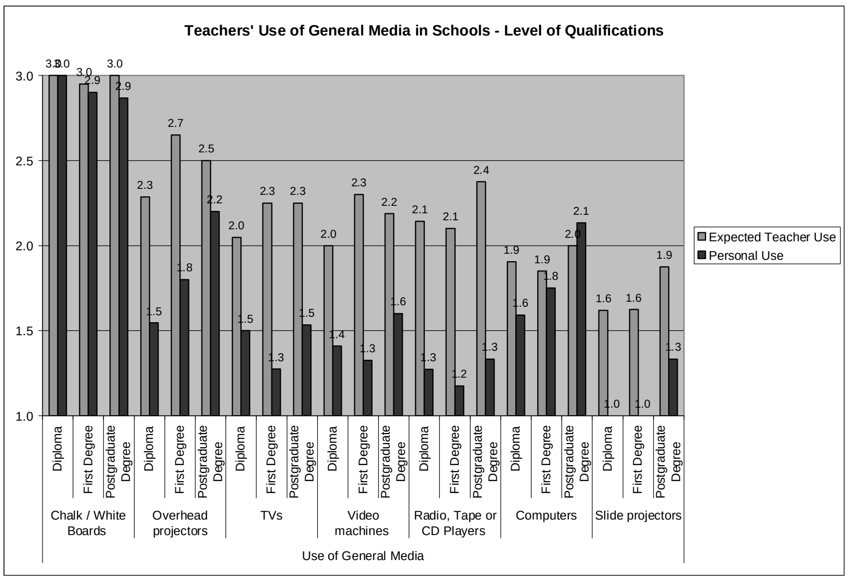
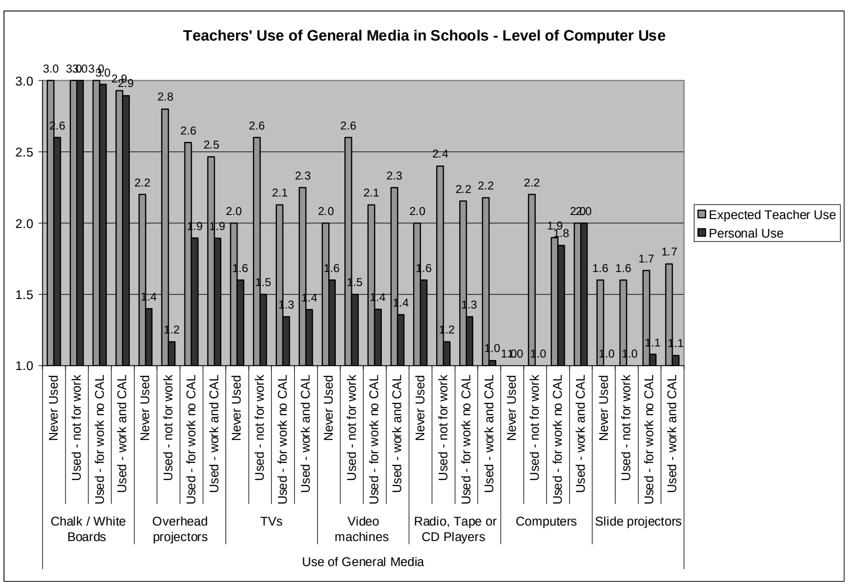


Table 27: Teachers' Use of General Media – Level of Qualification Breakdown

Media Items	Level of Qualifications	Media Use	Category Breakdown			Totals	
			Frequently	Seldom	Never	Use	Never Use
Chalk / White Boards	Diploma	Expected Teacher Use	100	0	0	100	0
		Personal Use	100	0	0	100	0
	First Degree	Expected Teacher Use	95	5	0	100	0
		Personal Use	93	5	3	98	3
	Postgraduate Degree	Expected Teacher Use	100	0	0	100	0
		Personal Use	93	0	7	93	7
Overhead projectors	Diploma	Expected Teacher Use	38	52	10	90	10
		Personal Use	5	45	50	50	50
	First Degree	Expected Teacher Use	65	35	0	100	0
		Personal Use	28	25	48	53	48
	Postgraduate Degree	Expected Teacher Use	50	50	0	100	0
		Personal Use	47	27	27	73	27
TVs	Diploma	Expected Teacher Use	33	38	29	71	29
		Personal Use	5	41	55	45	55
	First Degree	Expected Teacher Use	35	55	10	90	10
		Personal Use	3	23	75	25	75
	Postgraduate Degree	Expected Teacher Use	44	38	19	81	19
		Personal Use	13	27	60	40	60
Video machines	Diploma	Expected Teacher Use	29	43	29	71	29
		Personal Use	0	41	59	41	59
	First Degree	Expected Teacher Use	35	60	5	95	5
		Personal Use	3	28	70	30	70
	Postgraduate Degree	Expected Teacher Use	38	44	19	81	19
		Personal Use	13	33	53	47	53
Radio, Tape or CD Players	Diploma	Expected Teacher Use	29	57	14	86	14
		Personal Use	5	18	77	23	77
	First Degree	Expected Teacher Use	23	65	13	88	13
		Personal Use	3	13	85	15	85
	Postgraduate Degree	Expected Teacher Use	44	50	6	94	6
		Personal Use	0	33	67	33	67
Computers	Diploma	Expected Teacher Use	14	62	24	76	24
		Personal Use	9	41	50	50	50
	First Degree	Expected Teacher Use	13	60	28	73	28
		Personal Use	18	40	43	58	43
	Postgraduate Degree	Expected Teacher Use	13	75	13	88	13
		Personal Use	20	73	7	93	7
Slide projectors	Diploma	Expected Teacher Use	10	43	48	52	48
		Personal Use	0	0	100	0	100
	First Degree	Expected Teacher Use	5	53	43	58	43
		Personal Use	0	0	100	0	100
	Postgraduate Degree	Expected Teacher Use	6	75	19	81	19
		Personal Use	0	33	67	33	67

4.3.1.1.1.6 Level of Computer Use

Figure 6



In the results, teachers who have used computers for work activities have expectations of teacher computer use that fall very closely to the levels of computer use in reality. Otherwise, besides the use of chalk and white boards, again the levels of personal use never exceed expectations.

Table 28: Teachers' Use of General Media – Level of Computer Use Breakdown

Media Items	Level of Computer Use	Media Use	Category Breakdown Frequently	Seldom	Never	Totals Use	Never Use
Chalk / White Boards	Never Used	Expected Teacher Use	100	0	0	100	0
		Personal Use	80	0	20	80	20
	Used - not for work	Expected Teacher Use	100	0	0	100	0
		Personal Use	100	0	0	100	0
	Used - for work no CAL	Expected Teacher Use	100	0	0	100	0
		Personal Use	97	3	0	100	0
	Used - work and CAL	Expected Teacher Use	93	7	0	100	0
		Personal Use	93	4	4	96	4
Overhead projectors	Never Used	Expected Teacher Use	20	80	0	100	0
		Personal Use	0	40	60	40	60
	Used - not for work	Expected Teacher Use	80	20	0	100	0
		Personal Use	0	17	83	17	83
	Used - for work no CAL	Expected Teacher Use	56	44	0	100	0
		Personal Use	29	32	39	61	39
	Used - work and CAL	Expected Teacher Use	54	39	7	93	7
		Personal Use	29	32	39	61	39
TVs	Never Used	Expected Teacher Use	20	60	20	80	20
		Personal Use	20	20	60	40	60
	Used - not for work	Expected Teacher Use	60	40	0	100	0
		Personal Use	0	50	50	50	50
	Used - for work no CAL	Expected Teacher Use	31	51	18	82	18
		Personal Use	5	24	71	29	71
	Used - work and CAL	Expected Teacher Use	43	39	18	82	18
		Personal Use	4	32	64	36	64
Video machines	Never Used	Expected Teacher Use	0	100	0	100	0
		Personal Use	0	60	40	60	40
	Used - not for work	Expected Teacher Use	60	40	0	100	0
		Personal Use	0	50	50	50	50
	Used - for work no CAL	Expected Teacher Use	31	51	18	82	18
		Personal Use	5	29	66	34	66
	Used - work and CAL	Expected Teacher Use	39	46	14	86	14
		Personal Use	4	29	68	32	68
Radio, Tape or CD Players	Never Used	Expected Teacher Use	20	60	20	80	20
		Personal Use	20	20	60	40	60
	Used - not for work	Expected Teacher Use	40	60	0	100	0
		Personal Use	0	17	83	17	83
	Used - for work no CAL	Expected Teacher Use	26	64	10	90	10
		Personal Use	3	29	68	32	68
	Used - work and CAL	Expected Teacher Use	32	54	14	86	14
		Personal Use	0	4	96	4	96
Computers	Never Used	Expected Teacher Use	0	0	100	0	100
		Personal Use	0	0	100	0	100
	Used - not for work	Expected Teacher Use	20	80	0	100	0
		Personal Use	0	0	100	0	100
	Used - for work no CAL	Expected Teacher Use	10	69	21	79	21
		Personal Use	13	58	29	71	29
	Used - work and CAL	Expected Teacher Use	18	64	18	82	18
		Personal Use	25	50	25	75	25
Slide projectors	Never Used	Expected Teacher Use	0	60	40	60	40
		Personal Use	0	0	100	0	100
	Used - not for work	Expected Teacher Use	20	20	60	40	60
		Personal Use	0	0	100	0	100
	Used - for work no CAL	Expected Teacher Use	5	56	38	62	38
		Personal Use	0	8	92	8	92
	Used - work and CAL	Expected Teacher Use	7	57	36	64	36
		Personal Use	0	7	93	7	93

The information provides some insight by indicating that teachers who use computers for school activities tend to use computers at a similar frequency as they use overhead projectors, perhaps suggesting a preference for teachers to use electronic media that allows them to display and project customised and self developed material to learners in teaching time.

4.3.1.1.2 The Most Effective Teaching Medium

In this item, a comparison is made between:

- the media that teachers expect are used the most in teaching situations
- the media that teachers personally use the most
- the media that teachers believe to be most effective.

Results are presented in graph formats as a relative percentage share of answers provided per item.

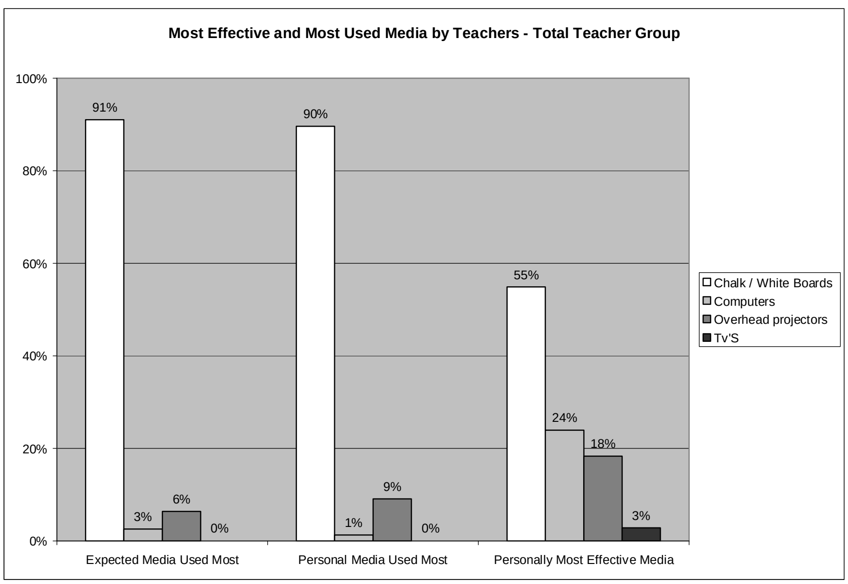
4.3.1.1.2.1 Total Teacher Group

The picture for expected and personal media used most is almost identical. Teacher media use is dominated by the traditional use of chalk and white boards, while the use of overhead projectors falls at a very low second for both expectation and personal use. Computers feature insignificantly at very low levels, and the literature suggests that as most teachers were trained before computers became an integral part of work, there is a tendency to feel suspicious of its benefits or inexperienced due to a lack of training (Schofield, 1995). Also, teachers tend to be inexperienced through little exposure to technologies due to the low integration levels of computers into the teaching context (Schofield, 1995). In schools where there are greater barriers to the implementation and use of educational technologies, such as the lack of funds or adequate training, teachers have a lower tendency to accept and utilize educational technologies (NCETDE, 1998). Some teachers also do not have the mental readiness to accept new innovations in the educational context

(Koszalka, 2001). However, studies indicate that the majority of teachers are unaware of how to integrate technologies into teaching practice (Firek, 2003; Newhouse, 1999; Robinson *et al.*, 2003).

In the evaluations of most effective media, a higher score of 55% for the choice of chalk and white boards suggests a general propensity for the use of traditional media amongst the teaching group as a whole. However, a score of 24% for computers as the most effective media suggests an opportunity for computer implementation. The difference in scores between effectiveness at 24% and expected and personal media used most at 8% and 9% respectively, suggests that despite lower availability and use of computer media, a level of interest and desire for use exists among some teachers. The representation is similar for overhead projectors, though at lower levels.

Figure 7

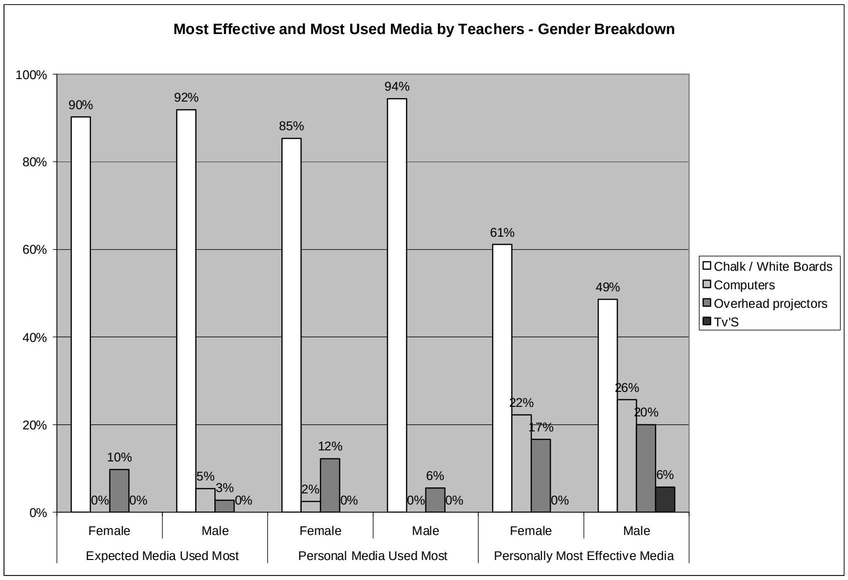


4.3.1.1.2.2 Gender Breakdown

The levels of expected and personal use between female and male groups largely resemble each other, though female teachers show more inclination to overhead projectors than male teachers, but at low levels.

Female teachers largely see chalk and white boards as the most effective teaching medium at 61%, while computers and overhead projectors fall second and third at 22% and 17% respectively. Though the picture looks similar for male teachers, the male group tends to place slightly more emphasis on electronic media with higher scores for computers, overhead projectors and TV's, though chalk and whiteboards still dominate at 49%.

Figure 8

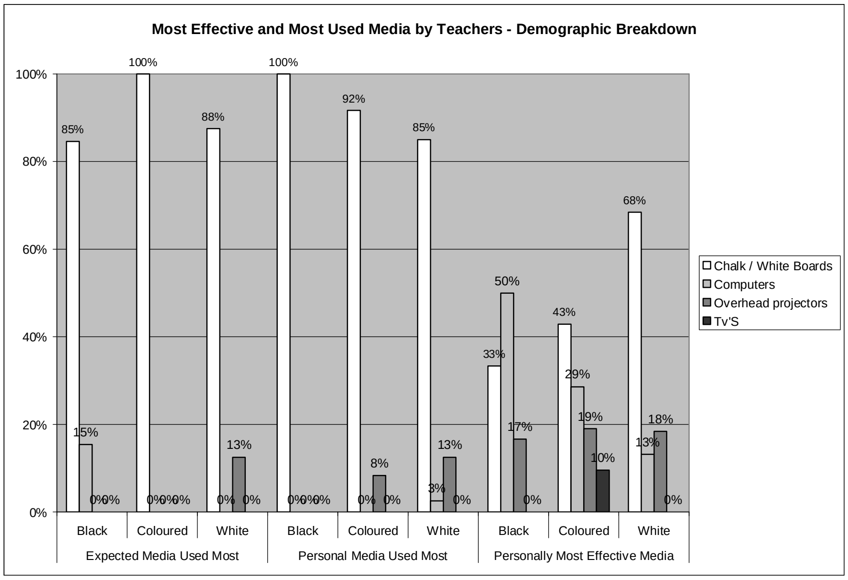


4.3.1.1.2.3 Demographic Breakdown

Traditional chalk and whiteboards dominate expected and personal media use across the groups. Overhead projector use matches expectation among White teachers, while chalk and whiteboard use falls below expectation amongst teachers who belong to the Coloured demographic group.

The views of media effectiveness differ significantly across the demographic groups. Black teachers view computers as the most effective medium at 50%, while chalk and whiteboards fall second at 33%. This again indicates an interest and desire to use computers as a teaching medium, though low levels of expected and personal use could show some technological idealism (NCETDE, 1998). Teachers in the Coloured and White demographic groups see chalk and whiteboards as the most effective media, though White teachers opt more for the traditional method at 68%, while Coloured teachers fall lower at 43% as some emphasis is also placed on computers at 29%.

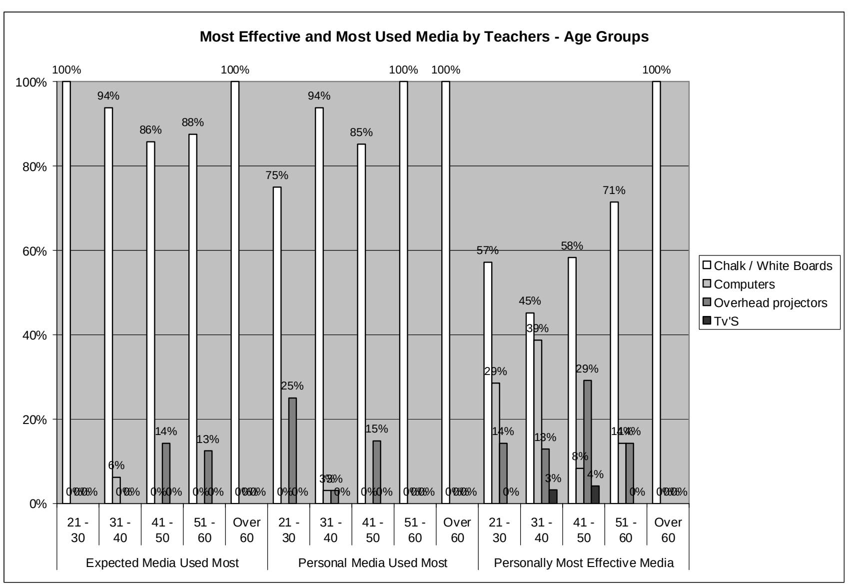
Figure 9



4.3.1.1.2.4 Age Groups

Traditional chalk and whiteboard media dominate expected and personal media use across all age groups. Though the 21 to 30 age group has higher expectations of the traditional medium, 25% of the age group uses overhead projectors most often. Computers feature strongly as an effective medium in the lower age groups, and fall as the preference for the traditional chalk and whiteboard medium increases with age, suggesting that teachers more recently trained tend to have a more positive view of the use of computers, though they do not feature strongly in use.

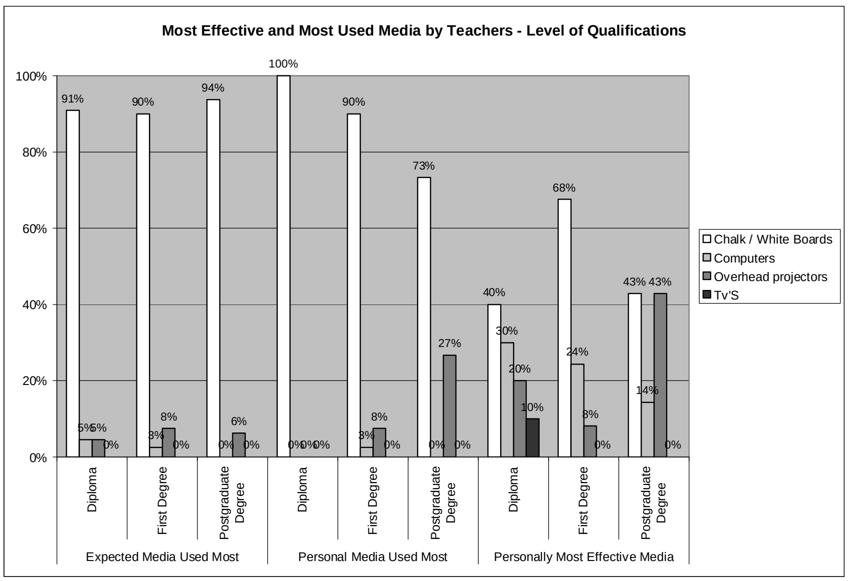
Figure 10



4.3.1.1.2.5 Level of Qualifications

Despite an overall higher expectation and use of the chalk and whiteboard medium, teachers with postgraduate qualifications tend to use overhead projectors more than expectation, while also showing higher levels of preference for overhead projectors and the traditional medium as effective media. Teachers who have diplomas tend to prefer a variety of methods, while teachers who have degrees have a stronger preference for the traditional chalk and whiteboard medium.

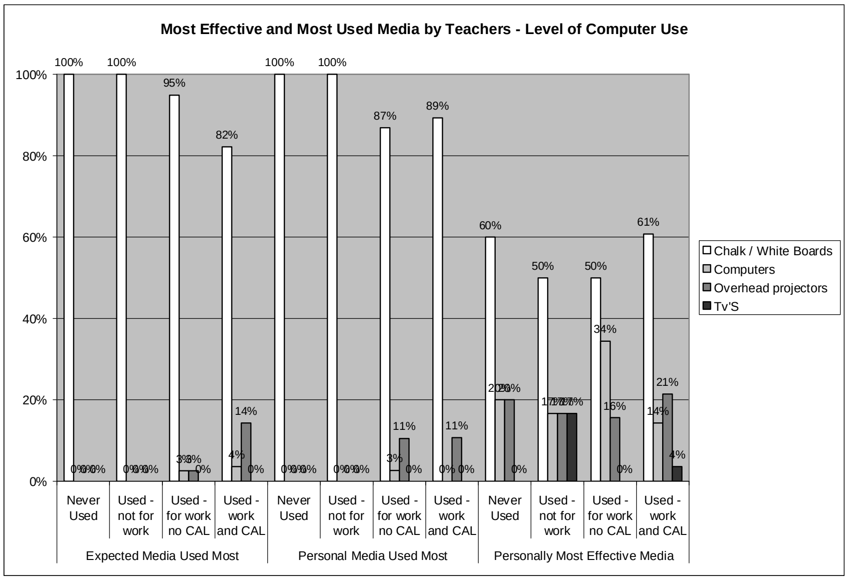
Figure 11



4.3.1.1.2.6 Level of Computer Use

Again, the traditional medium leads across the board, though 34% of teachers who have used computers for work related activity other than for CAL tend to view computers as the most effective teaching medium. In comparison, 14% of teachers who have used computers to teach show preference for computers, while a larger 21% prefer overhead projectors. Though many variables could influence the evaluations, a preference for chalk and whiteboards and overhead projectors among teachers who have taught with computers may indicate that factors in the current teaching infrastructure and layout may not be conducive to the integration of CAL into the school system.

Figure 12



4.3.1.2 Teachers and Computers in Schools

4.3.1.2.1 Teacher Computer Use at School

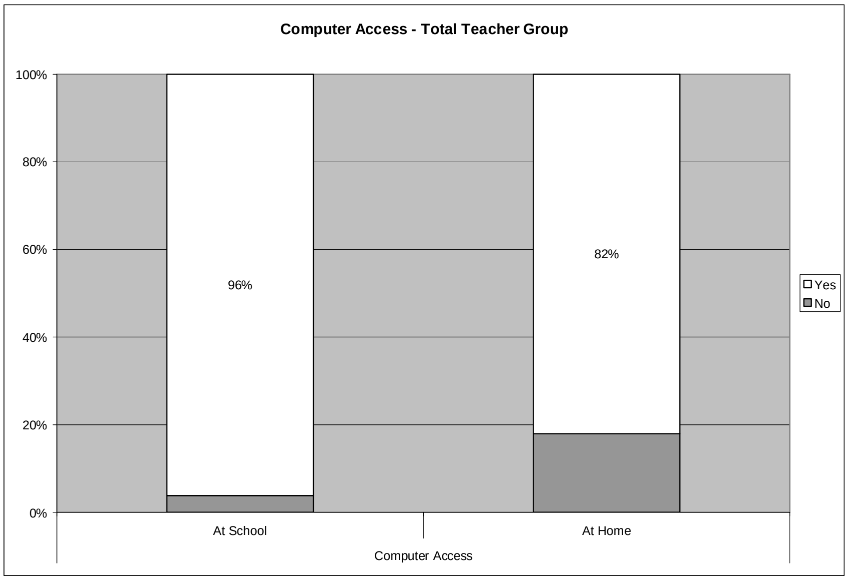
4.3.1.2.1.1 Computer Access

In this section a comparison is made between the levels of access that teachers have to computers at school and at home. Findings indicating the percentages of teacher access are presented in graph formats. The perceptions of the percentage proportion of schools with varying degrees of computer access are presented in tabular format, with a totals column added to provide a general summary of access.

4.3.1.2.1.1.1 Total Teacher Group

In general, the teaching group surveyed as a whole had high levels of access to computers both at school and at home, at 96% and 82% respectively.

Figure 13



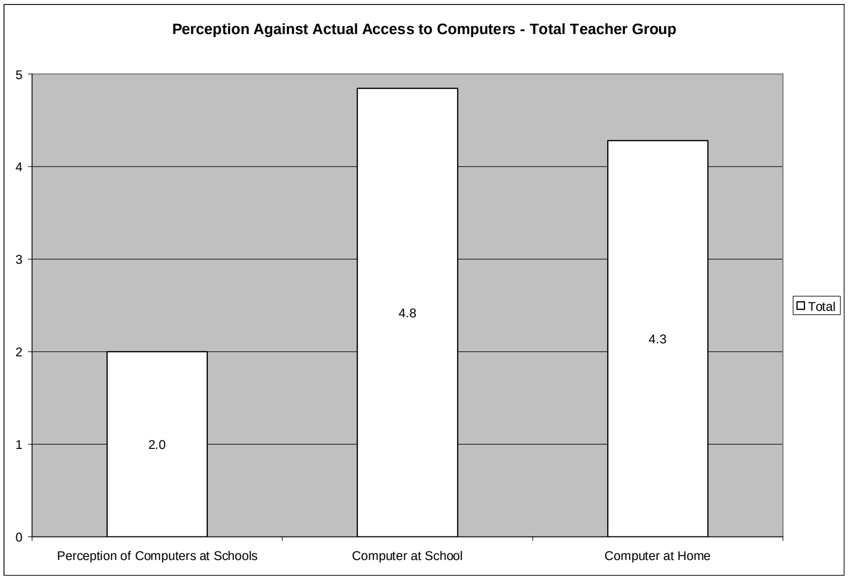
However, despite high levels of personal access teachers generally believe there to be a low availability of computers in schools in their own areas, as a low 5% of teachers believe that more than 60% of schools have computers.

Table 29: Teachers' Perceptions of the Percentage of Schools with Computer Access in Port Elizabeth – Total Teacher Group

	Intervals					Totals	
Total Teacher Group	**0 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**0 - 60%**	**61 - 100%**
Total Teacher Group	35	35	24	5	0	95	5

The low perception of the availability of computers, despite high levels of personal access, suggests a low level of awareness of educational technology in the schools system amongst the teaching fraternity. The implementation of CAL into the school system therefore may have less to do with the implementation of computers in schools than the integration of computers into the school curriculum, as suggested in the literature (DOE, 2003c). This provides some validity to statements in the literature that the implementation of computers absent from the school curricula may leave computers underutilized or unused (NCETDE, 1998). However, studies do indicate that schools in the Eastern Cape have very low availability levels of computers in general at 8.8% availability in 2002 (DOE, 2003c), and therefore the high availability figures in the study could demonstrate the disparities that exist in the availability of technologies between urban and rural areas (Hall, 1998).

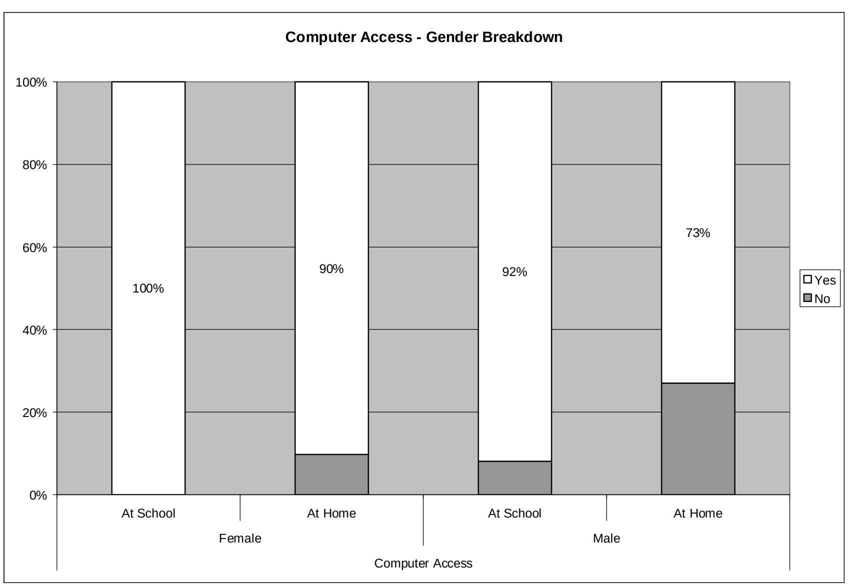
Figure 14



4.3.1.2.1.1.2 Gender Breakdown

In general, female teachers tend to have higher levels of access than their male colleagues. At school, female teachers have 100% access to computers than male teachers who have 92%, and at home, levels are at 90% and 73% respectively.

Figure 15



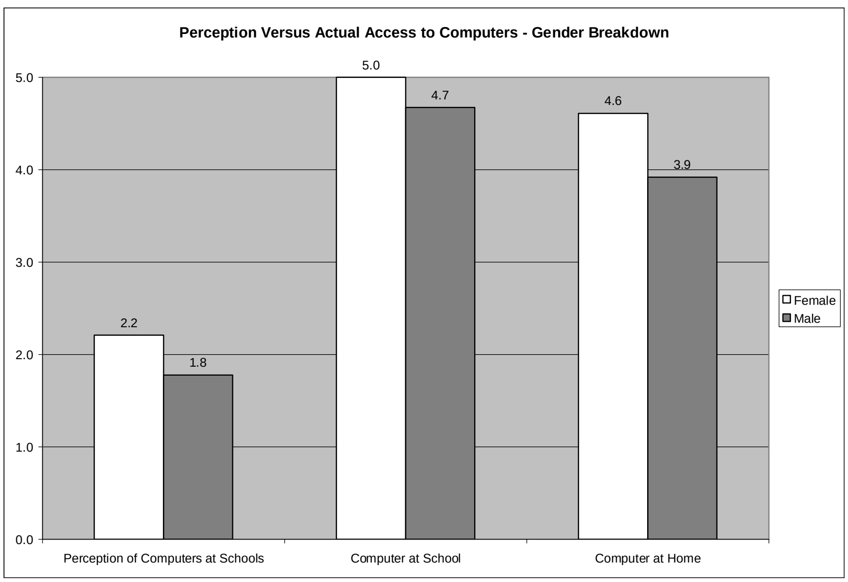
In general, both gender groups share the view that 60% or less of schools in their areas has computers available for use.

Table 30: Teachers' Perceptions of the Percentage of Schools with Computer Access in Port Elizabeth – Gender Breakdown

	Intervals					Totals	
Gender Breakdown	**0 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**0 - 60%**	**61 - 100%**
Female	24	42	24	11	0	89	11
Male	47	28	25	0	0	100	0

However, at low levels, female teachers, who have higher levels of computer access than male teachers do, also have a higher perception of computer availability of schools in their area than their male colleagues.

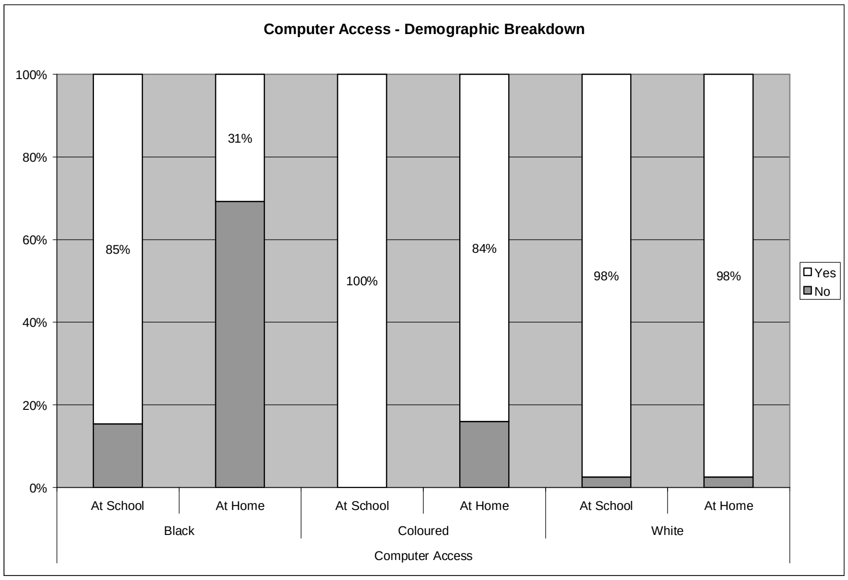
Figure 16



4.3.1.2.1.1.3 Demographic Breakdown

Comparisons in computer access are distinct between the demographic groups. White teachers have high levels of computer access at both school and at home. Coloured teachers have high levels of computers access at school, and moderately high levels at home at 84%. Black teachers have higher levels of access at school at 85%, but a low level of 31% has access to computers at home.

Figure 17



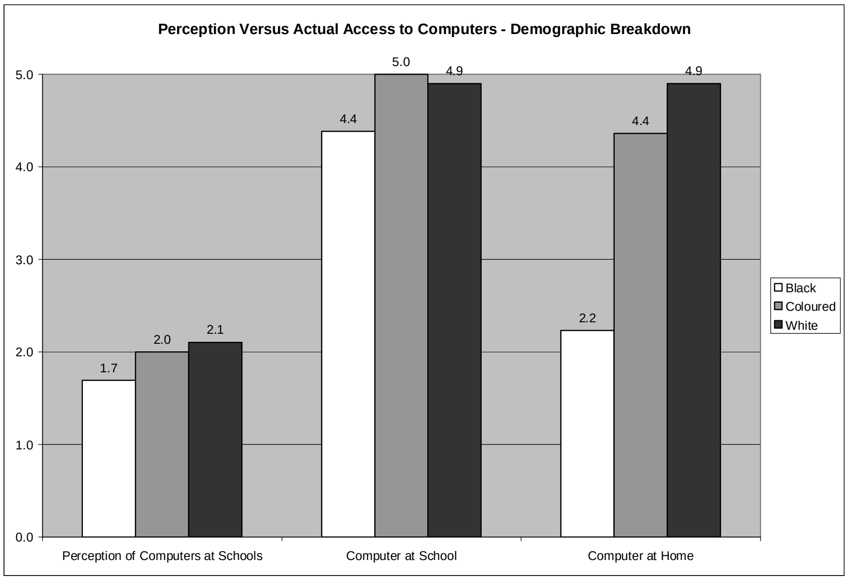
Despite demographic differences in computer access, the demographic groups share the view that 60% or less of schools in their areas has computers available for use.

Table 31: Teachers' Perceptions of the Percentage of Schools with Computer Access in Port Elizabeth – Demographic Breakdown

	Intervals					Totals	
Demographic Breakdown	**0 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**0 - 60%**	**61 - 100%**
Black	46	38	15	0	0	100	0
Coloured	36	32	27	5	0	95	5
White	31	36	26	8	0	92	8

To a small degree, the level of computer access again influences the perception of general computer availability in schools, as White teachers have a higher perception of computer availability and Black teachers have the lowest.

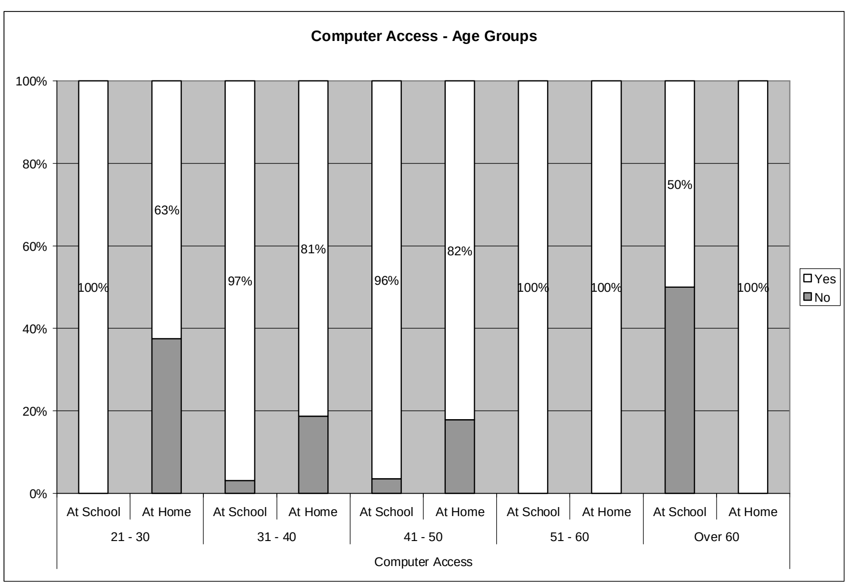
Figure 18



4.3.1.2.1.1.4 Age Groups

Generally, teachers across all age groups have high levels of computer access at schools, though 50% of the above 60 age group claimed to have access. However, access to computers at home increases with the rise in age group, as 63% of teachers in the 21-30 age group have computer access at home, compared to 100% at the 51-60 and 60 and above age group.

Figure 19



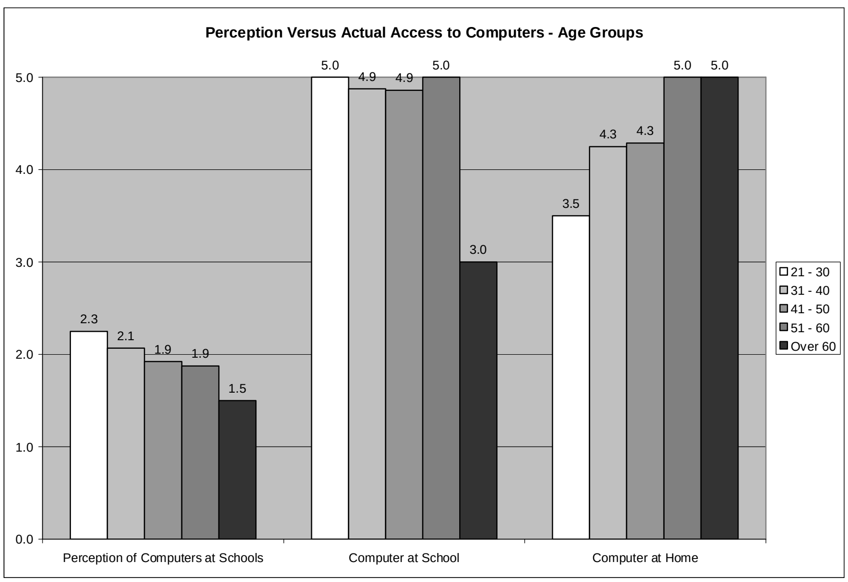
In general, most age groups share the view that 60% or less of schools in their areas has computers available for use.

Table 32: Teachers' Perceptions of the Percentage of Schools with Computer Access in Port Elizabeth – Age Group Breakdown

	Intervals					Totals	
Age Groups	**0 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**0 - 60%**	**61 - 100%**
21 - 30	25	25	50	0	0	100	0
31 - 40	30	43	17	10	0	90	10
41 - 50	42	27	27	4	0	96	4
51 - 60	38	38	25	0	0	100	0
Over 60	50	50	0	0	0	100	0

However, the lower age groups tend to have a higher perception of the availability of computers in schools in their areas than older teacher groups.

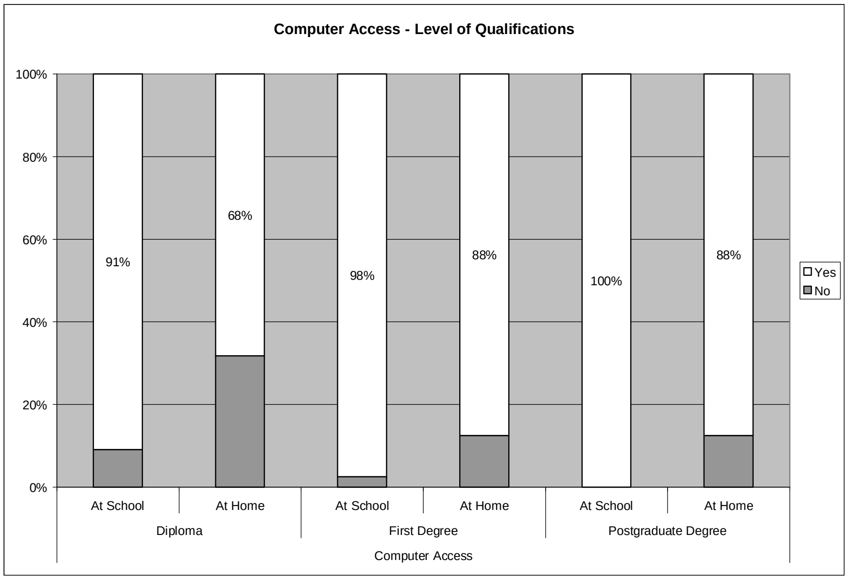
Figure 20



4.3.1.2.1.1.5 Level of Qualifications

All qualification groups have computer access at schools in excess of 90%. However, teachers who have diplomas have moderate levels of access at home at 68%, while teachers with degrees and postgraduate degrees have higher levels at 88%.

Figure 21

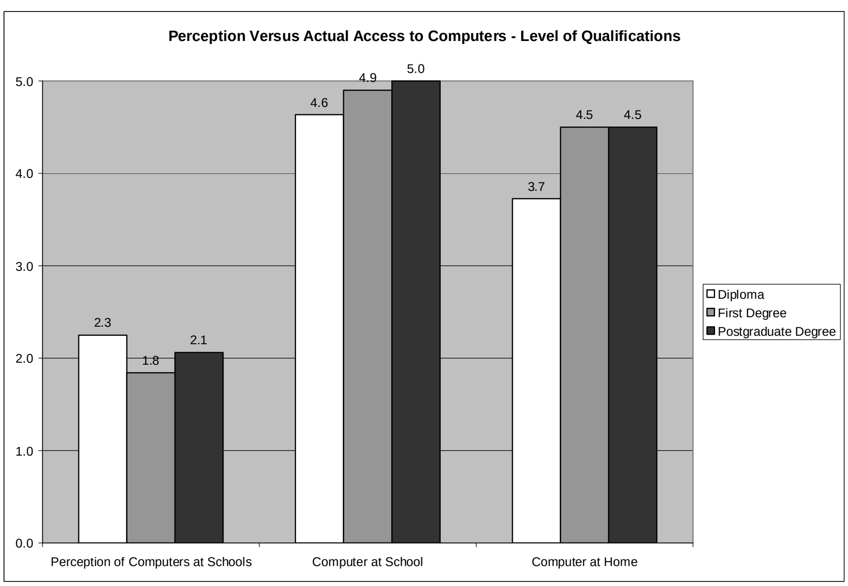


In general, all qualification groups share the view that 60% or less of schools in their areas has computers available for use. Teachers with diplomas have the highest perception of computer availability in schools in their areas, while those with degrees share the lowest. However, the differences are at low levels.

Table 33: Teachers' Perceptions of the Percentage of Schools with Computer Access in Port Elizabeth – Level of Qualification Breakdown

	Intervals					Totals	
Level of Qualifications	**0 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**0 - 60%**	**61 - 100%**
Diploma	20	45	25	10	0	90	10
First Degree	45	32	18	5	0	95	5
Postgraduate Degree	31	31	38	0	0	100	0

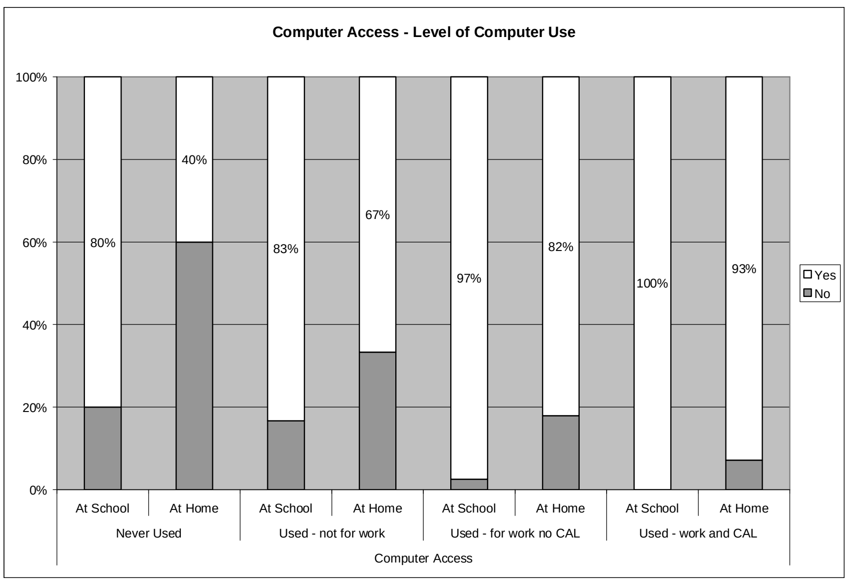
Figure 22



4.3.1.2.1.1.6 Level of Computer Use

The difference in access to computers in schools and at home is relative to the level of computer involvement, as the results indicate that levels of computer access improve as teachers are more involved with computers. Teachers who have never used computers have the lowest levels of access at school and at home, while teachers on the other end of the continuum, who use computers to teach, have the highest levels of access both at home and at school.

Figure 23



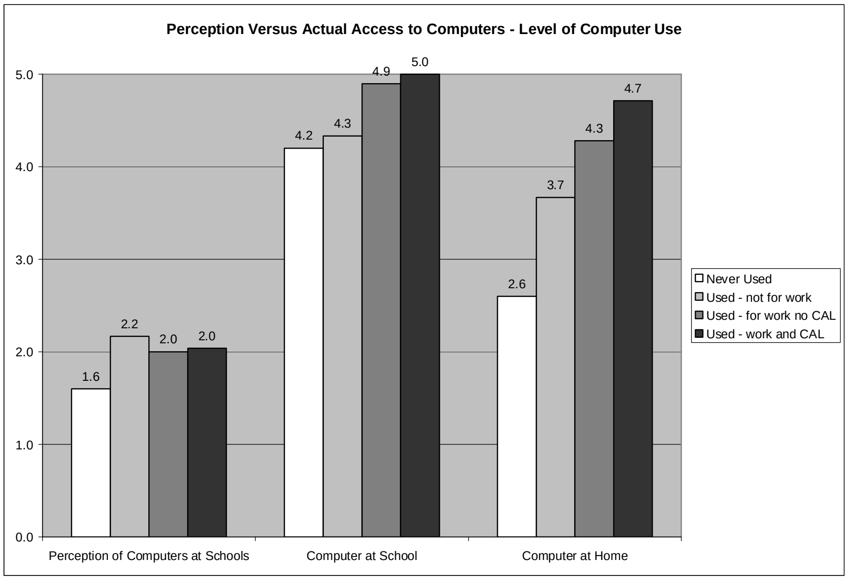
Of teachers who have used computers but not for work activities, 17% believe that between 61% and 80% of schools in their area have access to computers. Otherwise, in general across the groups, the majority of teachers reflect that less than 60% of schools in their areas have computers available for use.

Table 34: Teachers' Perceptions of the Percentage of Schools with Computer Access in Port Elizabeth – Level of Computer Use Breakdown

	Intervals					Totals	
Level of Computer Use	**0 - 20%**	**21 - 40%**	**41 - 60%**	**61 - 80%**	**81 - 100%**	**0 - 60%**	**61 - 100%**
Never Used	60	20	20	0	0	100	0
Used - not for work	33	33	17	17	0	83	17
Used - for work no CAL	32	42	21	5	0	95	5
Used - work and CAL	36	28	32	4	0	96	4

Teachers who have never used computers generally have the lowest perception of the availability of computers in schools in their areas.

Figure 24



4.3.1.2.1.2 The Profile of Teacher Computer Use

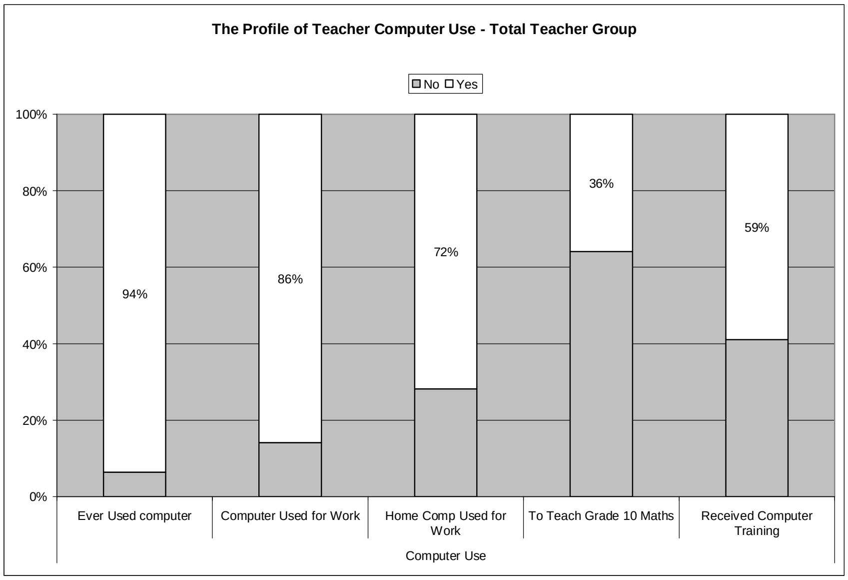
The results presented here show the levels of computer use and involvement amongst teachers, and demonstrate in comparison the proportion of teachers who have:

- ever used computers
- used computers for work related activities
- used home computers for work related activities
- used computers to teach Grade 10 Mathematics
- received computer training.

Results are presented in a graph format and indicate the relative percentage proportion of ‘Yes’ and ‘No’ responses per item.

4.3.1.2.1.2.1 Total Teacher Group

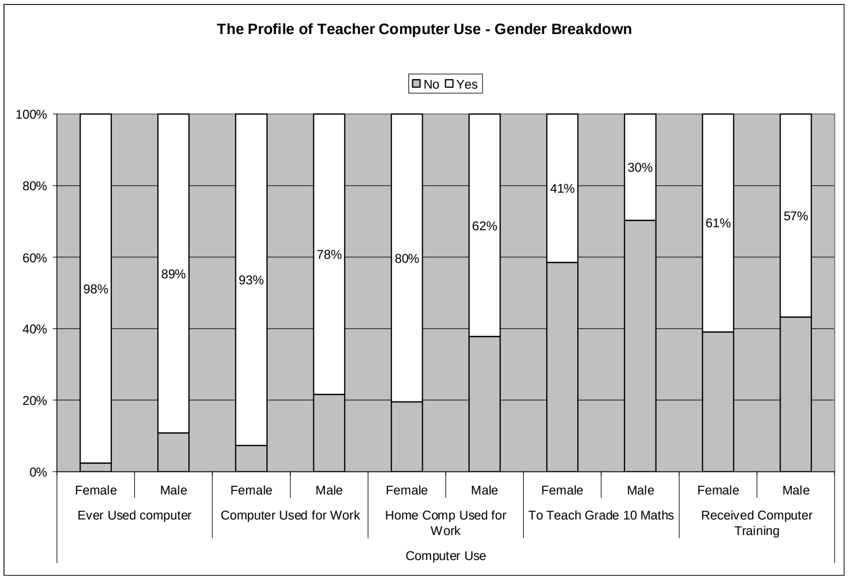
Figure 25



In general at 94%, a greater majority of teachers have used computers before, while work activities have featured high in patterns of computer use as 86% of teachers have used a computer for work related activities. Of the teacher group, 72% of teachers have used a computer at home for school related activities, indicative of a high level of computer use for the purposes of school lesson preparation and administration among teachers. However, 36% of all teachers have used the computer to teach or to assist in the teaching of Grade 10 Mathematics, suggesting that the use of computers to teach is not a priority of work related computer use. Despite a majority of teachers, at 59%, who have received computer training, teachers who have not received training seem to have taught themselves and developed their own computer skills over time, suggesting a high level of motivation and desire to use computer technology amongst the teacher group as a whole. The literature indicates that, despite educational background, learners and teachers generally demonstrate the ability to develop their own computers skills through relative technologies and independent trial and error learning processes (McCabe *et al.*, 2003).

4.3.1.2.1.2.2 Gender Breakdown

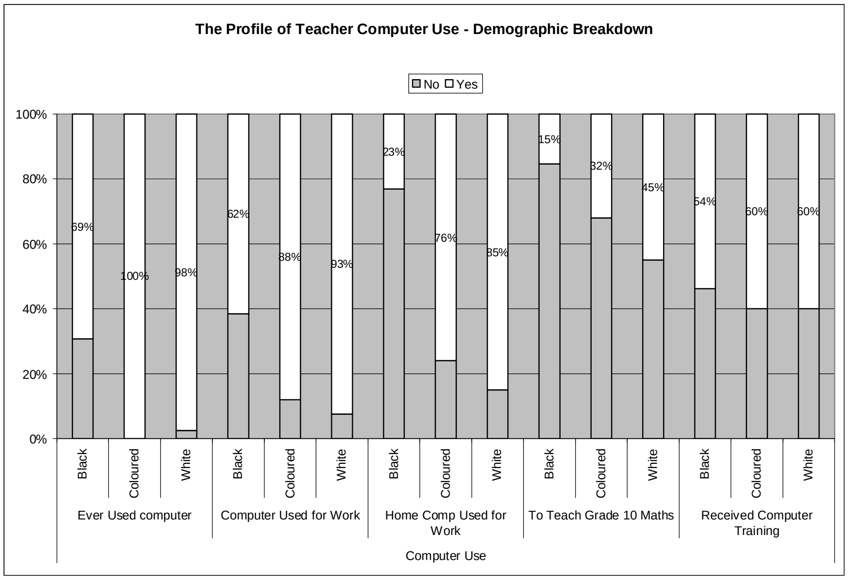
Figure 26



Levels of computer activity vary distinctly between the gender groups, as female teachers tend to lead the male teachers in aspects of computer use. More female teachers have used a computer before at 98%, compared to 89% of male teachers. Female teachers have used computers for work activities at a higher significance than their male colleagues, at a difference of 15% and 22% for having used computers for work and home computers for work respectively. In addition, 41% of female teachers have used computers to teach Grade 10 Mathematics in comparison to 30% of male teachers, and though at similar levels, more female teachers have received computer training at 61%. Traditionally literature has stated that the use of computers is skewed toward males as the technical nature of computers appeal more to males than female (Owen *et al.*, 1998), yet the results indicate the contrary.

4.3.1.2.1.2.3 Demographic Breakdown

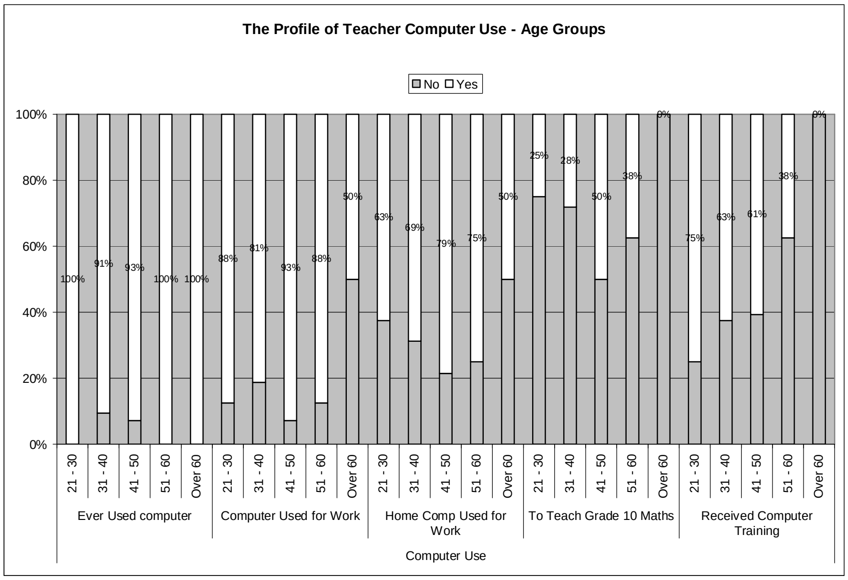
Figure 27



Significantly fewer teachers who fall in the Black demographic group have used computers before at 69%, compared to Coloured and White teachers at 100% and 98% respectively. In addition, such large differences are also seen between the demographic groups for computer use for school activities, the Black demographic group falling very low at 23% for having used home computers for school activities compared to the White demographic group at 85%. However, the difference in the level of training received between the demographic groups is small at a level of 6%. It therefore seems that the greater access to, and integration of, computers in the school and home environment tends to help teachers who have not received training to independently develop functional computer skills. Despite similar levels of training for Black teachers to other demographic groups, a smaller proportion of Black teachers beyond the trained group have accessed computers at 15%, compared to the Coloured and White teachers at 40% and 38% respectively.

4.3.1.2.1.2.4 Age Groups

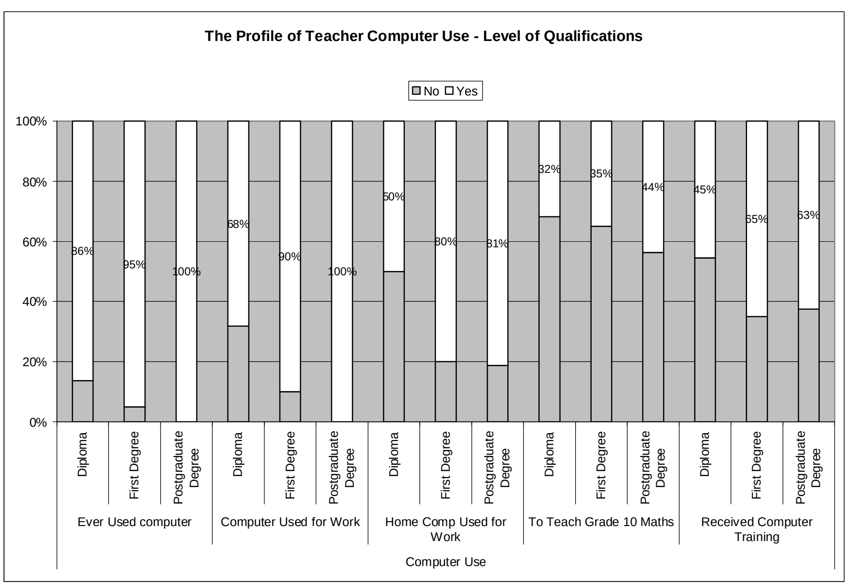
Figure 28



More younger teachers have received computer training than older teachers, and levels of training received decline as age groups increase, up to the over 60 group who have never received computer training. Although levels of computer use are similar across the age groups, more older teachers tend to access home computers for work activities than do younger people. Despite lower levels of training, more older teachers have used computers to teach Grade 10 Mathematics than younger teachers.

4.3.1.2.1.2.5 Level of Qualifications

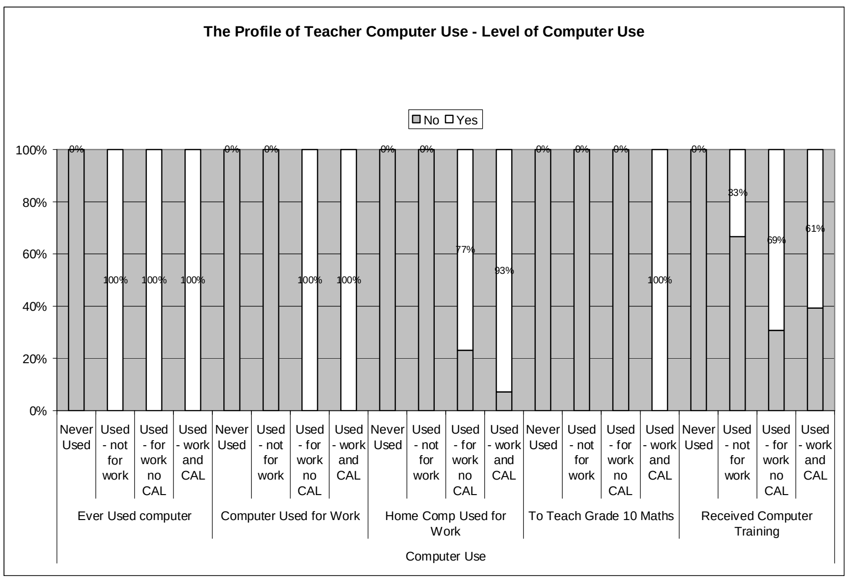
Figure 29



The patterns of computer use between groups of teachers with different levels of qualifications show that postgraduate teachers lead in most aspects of computer use, while teachers with degrees generally fall second and teachers with diplomas fall at lower levels. The results therefore suggest a correlation between the level of qualification and level of computer use. However, despite larger differences between teachers of different qualification levels, there are smaller variations between the groups in using computers to teach where all groups fall at lower levels.

4.3.1.2.1.2.6 Level of Computer Use

Figure 30



The patterns of computer use between groups of teachers with various levels of computers use indicate that to a smaller degree teachers who use computers for work activities and CAL use home computers more extensively than teachers who use computers for general work activities only, though both are at higher levels. In addition, a higher proportion of teachers who use computers for work all activities have received computer training.

4.3.1.2.1.3 Time Spent on Computers

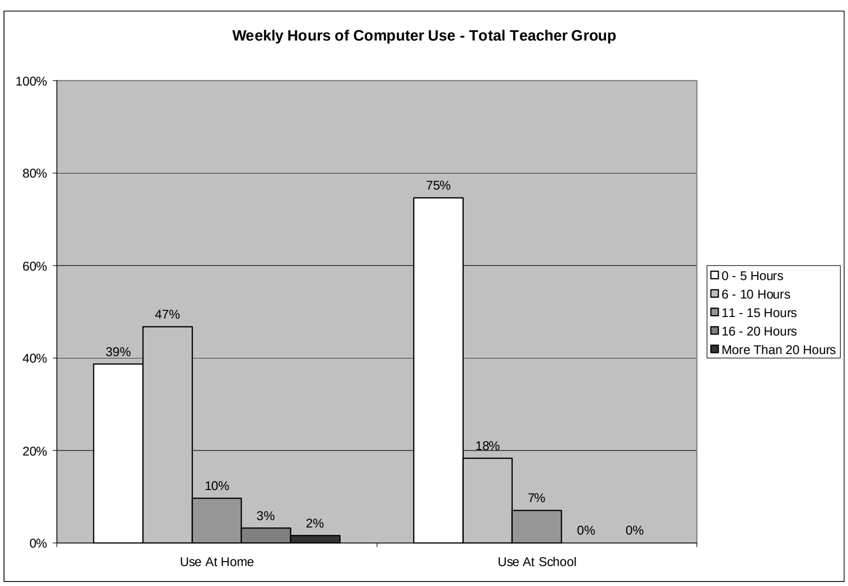
This item explores the difference between the time that teachers spend on computers at school compared to at home. The results are indicated in weekly hours, and show the proportional percentage breakdown by hourly group segment set up as follows:

- 0 to 5 hours
- 6 to 10 hours
- 11 to 15 hours
- 16 to 20 hours
- More than 20 hours.

4.3.1.2.1.3.1 Total Teacher Group

In general, the majority of teachers spend 0 to 5 hours a week using computers at school, while at home the majority of teachers spend 6 to 10 hours per week using computers. The reason that teachers tend to spend more time on computers at home than at school could be the convenient availability and time available for computer use at home. However, the lack of time and availability of computers in the school context may impact the implementation of CAL systems into schools, as is documented in the literature and evidenced here (NCETDE, 1998).

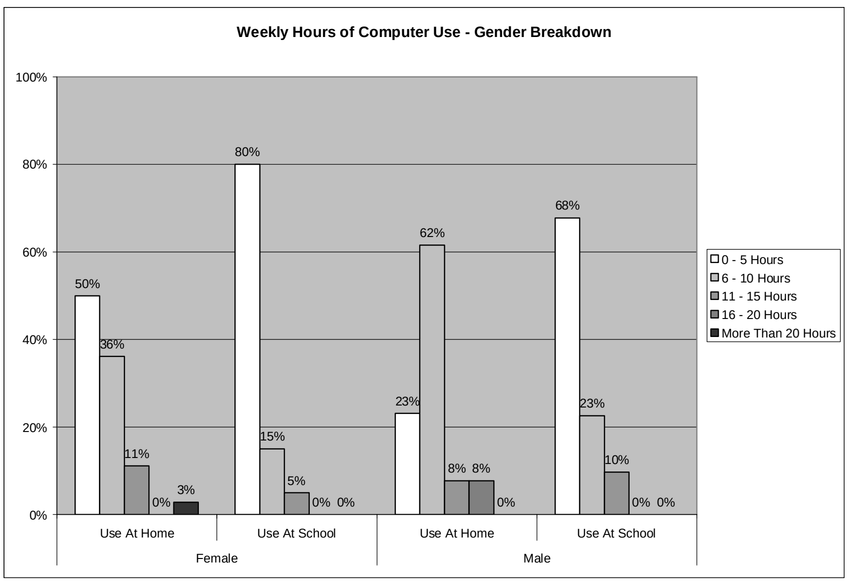
Figure 31



4.3.1.2.1.3.2 Gender Breakdown

Female teachers tend to spend a majority of 0 to 5 hours a week on computers at home and at school, though a greater proportion of home use occurs between 6 and 10 hours a week than at school. Male teachers, despite having lower levels of computer use than female teachers have as indicated earlier, tend to spend longer periods on computers than their female colleagues do. At home, 62% of male teachers spend 6 to 10 hours a week on computer, compared to 36% of female teachers.

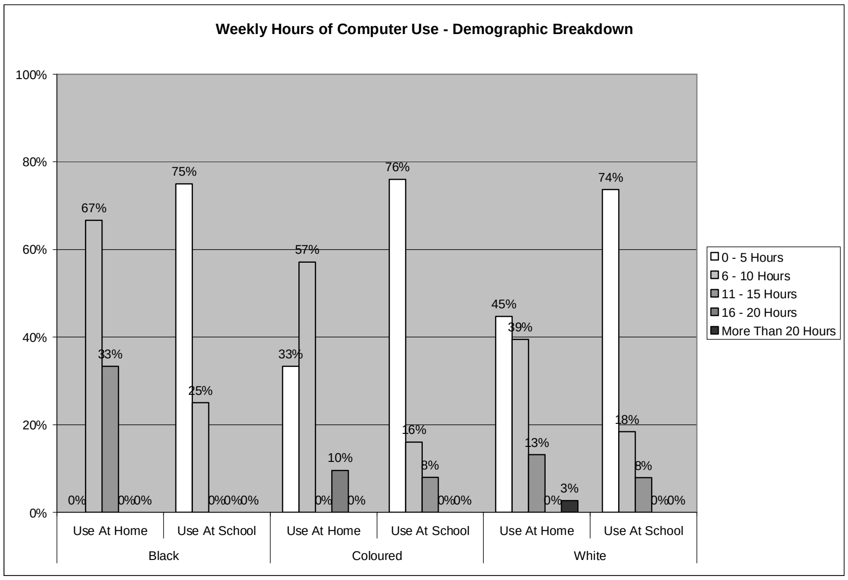
Figure 32



4.3.1.2.1.3.3 Demographic Breakdown

The results indicate that teachers who belong to the Black demographic group spend more time on computers at home than do Coloured and White teachers, as 67% of Black teachers spend 6 to 10 hours and 33% spend 11 to 15 hours per week on computer, though these figures are off a small base. Of Coloured teachers, 67% spend 6 to 10 hours a week on computers at home, compared to 39% of White teachers, who mostly spend time at home using computers for periods of 0 to 6 hours at 45%. However, around 75% of teachers in all demographic groups spend 0 to 5 hours per week using computers at school.

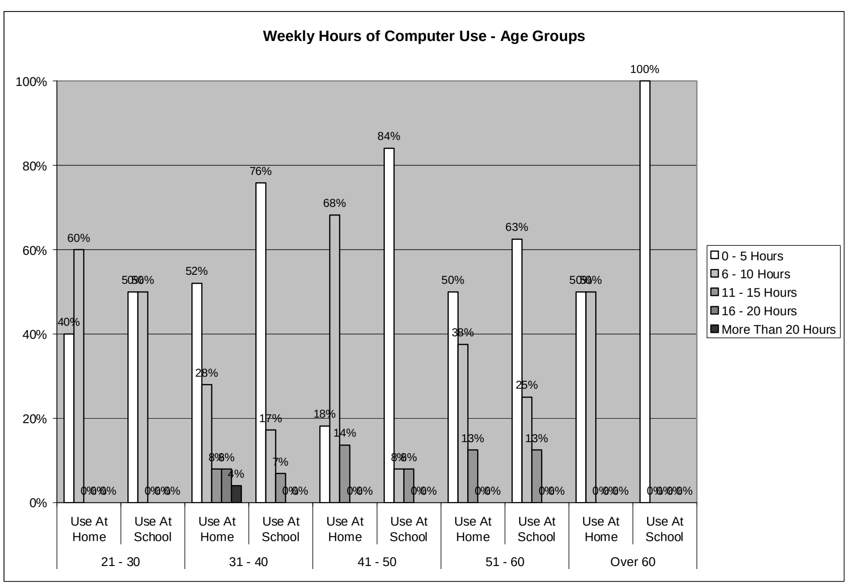
Figure 33



4.3.1.2.1.3.4 Age Groups

Patterns of home use vary extensively between age groups, though teachers generally show a greater proportion in the 6 to 10 hour computer use category at home than at school. However, teachers across the majority of age groups spend 0 to 6 hours per week using computers at school, with the exception of the 21 to 30 age group, 50% of whom spend 0 to 6 and 7 to 10 hours per week using computers at school.

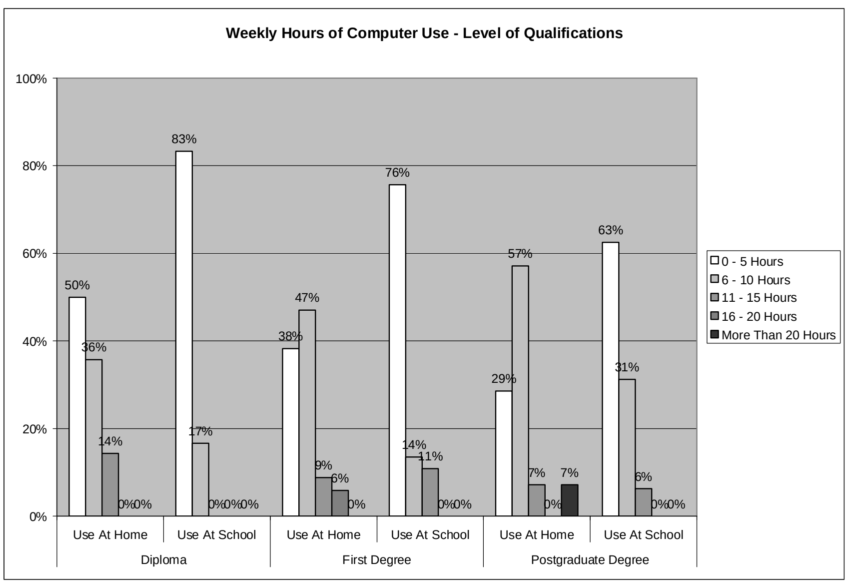
Figure 34



4.3.1.2.1.3.4 Level of Qualifications

The results suggest a correlation between the level of qualifications and patterns of computer use at home and school. In general, a majority of teachers spend 0 to 6 hours a week using computers at school. However, 37% of postgraduate teachers spend more than 6 hours a week using computers at school, compared to 24% of teachers with degrees and 16% of teachers with diplomas. At home, 50% of teachers with diplomas spend more than 6 hours per week using computers, compared to 62% of degreed teachers and 71% of teachers with postgraduate qualifications. It therefore appears that teachers with higher qualifications tend to spend longer periods weekly on computers than teachers with lower qualifications.

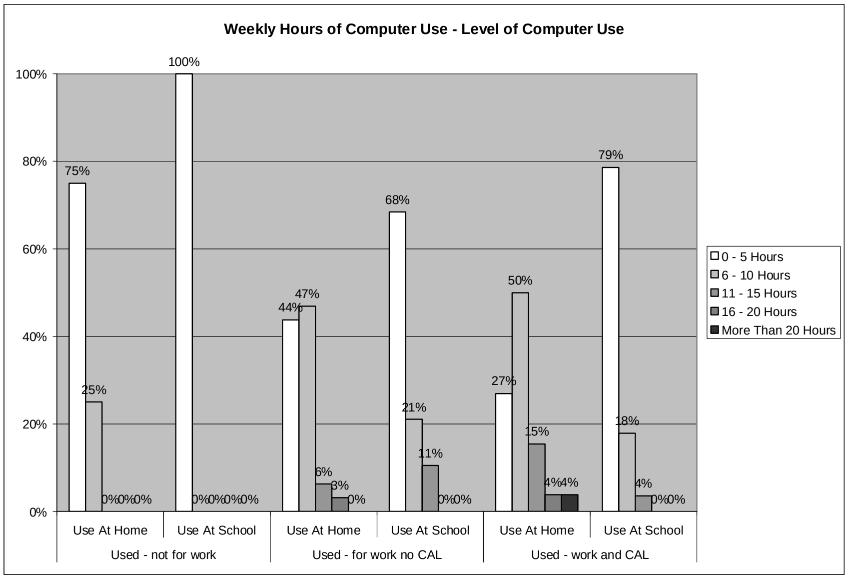
Figure 35



4.3.1.2.1.3.5 Level of Computer Use

The results also suggest a correlation between the level of involvement teachers have with computers and the pattern of computer use at school and home. Teachers who use computers to teach tend to spend longer periods of time on computers at home, while teachers who use computers for work but not to teach tend to spend longer periods of time on computers at school. This could be attributed to the level of preparation required for teachers who use computers to teach, and therefore would require longer periods of time at home in preparation.

Figure 36



4.3.1.2.2 Computer Ability

4.3.1.2.2.1 Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners

Teaching with CAL systems would require a functional level of general computer ability for both teachers and learners. This item assesses how teachers rate their own general computer ability, in comparison to how they rate the Grade 10 Mathematics learners' computer abilities.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: very poor, fairly poor, fairly capable and very capable. The totals are added in the table for a summary of general capable and poor abilities.

A weighted average has also been calculated by assigning values to the ratings, from 1 for very poor to 4 for very capable. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 is very poor
- 1.76 to 2.5 is fairly poor
- 2.51 to 3.25 is fairly capable
- 3.26 to 4 is very capable.

4.3.1.2.2.1.1 Total Teacher Group

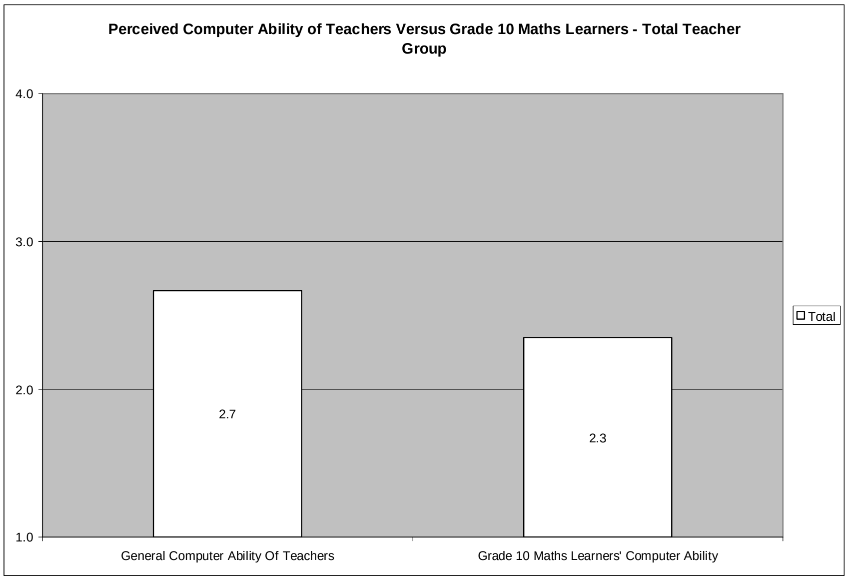
In general, 64% of teachers rate their general computer ability as capable, while the majority feel that their level of capability is fairly capable. Teachers feel that 52% of Grade 10 Mathematics learners are capable, and the majority also feel that the learners' level of capability is fairly capable.

Table 35: The Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners – Total Teacher Group

	Category Breakdown				Totals	
Items	Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
General Computer Ability Of Teachers	8	56	31	6	64	36
Grade 10 Maths Learners' Computer Ability	11	41	19	29	52	48

From a weighted average perspective, teachers as a group rate themselves at 2.7 that places them on the lower level of the fairly capable category. Teachers however, rate the general ability of learners at 2.3, which places them at the higher end of the fairly poor category of computer ability. In general, both ability levels question, as is stated in the literature, how lower computer abilities may affect the implementation of CAL, and in turn how the implementation of CAL may affect the educational quality and success of teachers and learners (NCETDE, 1998). In addition, the literature indicates that technologically inexperienced teachers tend to feel that their learners are more competent in technology use than they are and believe that computers in classrooms would challenge their teaching authority (Schofield, 1995).

Figure 37



4.3.1.2.2.1.2 Gender Breakdown

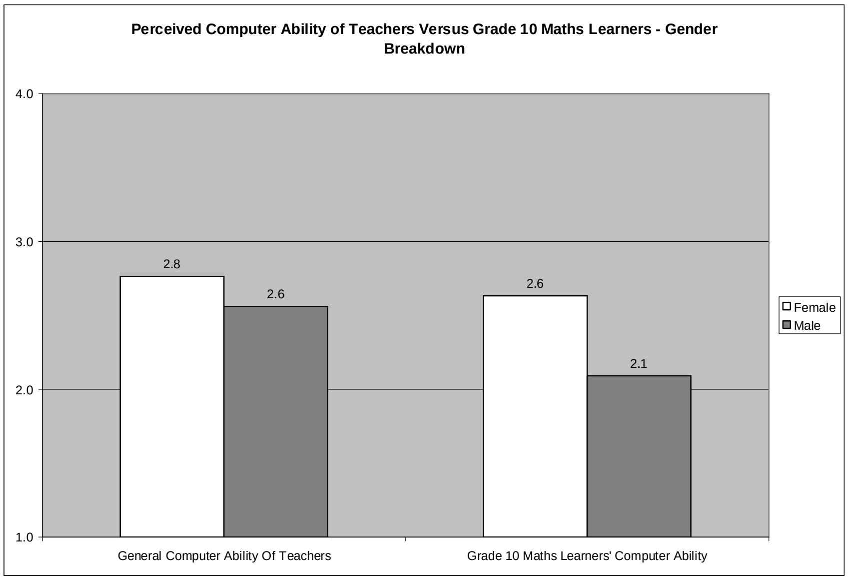
Female teachers feel that the computer ability of 68% of teachers is capable, while male teachers state the same at 63%. Female teachers, however, rate that 59% of Grade 10 Mathematics learners have capable computer abilities, compared to a lower 42% indicated by the male teacher group.

Table 36: The Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners – Gender Breakdown

Items	Gender Breakdown	Category Breakdown				Totals	
		Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
General Computer Ability Of Teachers	Female	13	55	26	5	68	32
	Male	3	56	35	6	59	41
Grade 10 Maths Learners' Computer Ability	Female	20	43	17	20	63	37
	Male	3	39	21	36	42	58

In the weighted average breakdown, female teachers as a group rate themselves at 2.8, falling in the mid area of the fairly capable category, while male teachers rate themselves at 2.6, placing them on the lower level of the fairly capable category. Female teachers therefore rate their ability at a higher level than their male colleagues. Also, female teachers tend to rate the learners' abilities at higher levels than do male teachers, placing learners average abilities at the lower end of fairly capable at 2.6, while male teachers rate learners' abilities at 2.1, falling at the mid end of fairly poor.

Figure 38



4.3.1.2.2.1.3 Demographic Breakdown

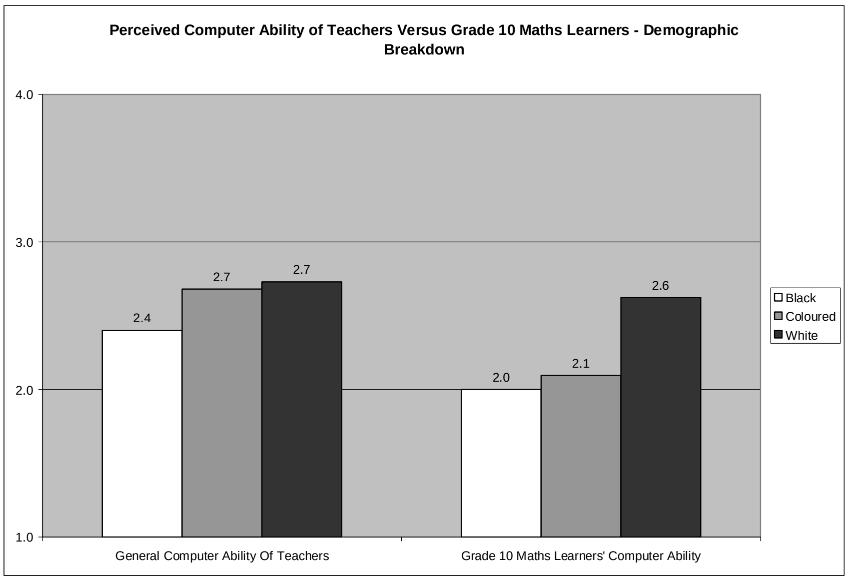
Half of the Black teacher group saw themselves as capable on computer, compared to the Coloured and White groups who indicated capability at 64% and 68% respectively. The White teacher group has a higher rating of learners' computer ability at 66%, than the Black and Coloured teacher groups at 40% and 38% respectively.

Table 37: The Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners – Demographic Breakdown

		Category Breakdown				Totals	
Items	**Demographic Breakdown**	Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
General Computer Ability Of Teachers	Black	10	40	30	20	50	50
	Coloured	4	60	36	0	64	36
	White	11	57	27	5	68	32
Grade 10 Maths Learners' Computer Ability	Black	0	40	20	40	40	60
	Coloured	14	24	19	43	38	62
	White	13	53	19	16	66	34

In the weighted average breakdown, teachers in the Black demographic group generally rate themselves as having fairly poor computer abilities at 2.4, while Coloured and White teachers both evaluate themselves as capable at 2.7. However, the Coloured and Black teacher groups place learners' computer abilities at fairly poor standings at 2.1 and 2 respectively. White teachers indicate though, that learners tend to be capable on computers, though still at lower levels at 2.6. Differences here could be indicative of the so called digital divide, indicating that less access to computers and technology due to the lack of resources exacerbate the differences between advantaged and disadvantaged groups, and that the divide increases as society becomes more entrenched in technological use (Ishaq, 2001). Therefore, the lack of technological resources in poorer schools would disadvantage teachers and learners who would need to perform CAL at the same level as technologically advantaged schools, despite the lack of technological experience, integration and lower levels of computer ability.

Figure 39



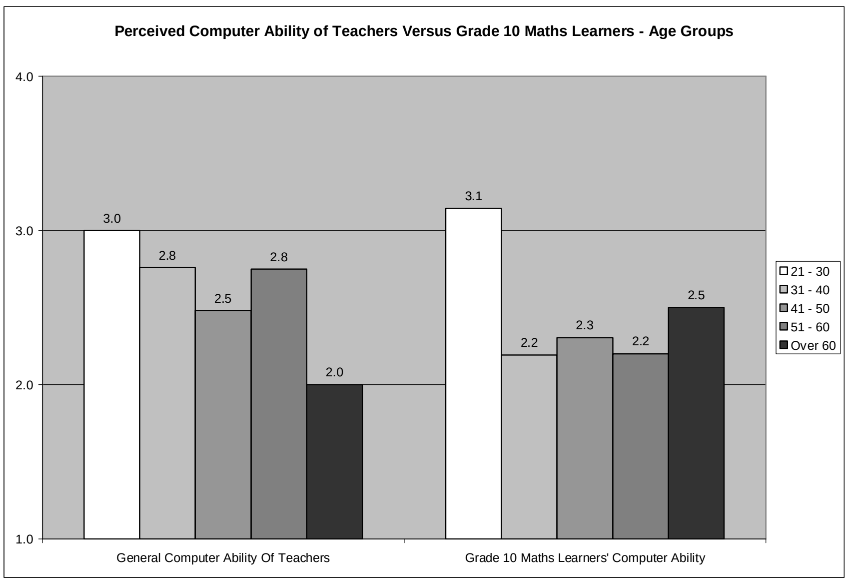
4.3.1.2.2.1.4 Age Groups

Table 38: The Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners – Demographic Breakdown

Items	Age Groups	Category Breakdown: Very Capable	Fairly Capable	Fairly Poor	Very Poor	Totals: Capable	Poor
General Computer Ability Of Teachers	21 - 30	29	43	29	0	71	29
	31 - 40	7	66	24	3	72	28
	41 - 50	7	44	37	11	52	48
	51 - 60	0	75	25	0	75	25
	Over 60	0	0	100	0	0	100
Grade 10 Maths Learners' Computer Ability	21 - 30	29	57	14	0	86	14
	31 - 40	8	38	19	35	46	54
	41 - 50	13	39	13	35	52	48
	51 - 60	0	40	40	20	40	60
	Over 60	0	50	50	0	50	50

Generally, the 41 to 50 and over 60 age groups rate their computer abilities as fairly poor, while other age groups feel that their computer levels are fairly capable. The 21 to 30 group have the highest ability rating at 3, while at the other end the over 60 group have the lowest rating at 2, providing some validity to the statement in the literature that teachers trained more recently tend to have higher levels of computer literacy (Valdez *et al.,* 2004). The 21 to 30 group and over 60 groups, however, both rate the computer abilities of Grade 10 Mathematics learners as better than their own at levels of fair capability.

Figure 40



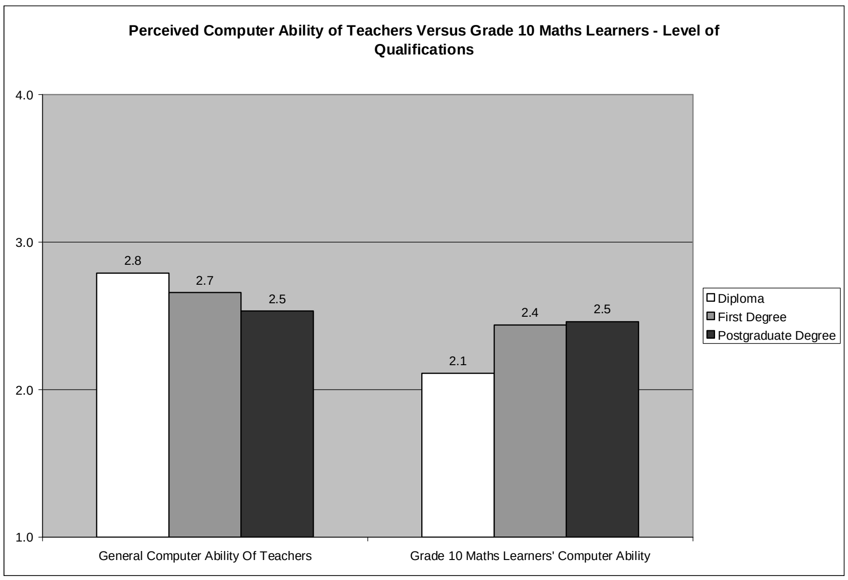
4.3.1.2.2.1.5 Level of Qualifications

Table 39: The Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners – Level of Qualification Breakdown

Items	Level of Qualification	Category Breakdown: Very Capable	Fairly Capable	Fairly Poor	Very Poor	Totals: Capable	Poor
General Computer Ability Of Teachers	Diploma	21	42	32	5	63	37
	First Degree	5	61	29	5	66	34
	Postgraduate Degree	0	60	33	7	60	40
Grade 10 Maths Learners' Computer Ability	Diploma	11	33	11	44	44	56
	First Degree	16	38	22	25	53	47
	Postgraduate Degree	0	62	23	15	62	38

The trend in the data shows that as the level of qualification increases, so teachers' evaluations of their own computer abilities lower while their evaluation of learners' computer abilities rise. Though all at levels that indicate fair capability, teachers with diplomas, degrees and postgraduate degrees rate teachers' computer abilities at 2.8, 2.7 and 2.5 respectively, while rating learners abilities at 2.1, 2.4 and 2.5 in the same order. Teachers with diplomas have a significantly lower evaluation of learners' abilities than teachers in other qualification groups.

Figure 41



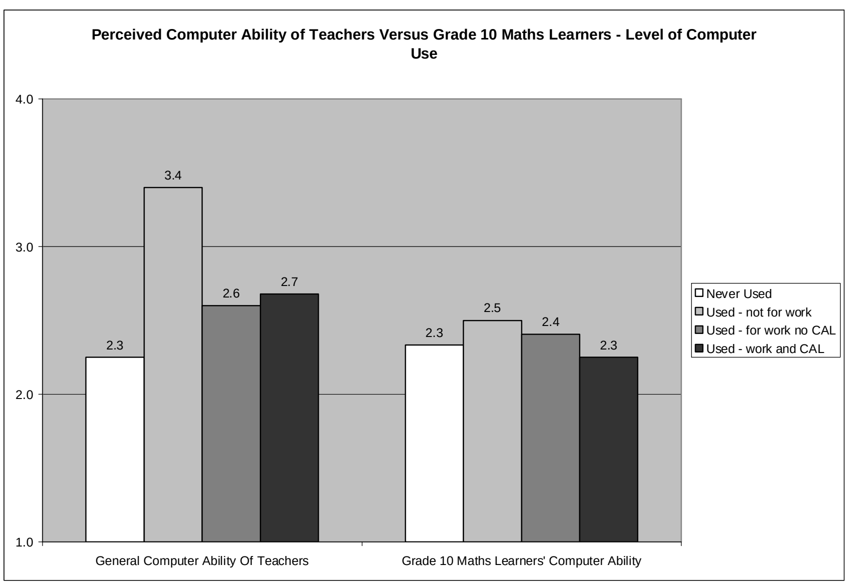
4.3.1.2.2.1.6 Level of Computer Use

Table 40: The Perceived Computer Ability of Teachers and Grade 10 Mathematics Learners – Level of Computer Use Breakdown

		Category Breakdown				Totals	
Items	**Level of Computer Use**	Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
General Computer Ability Of Teachers	Never Used	0	25	75	0	25	75
	Used - not for work	40	60	0	0	100	0
	Used - for work no CAL	6	57	29	9	63	37
	Used - work and CAL	7	57	32	4	64	36
Grade 10 Maths Learners' Computer Ability	Never Used	0	67	0	33	67	33
	Used - not for work	0	75	0	25	75	25
	Used - for work no CAL	19	28	28	25	47	53
	Used - work and CAL	4	50	13	33	54	46

Teachers who have used computers but not for work related activities tend to have a significantly higher rating of their own, and of Grade 10 learners', computer abilities. Teachers who have never used computers tend to rate their computers ability as fairly poor, while other teachers feel they are fairly capable to very capable computer abilities. All teachers rate their own abilities higher than their learners, but generally not by large margins, other than the teaching group who has used computers but not for work purposes. The results suggest that teachers who have not used computers, or have used computers but not for work purposes, could tend to overrate their abilities and be generally idealistic of CAL implementation in schools as teachers who have used computers at higher and more experienced levels fall at moderate margins. The literature indicates that there is a tendency to idealise the use of educational technology among people who are less experienced in technology use (NCETDE, 1998), and the results here provide some confirmation to the statement in the school context. It would therefore be helpful to perform objective computer performance tests to achieve a true reflection of teachers' computer abilities, rather than relying on personal evaluations as criteria supporting the implementation of CAL systems into schools.

Figure 42



4.3.1.2.2.2 Teachers' Personal Computer Ability

More specifically, the implementation of CAL systems would rely on software programmes as informational, instructive, constructive and assessment delivery tools. To assess which programmes would form the basis of a widespread CAL implementation programme, it is beneficial to evaluate the teachers' levels of software ability to understand the effect that the CAL implementation would have at ground level in classrooms, and therefore determine the level of success that would be achieved in implementation.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: very poor, fairly poor, fairly capable and very capable. A totals column is included to provide an overall summary of general capable and poor abilities.

A weighted average has also been calculated by assigning values to the ratings, from 1 for very poor to 4 for very capable. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 is very poor
- 1.76 to 2.5 is fairly poor
- 2.51 to 3.25 is fairly capable
- 3.26 to 4 is very capable.

4.3.1.2.2.2.1 Total Teacher Group

Table 41: Teachers' Personal Computer Abilities – Total Teacher Group

	Category Breakdown				Totals	
Software	Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
Word Proc.	46	50	3	1	96	4
Spreadsheets	30	43	13	13	74	26
E-Mail	25	40	10	24	66	34
CD-Rom Based Software	22	38	10	30	60	40
Internet	21	39	16	24	60	40
Presentation	15	20	32	33	35	65
Games	14	31	28	28	45	55
Admin	11	35	14	40	46	54
Publishing	8	16	24	52	24	76
Drill & Testing	6	25	13	56	32	68
Programming	5	5	13	78	10	90
Databases	5	19	20	56	23	77
Design	3	7	11	79	10	90
Simulation	2	10	21	68	11	89
Web Design	2	3	10	86	5	95

As a group, teachers feel that they are most capable on five specific software packages set out as follows in descending order:

- word processing software, that 96% of teachers feel they are capable of using, and on average teachers show a very capable level of 3.4

- spreadsheets, that 74% of teachers feel they are capable of using, and on average teachers show a fairly capable level of 2.9

- e-mail packages, that 66% of teachers feel they are capable of using, and on average teachers show a fairly capable level of 2.7

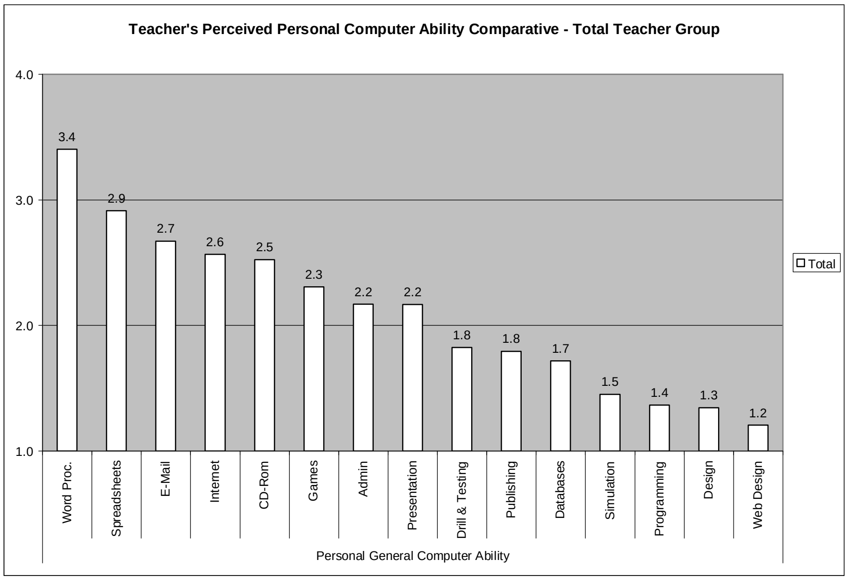
- CD Rom informational packages, that 60% of teachers feel they are capable of using, and on average teachers show a fairly capable level of 2.6

- Internet search and navigational packages, that 60% of teachers feel they are capable of using, and on average teachers show a fairly capable level of 2.5.

In the literature it is documented that previous research conducted in South African schools also reported that the use of word processing software, spreadsheet software and CD Rom informational packages featured highly in school contexts (NCETDE, 1998).

The use of games, administration and presentation software fall at the higher end of the fairly poor category of ability at 2.3, 2.2 and 2.2 respectively, while the general ability on other software packages fall at very low levels. Teachers' computer abilities on traditional CAL instructive, simulation and drill software fall at very low levels, while skills on software for informational search, Internet skills and constructive word processing and spreadsheet software are higher.

Figure 43



The results suggest that teachers' skills have been developed on tasks that are geared toward lesson preparation, gathering information and administrative tasks such as preparing mark and grade sheets or setting test papers. This would imply that the implementation of traditional CAL instructive software would require widespread teacher training and the development of teacher skills on new packages on which they are currently inexperienced. However, implementing CAL systems that are based on software packages in which teachers currently show proficiency could require less intensive training, and easier implementation.

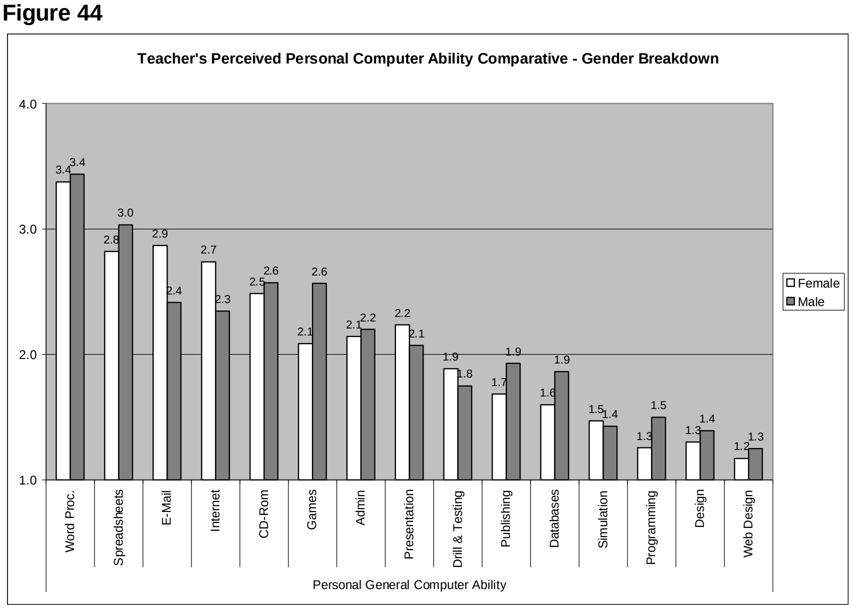
4.3.1.2.2.2.2 Gender Breakdown

Table 42: Teachers' Personal Computer Abilities – Gender Breakdown

		Category Breakdown				Totals	
Software	Gender	Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
Word Proc.	Female	43	55	0	3	98	3
	Male	50	44	6	0	94	6
Spreadsheets	Female	31	38	13	18	69	31
	Male	30	50	13	7	80	20
E-Mail	Female	29	47	5	18	76	24
	Male	21	31	17	31	52	48
CD-Rom Based Software	Female	20	40	9	31	60	40
	Male	25	36	11	29	61	39
Internet	Female	21	47	16	16	68	32
	Male	21	28	17	34	48	52
Presentation	Female	21	18	24	37	39	61
	Male	7	21	43	29	29	71
Games	Female	9	23	37	31	31	69
	Male	20	40	17	23	60	40
Admin	Female	6	43	11	40	49	51
	Male	17	27	17	40	43	57
Publishing	Female	9	11	20	60	20	80
	Male	7	21	29	43	29	71
Drill & Testing	Female	3	34	11	51	37	63
	Male	11	14	14	61	25	75
Programming	Female	3	6	6	86	9	91
	Male	7	4	21	68	11	89
Databases	Female	3	17	17	63	20	80
	Male	7	21	24	48	28	72
Design	Female	3	6	9	82	9	91
	Male	4	7	14	75	11	89
Simulation	Female	0	12	24	65	12	88
	Male	4	7	18	71	11	89
Web Design	Female	0	3	11	86	3	97
	Male	4	4	7	86	7	93

Both female and male teachers, at 3.4, show very capable levels at using word processing software, and indicate levels of fair capability for using spreadsheet software and CD-Rom software packages. However, female teachers demonstrate a greater propensity for Internet and e-mail systems, while male teachers significantly outscore female teachers on gaming software.

Figure 44



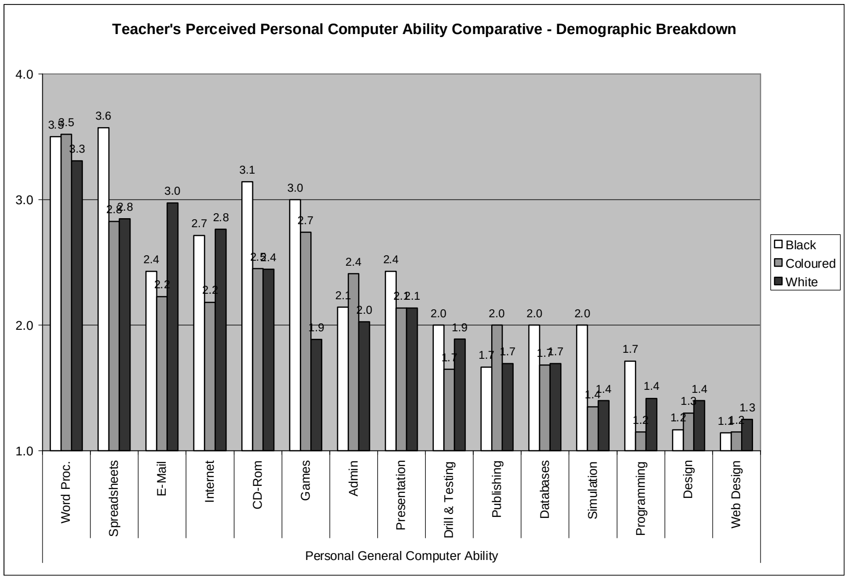
4.3.1.2.2.2.3 Demographic Breakdown

Table 43: Teachers' Personal Computer Abilities – Demographic Breakdown

Software	Demographic	Category Breakdown				Totals	
		Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
Word Proc.	Black	50	50	0	0	100	0
	Coloured	52	48	0	0	100	0
	White	41	51	5	3	92	8
Spreadsheets	Black	57	43	0	0	100	0
	Coloured	26	43	17	13	70	30
	White	28	44	13	15	72	28
E-Mail	Black	14	43	14	29	57	43
	Coloured	23	23	9	45	45	55
	White	29	50	11	11	79	21
CD-Rom Based Software	Black	29	57	14	0	86	14
	Coloured	25	30	10	35	55	45
	White	19	39	8	33	58	42
Internet	Black	29	43	0	29	71	29
	Coloured	23	18	14	45	41	59
	White	18	50	21	11	68	32
Presentation	Black	14	43	14	29	57	43
	Coloured	9	18	50	23	27	73
	White	19	16	24	41	35	65
Games	Black	29	43	29	0	71	29
	Coloured	22	43	22	13	65	35
	White	6	20	31	43	26	74
Admin	Black	14	14	43	29	29	71
	Coloured	23	32	9	36	55	45
	White	3	42	11	44	44	56
Publishing	Black	0	17	33	50	17	83
	Coloured	10	24	24	43	33	67
	White	8	11	22	58	19	81
Drill & Testing	Black	0	43	14	43	43	57
	Coloured	10	15	5	70	25	75
	White	6	28	17	50	33	67
Programming	Black	14	0	29	57	14	86
	Coloured	0	5	5	90	5	95
	White	6	6	14	75	11	89
Databases	Black	0	50	0	50	50	50
	Coloured	5	14	27	55	18	82
	White	6	17	19	58	22	78
Design	Black	0	0	17	83	0	100
	Coloured	0	15	0	85	15	85
	White	6	3	17	74	9	91
Simulation	Black	14	14	29	43	29	71
	Coloured	0	10	15	75	10	90
	White	0	9	23	69	9	91
Web Design	Black	0	0	14	86	0	100
	Coloured	0	5	5	90	5	95
	White	3	3	11	83	6	94

Significant differences are shown in the results of demographic breakdowns of computer software capabilities. All demographic groups score at very capable levels for using word processing software and at fairly capable levels for using spreadsheet software, though teachers in the Black demographic group show greater tendencies in using spreadsheet software. Black teachers also score significantly higher in the use of CD-Rom software packages, games, presentation software, databases, and simulation packages. White teachers seem to have greater abilities in e-mail and Internet packages, while Coloured teachers have a higher showing in administration and publishing software. Coloured teachers also score significantly lower in Internet use at fairly poor levels.

Figure 45



4.3.1.2.2.2.4 Age Groups

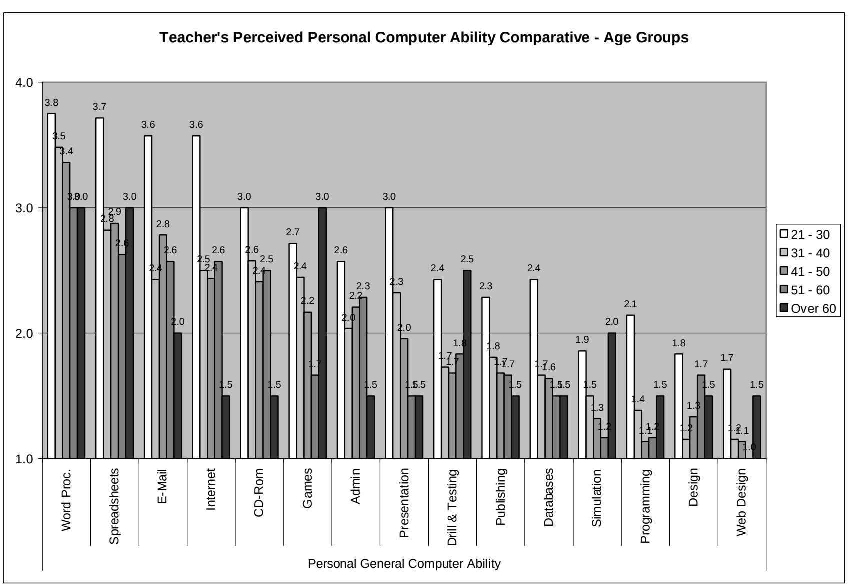
Table 44: Teachers' Personal Computer Abilities – Age Group Breakdown (*Continued Overleaf*)

		Category Breakdown				Totals	
Software	**Age Group**	Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
Word Proc.	21 - 30	75	25	0	0	100	0
	31 - 40	48	52	0	0	100	0
	41 - 50	36	64	0	0	100	0
	51 - 60	38	38	13	13	75	25
	Over 60	50	0	50	0	50	50
Spreadsheets	21 - 30	71	29	0	0	100	0
	31 - 40	32	32	21	14	64	36
	41 - 50	21	58	8	13	79	21
	51 - 60	13	63	0	25	75	25
	Over 60	50	0	50	0	50	50
E-Mail	21 - 30	57	43	0	0	100	0
	31 - 40	25	32	4	39	57	43
	41 - 50	17	52	22	9	70	30
	51 - 60	29	29	14	29	57	43
	Over 60	0	50	0	50	50	50
CD-Rom Based Software	21 - 30	29	57	0	14	86	14
	31 - 40	31	31	4	35	62	38
	41 - 50	14	41	18	27	55	45
	51 - 60	17	50	0	33	67	33
	Over 60	0	0	50	50	0	100
Internet	21 - 30	57	43	0	0	100	0
	31 - 40	25	32	11	32	57	43
	41 - 50	4	57	17	22	61	39
	51 - 60	29	14	43	14	43	57
	Over 60	0	0	50	50	0	100
Presentation	21 - 30	43	29	14	14	71	29
	31 - 40	14	25	39	21	39	61
	41 - 50	13	13	30	43	26	74
	51 - 60	0	17	17	67	17	83
	Over 60	0	0	50	50	0	100
Games	21 - 30	14	57	14	14	71	29
	31 - 40	22	30	19	30	52	48
	41 - 50	8	25	42	25	33	67
	51 - 60	0	17	33	50	17	83
	Over 60	0	100	0	0	100	0
Admin	21 - 30	14	57	0	29	71	29
	31 - 40	20	16	12	52	36	64
	41 - 50	4	46	17	33	50	50
	51 - 60	0	57	14	29	57	43
	Over 60	0	0	50	50	0	100
Publishing	21 - 30	29	0	43	29	29	71
	31 - 40	4	27	15	54	31	69

	41 - 50	9	5	32	55	14	86
	51 - 60	0	33	0	67	33	67
	Over 60	0	0	50	50	0	100
Drill & Testing	21 - 30	14	29	43	14	43	57
	31 - 40	8	23	4	65	31	69
	41 - 50	0	27	14	59	27	73
	51 - 60	17	17	0	67	33	67
	Over 60	0	50	50	0	50	50
Programming	21 - 30	14	29	14	43	43	57
	31 - 40	8	4	8	81	12	88
	41 - 50	0	0	14	86	0	100
	51 - 60	0	0	17	83	0	100
	Over 60	0	0	50	50	0	100
Databases	21 - 30	14	43	14	29	57	43
	31 - 40	7	15	15	63	22	78
	41 - 50	0	18	27	55	18	82
	51 - 60	0	17	17	67	17	83
	Over 60	0	0	50	50	0	100
Design	21 - 30	17	0	33	50	17	83
	31 - 40	0	8	0	92	8	92
	41 - 50	0	10	14	76	10	90
	51 - 60	17	0	17	67	17	83
	Over 60	0	0	50	50	0	100
Simulation	21 - 30	0	14	57	29	14	86
	31 - 40	4	15	8	73	19	81
	41 - 50	0	5	23	73	5	95
	51 - 60	0	0	17	83	0	100
	Over 60	0	0	100	0	0	100
Web Design	21 - 30	14	0	29	57	14	86
	31 - 40	0	8	0	92	8	92
	41 - 50	0	0	14	86	0	100
	51 - 60	0	0	0	100	0	100
	Over 60	0	0	50	50	0	100

In general, younger teachers tend to rate their abilities on software packages more highly . Teachers in the 21 to 30 age group are the only to score at very capable levels, scoring high for the use of word processing and spreadsheet software, e-mail and Internet packages. Teachers in the over 60 age group show greater abilities in older forms of CAL, such as educational games, drill and testing and simulation software. However, all age groups are capable in using word processing and spreadsheet software packages.

Figure 46



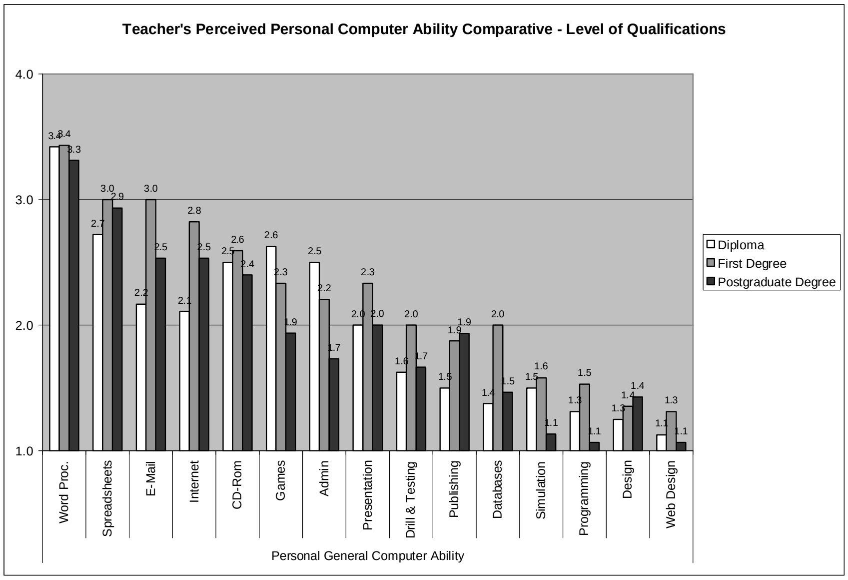
4.3.1.2.2.2.5 Level of Qualifications

Table 45: Teachers' Personal Computer Abilities – Level of Qualification Breakdown

Software	Level of Qualification	Category Breakdown				Totals	
		Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
Word Proc.	Diploma	47	47	5	0	95	5
	First Degree	49	49	0	3	97	3
	Postgraduate Degree	38	56	6	0	94	6
Spreadsheets	Diploma	33	28	17	22	61	39
	First Degree	31	50	8	11	81	19
	Postgraduate Degree	27	47	20	7	73	27
E-Mail	Diploma	0	56	6	39	56	44
	First Degree	41	32	12	15	74	26
	Postgraduate Degree	20	40	13	27	60	40
CD-Rom Based Software	Diploma	19	38	19	25	56	44
	First Degree	28	34	6	31	63	38
	Postgraduate Degree	13	47	7	33	60	40
Internet	Diploma	6	39	17	39	44	56
	First Degree	32	35	15	18	68	32
	Postgraduate Degree	13	47	20	20	60	40
Presentation	Diploma	11	17	33	39	28	72
	First Degree	18	21	36	24	39	61
	Postgraduate Degree	13	20	20	47	33	67
Games	Diploma	19	38	31	13	56	44
	First Degree	18	27	24	30	45	55
	Postgraduate Degree	0	31	31	38	31	69
Admin	Diploma	6	56	19	19	63	38
	First Degree	18	26	15	41	44	56
	Postgraduate Degree	0	33	7	60	33	67
Publishing	Diploma	0	19	13	69	19	81
	First Degree	9	13	34	44	22	78
	Postgraduate Degree	13	20	13	53	33	67
Drill & Testing	Diploma	0	25	13	63	25	75
	First Degree	6	31	19	44	38	63
	Postgraduate Degree	13	13	0	73	27	73
Programming	Diploma	6	0	13	81	6	94
	First Degree	6	9	16	69	16	84
	Postgraduate Degree	0	0	7	93	0	100
Databases	Diploma	0	6	25	69	6	94
	First Degree	9	27	18	45	36	64
	Postgraduate Degree	0	13	20	67	13	87
Design	Diploma	0	6	13	81	6	94
	First Degree	3	6	13	77	10	90
	Postgraduate Degree	7	7	7	79	14	86
Simulation	Diploma	0	13	25	63	13	88
	First Degree	3	10	29	58	13	87
	Postgraduate Degree	0	7	0	93	7	93
Web Design	Diploma	0	0	13	88	0	100
	First Degree	3	6	9	81	9	91
	Postgraduate Degree	0	0	7	93	0	100

Teachers in all qualification groups score at very capable levels for the use of word processing software and at fairly capable levels for the use of spreadsheet software. Otherwise, on average teachers with first degrees outscore other groups in the use of e-mail, the Internet, CD-Rom software packages, presentation and database software. However, teachers with diplomas show greater abilities in the use of gaming and administration software.

Figure 47



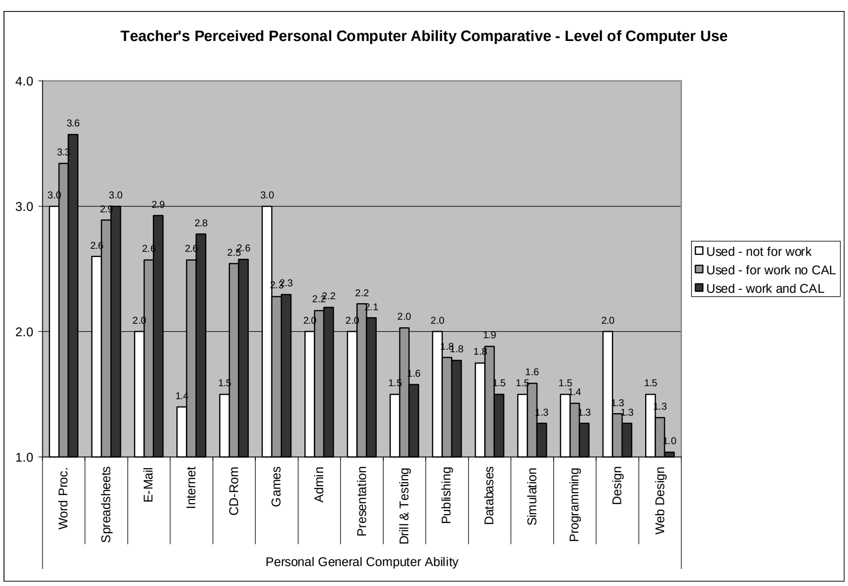
4.3.1.2.2.2.6 Level of Computer Use

Teachers who have used computers for work and for CAL purposes outscore other groups in the use of word processing and spreadsheet software, e-mail and Internet packages. While teachers who have used computers but not for work activities score highly in the use of word processing and gaming software, while scoring at lower levels for the use of spreadsheet software, the Internet, e-mail packages and the use of CD-Rom based software. This reflects the differences in experience in software use between teachers who have used computers in the work context and those who have not, defined by the tasks performed on computer that seem split between the use of work related task oriented software and the tasks of social and occasional computer use. Therefore as a group, though teachers who have not used computers in the work context have levels of computer literacy, the results suggest that they would require some specific training in software packages that are beyond their experience.

Table 46: Teachers' Personal Computer Abilities – Level of Computer Use Breakdown

Software	Levels of Computer Use	Category Breakdown				Totals	
		Very Capable	Fairly Capable	Fairly Poor	Very Poor	Capable	Poor
Word Proc.	Used - not for work	17	67	17	0	83	17
	Used - for work no CAL	42	53	3	3	95	5
	Used - work and CAL	57	43	0	0	100	0
Spreadsheets	Used - not for work	20	40	20	20	60	40
	Used - for work no CAL	33	36	17	14	69	31
	Used - work and CAL	29	54	7	11	82	18
E-Mail	Used - not for work	0	40	20	40	40	60
	Used - for work no CAL	23	40	9	29	63	37
	Used - work and CAL	33	41	11	15	74	26
CD-Rom Based Software	Used - not for work	0	0	50	50	0	100
	Used - for work no CAL	20	43	9	29	63	37
	Used - work and CAL	27	35	8	31	62	38
Internet	Used - not for work	0	0	40	60	0	100
	Used - for work no CAL	20	40	17	23	60	40
	Used - work and CAL	26	44	11	19	70	30
Presentation	Used - not for work	0	33	33	33	33	67
	Used - for work no CAL	22	11	33	33	33	67
	Used - work and CAL	7	30	30	33	37	63
Games	Used - not for work	0	100	0	0	100	0
	Used - for work no CAL	14	28	31	28	42	58
	Used - work and CAL	15	30	26	30	44	56
Admin	Used - not for work	0	33	33	33	33	67
	Used - for work no CAL	11	36	11	42	47	53
	Used - work and CAL	12	35	15	38	46	54
Publishing	Used - not for work	0	33	33	33	33	67
	Used - for work no CAL	12	9	26	53	21	79
	Used - work and CAL	4	23	19	54	27	73
Drill & Testing	Used - not for work	0	0	50	50	0	100
	Used - for work no CAL	6	37	11	46	43	57
	Used - work and CAL	8	12	12	69	19	81
Programming	Used - not for work	0	0	50	50	0	100
	Used - for work no CAL	6	6	14	74	11	89
	Used - work and CAL	4	4	8	85	8	92
Databases	Used - not for work	0	25	25	50	25	75
	Used - for work no CAL	9	21	21	50	29	71
	Used - work and CAL	0	15	19	65	15	85
Design	Used - not for work	0	33	33	33	33	67
	Used - for work no CAL	3	6	13	78	9	91
	Used - work and CAL	4	4	8	85	8	92
Simulation	Used - not for work	0	0	50	50	0	100
	Used - for work no CAL	0	15	29	56	15	85
	Used - work and CAL	4	4	8	85	8	92
Web Design	Used - not for work	0	0	50	50	0	100
	Used - for work no CAL	3	6	11	80	9	91
	Used - work and CAL	0	0	4	96	0	100

Figure 48



4.3.1.2.3 Reasons for Computer Use at School

In this item, teachers express their opinions of the reasons that teachers use computers in the school context, which are placed in comparison to the stated personal reasons for computer use in schools in reality. This item only applied to respondents who had used computers in the school context.

The results are indicated in the percentage proportion of ‘Yes’ versus ‘No’ answers to each item, and set side to side are the results for teachers’ perceptions against teachers’ actual use in reality.

4.3.1.2.3.1 Total Teacher Group

Table 47: Teachers’ Reasons for Computer Use at School – Total Teacher Group

	Perception of Teacher Group		Personal Use	
Tasks	Yes	No	Yes	No
E-mailing	35	65	23	77
Gathering information on the Internet	38	62	44	56
Lesson preparation	53	47	60	40
School admin and management	86	14	69	31
Testing and assessment	28	72	45	55
To teach computer science	36	64	14	86
Used as a teaching tool	28	72	21	79

In descending order and more significantly, teachers who use computers in schools use them for the following reasons:

- school administration and management counts for the majority of teachers’ use at 69%

- 60% of teachers who use computers at schools use computers for lesson preparation

- 45% of teachers use computers for testing and assessment purposes, although this item may have been confused with the setting of tests rather than the testing process itself

- 44% of teachers use computers for searching for information on the Internet

- 23% of teachers use e-mail facilities at school

- at the lower level, 21% of teachers claim to have used computers as teaching tools.

In general, patterns of personal use generally match levels of perception of computer use in schools, though the perceptions of the use of computers for school administration fall 17% higher than personal use, while teachers use computers for testing and assessment at 17% higher than expectation.

4.3.1.2.3.2 Gender Breakdown

Table 48: Teachers' Reasons for Computer Use at School – Gender Breakdown

Gender Breakdown	Tasks	Perception of Teacher Group		Personal Use	
		Yes	No	Yes	No
Female	E-mailing	49	51	32	68
	Gathering information on the Internet	56	44	61	39
	Lesson preparation	59	41	59	41
	School admin and management	88	12	71	29
	Testing and assessment	29	71	49	51
	To teach computer science	51	49	17	83
	Used as a teaching tool	27	73	24	76
Male	E-mailing	19	81	14	86
	Gathering information on the Internet	19	81	24	76
	Lesson preparation	46	54	62	38
	School admin and management	84	16	68	32
	Testing and assessment	27	73	41	59
	To teach computer science	19	81	11	89
	Used as a teaching tool	30	70	16	84

Other than for lesson preparation, a greater proportion of female teachers tend to use computers than males across the tasks listed above. The differences, however, are marginal, except for using the Internet for searching for information that sits significantly higher for female teachers and using computers for e-mail and as teaching tools that have higher showing at lower levels. Despite the differences, both female and male teachers' expectations of computer use and actual personal use tend to be similar, suggesting that users possibly tend to feel that their levels and reasons for computer use are characteristic of the larger teaching group.

4.3.1.2.3.3 Demographic Breakdown

Table 49: Teachers' Reasons for Computer Use at School – Demographic Breakdown

Demographic Breakdown	Tasks	Perception of Teacher Group		Personal Use	
		Yes	No	Yes	No
Black	E-mailing	8	92	8	92
	Gathering information on the Internet	8	92	31	69
	Lesson preparation	46	54	46	54
	School admin and management	54	46	31	69
	Testing and assessment	15	85	23	77
	To teach computer science	15	85	8	92
	Used as a teaching tool	23	77	8	92
Coloured	E-mailing	12	88	20	80
	Gathering information on the Internet	8	92	32	68
	Lesson preparation	40	60	60	40
	School admin and management	96	4	84	16
	Testing and assessment	24	76	32	68
	To teach computer science	16	84	12	88
	Used as a teaching tool	20	80	12	88
White	E-mailing	58	43	30	70
	Gathering information on the Internet	68	33	55	45
	Lesson preparation	63	38	65	35
	School admin and management	90	10	73	28
	Testing and assessment	35	65	60	40
	To teach computer science	55	45	18	83
	Used as a teaching tool	35	65	30	70

In general, a greater proportion of teachers in the White demographic group have used computers than teachers from other demographic groups for searching for information on the Internet, using e-mail services, for testing and assessment purposes and as teaching tools. A greater proportion of Coloured teachers have used computers for administration and management purposes at 84%.

Teachers from all demographic groups tend to underestimate their use of the Internet, while Black and White teachers tend to overestimate their use of computers for schools administration and management purposes. Also, teachers from the Coloured demographic group tend to underestimate their use of computers for lesson preparation.

4.3.1.2.3.4 Age Groups

Table 50: Teachers' Reasons for Computer Use at School – Age Group Breakdown

Age Groups	Tasks	Perception of Teacher Group		Personal Use	
		Yes	No	Yes	No
21 - 30	E-mailing	50	50	38	63
	Gathering information on the Internet	63	38	75	25
	Lesson preparation	50	50	63	38
	School admin and management	88	13	75	25
	Testing and assessment	50	50	75	25
	To teach computer science	63	38	50	50
	Used as a teaching tool	38	63	50	50
31 - 40	E-mailing	25	75	19	81
	Gathering information on the Internet	19	81	28	72
	Lesson preparation	47	53	56	44
	School admin and management	84	16	59	41
	Testing and assessment	9	91	28	72
	To teach computer science	22	78	13	88
	Used as a teaching tool	19	81	9	91
41 - 50	E-mailing	36	64	32	68
	Gathering information on the Internet	50	50	61	39
	Lesson preparation	50	50	64	36
	School admin and management	86	14	79	21
	Testing and assessment	46	54	57	43
	To teach computer science	50	50	11	89
	Used as a teaching tool	36	64	25	75
51 - 60	E-mailing	63	38	0	100
	Gathering information on the Internet	63	38	25	75
	Lesson preparation	88	13	63	38
	School admin and management	100	0	75	25
	Testing and assessment	25	75	50	50
	To teach computer science	25	75	0	100
	Used as a teaching tool	38	63	25	75
Over 60	E-mailing	0	100	0	100
	Gathering information on the Internet	0	100	0	100
	Lesson preparation	50	50	50	50
	School admin and management	50	50	50	50
	Testing and assessment	0	100	0	100
	To teach computer science	0	100	0	100
	Used as a teaching tool	0	100	0	100

In general, teachers in the 21 to 30 age group tend to make more use of computers across a greater variety of tasks in schools than do teachers from older age groups. Teachers in the 21 to 30 age group make greater use of computers for searching for information on the Internet, using e-mail services as well as using computers as teaching tools. At the other end, the results indicate that teachers in the over 60 group have a limited variety of tasks for computer use. However, using computers for lesson preparation, as well as school administration and management seems to feature as prominent activities across all age groups.

4.3.1.2.3.5 Level of Qualifications

Table 51: Teachers' Reasons for Computer Use at School – Level of Qualification Breakdown

Level of Qualifications	Tasks	Perception of Teacher Group		Personal Use	
		Yes	No	Yes	No
Diploma	E-mailing	9	91	9	91
	Gathering information on the Internet	14	86	23	77
	Lesson preparation	45	55	36	64
	School admin and management	77	23	59	41
	Testing and assessment	23	77	23	77
	To teach computer science	14	86	9	91
	Used as a teaching tool	9	91	0	100
First Degree	E-mailing	48	53	30	70
	Gathering information on the Internet	48	53	53	48
	Lesson preparation	53	48	65	35
	School admin and management	88	13	75	25
	Testing and assessment	28	73	50	50
	To teach computer science	45	55	20	80
	Used as a teaching tool	38	63	28	73
Postgraduate Degree	E-mailing	38	63	25	75
	Gathering information on the Internet	50	50	50	50
	Lesson preparation	63	38	81	19
	School admin and management	94	6	69	31
	Testing and assessment	38	63	63	38
	To teach computer science	44	56	6	94
	Used as a teaching tool	31	69	31	69

In general, the results suggest that teachers with diplomas have a lower tendency to use computers in general, though teachers from all qualification groups score higher in using computers for school administration and management. Teachers with diplomas score very low for using the Internet and e-mail packages compared to their colleagues, while teachers with postgraduate degrees outscore others in using computers for lesson preparation, testing and assessment and as teaching tools.

The results indicate that teachers from all qualification groups overestimate the levels of computer use for school administration and management purposes, while those with first degrees and postgraduate degrees tend to overestimate the levels of computer use for lesson preparation and underestimate the use for testing and assessment.

4.3.1.2.3.6 Level of Computer Use

Table 52: Teachers' Reasons for Computer Use at School – Level of Computer Use Breakdown

Level of Computer Use	Tasks	Perception of Teacher Group		Personal Use	
		Yes	No	Yes	No
Never Used	E-mailing	20	80	0	100
	Gathering information on the Internet	20	80	0	100
	Lesson preparation	60	40	0	100
	School admin and management	80	20	0	100
	Testing and assessment	0	100	0	100
	To teach computer science	20	80	0	100
	Used as a teaching tool	0	100	0	100
Used - not for work	E-mailing	33	67	0	100
	Gathering information on the Internet	17	83	0	100
	Lesson preparation	33	67	0	100
	School admin and management	83	17	0	100
	Testing and assessment	17	83	0	100
	To teach computer science	0	100	0	100
	Used as a teaching tool	0	100	0	100
Used - for work no CAL	E-mailing	31	69	23	77
	Gathering information on the Internet	31	69	46	54
	Lesson preparation	54	46	67	33
	School admin and management	79	21	77	23
	Testing and assessment	28	72	54	46
	To teach computer science	41	59	23	77
	Used as a teaching tool	31	69	18	82
Used - work and CAL	E-mailing	43	57	32	68
	Gathering information on the Internet	57	43	57	43
	Lesson preparation	54	46	75	25
	School admin and management	96	4	86	14
	Testing and assessment	36	64	50	50
	To teach computer science	39	61	7	93
	Used as a teaching tool	36	64	32	68

Teachers who have used computers for work and CAL have generally outscored those teachers who have used computers for work but not for CAL, though by smaller degrees. For both groups lesson preparation, school administration and management, searching for information on the Internet and testing and assessment account for greater computer use. Also, of interest are the low estimation of computer use as a teaching tool and for testing and assessment and the high estimation of computer use for school management and administration by teachers who have never used computers or computer for work, again suggesting a lack of awareness of computer use in schools. As it seems that teachers generally tend to assume that their levels of computer use are characteristic of the teaching group as a whole as the levels of expected computer use mostly resemble the levels of personal use, it may be beneficial to perform computer related research on teachers who have used computers in the school context that tend to show a greater level of awareness of computers in the school context. This would provide greater validation to research findings, particularly if the research has bearing on the development of policy or the implementation of computers into schools.

4.3.1.3 Attitudes to the Use of Computers in Education

4.3.1.3.1 Attitudes to Computer Use in General

In this item, a comparison is made between the attitudes teachers have of:

- computers in everyday life in general
- the general use of computers in schools
- the use of computers specifically to teach.

The item aims to identify if there is any discrimination toward the use of computers specifically to teach, compared to the general scenarios of computer use in everyday life and in schools.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: very negative, negative, positive and very positive. A totals column is added to provide an overall summary of positive and negative attitudes.

A weighted average has also been calculated by assigning values to the ratings, from 1 for very negative to 4 for very positive. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates very negative
- 1.76 to 2.5 indicates general negativity
- 2.51 to 3.25 indicates generally positive
- 3.26 to 4 indicates very positive.

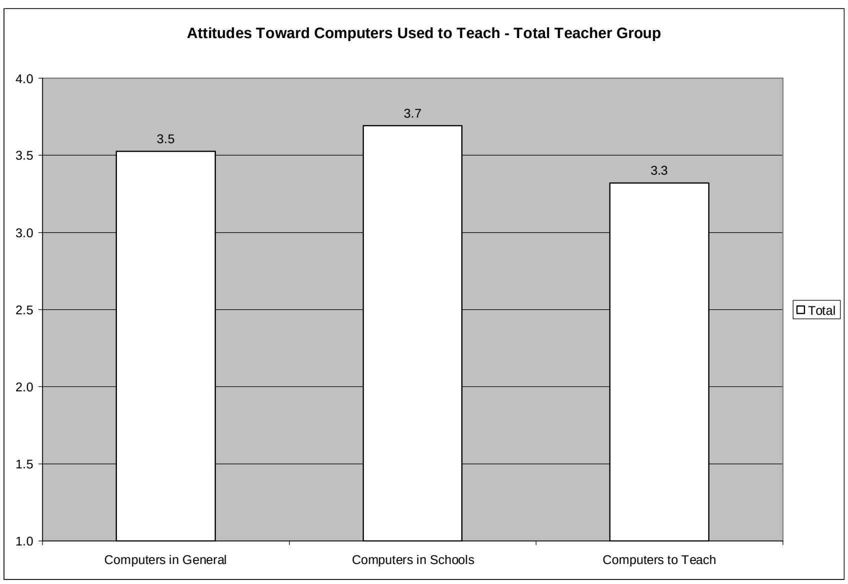
4.3.1.3.1.1 Total Teacher Group

Table 53: Teachers' Attitudes toward Computers – Total Teacher Group

Scenario	Category Breakdown				Totals	
	Very Positive	Positive	Negative	Very Negative	Positive	Negative
Computers in General	56	41	1	1	97	3
Computers in Schools	72	27	0	1	99	1
Computers to Teach	42	49	8	1	91	9

On average, teachers as a group feel very positive about the use of computers in society in general, in schools and specifically to teach. However, at very positive levels, 72% of teachers report very positive attitudes to using computers in schools in general, while 42% of teachers express the same for using computers to teach. These findings support the claims in the literature that teachers generally feel positive about the use of educational technologies and the value that the use of computers provides to schools (MacArthur *et al.*, 2003; NCETDE, 1998; Valdez *et al.,* 2004).

Figure 49



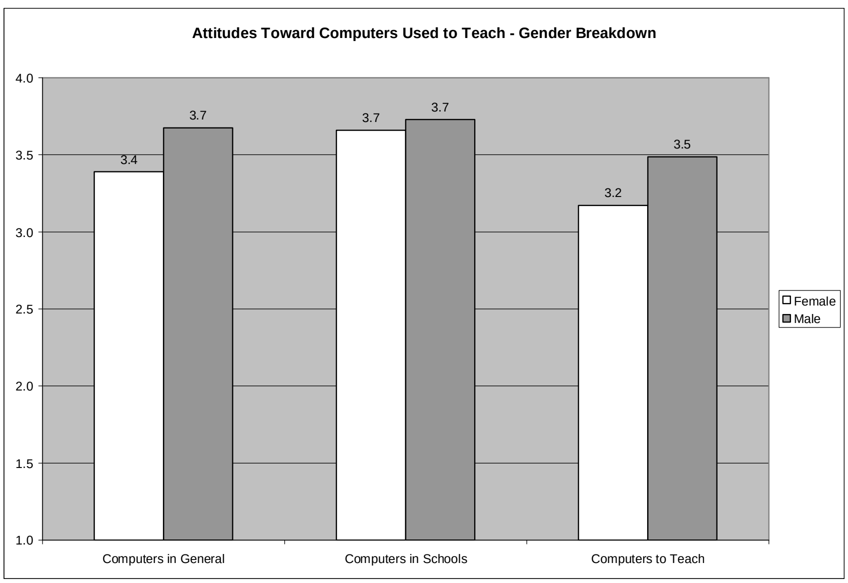
4.3.1.3.1.2 Gender Breakdown

Table 54: Teachers' Attitudes toward Computers – Gender Breakdown

Scenario	Gender Breakdown	Category Breakdown				Totals	
		Very Positive	Positive	Negative	Very Negative	Positive	Negative
Computers in General	Female	44	54	0	2	98	2
	Male	70	27	3	0	97	3
Computers in Schools	Female	71	27	0	2	98	2
	Male	73	27	0	0	100	0
Computers to Teach	Female	29	61	7	2	90	10
	Male	57	35	8	0	92	8

Though both male and female teachers show similar patterns of very positive attitudes to the use of computers in schools in general, the results suggest that male teachers feel more positive about the use of computers as teaching tools than female teachers. Male teachers on average feel very positive about the use of computers as teaching tools at a score of 3.5, while female teachers feel generally positive at a score of 3.2. Also, 29% of female teachers indicated very positive attitudes to the use of computers to teach, while 57% of male teachers indicated the same. Though both at very high levels, male teachers in general indicated more positive attitudes to the general use of computers in society than female teachers. This supports the literature that indicates that males generally have a higher propensity for technology and computer use than females (Owen *et al.*, 1998).

Figure 50



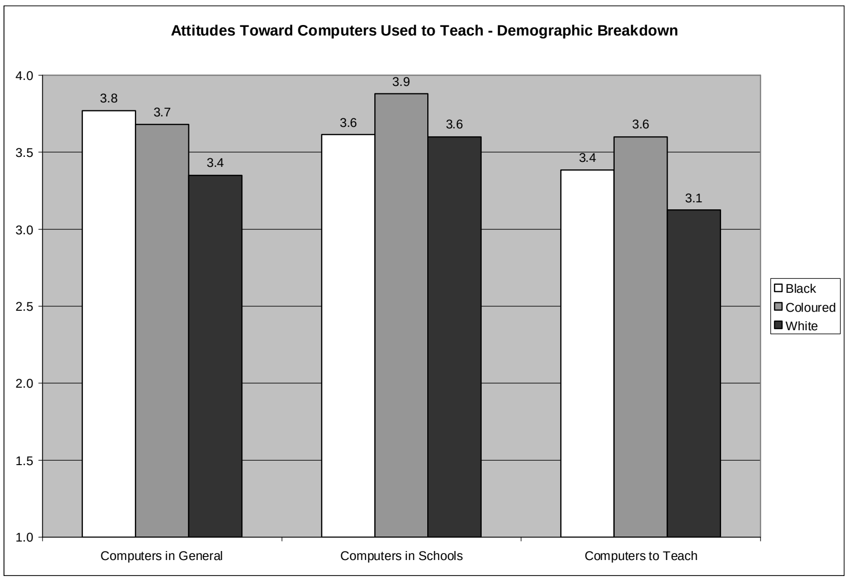
4.3.1.3.1.3 Demographic Breakdown

Table 55: Teachers' Attitudes toward Computers – Demographic Breakdown

Scenario	Demographic Breakdown	Category Breakdown				Totals	
		Very Positive	Positive	Negative	Very Negative	Positive	Negative
Computers in General	Black	77	23	0	0	100	0
	Coloured	68	32	0	0	100	0
	White	43	53	3	3	95	5
Computers in Schools	Black	62	38	0	0	100	0
	Coloured	88	12	0	0	100	0
	White	65	33	0	3	98	3
Computers to Teach	Black	38	62	0	0	100	0
	Coloured	64	32	4	0	96	4
	White	30	55	13	3	85	15

Though all demographic groups score at very positive levels, teachers from the Black demographic group tend to feel more positive about the use of computers in society in general, while teachers from the Coloured demographic group feel very positive about the use of computers in schools at 88%, as well as to teach at 64%. Though teachers from the Black and Coloured demographic groups tend to feel on average very positive about the use of computers to teach, White teachers are generally positive at lower levels.

Figure 51



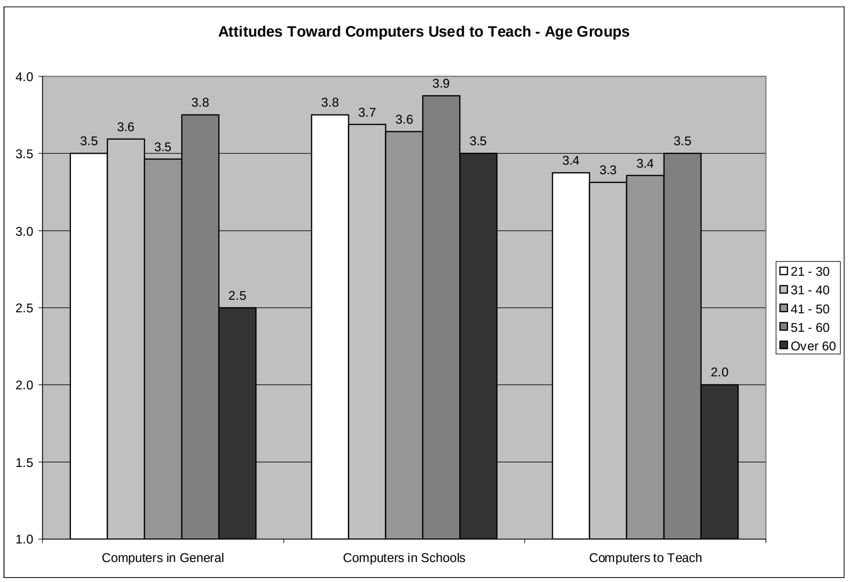
4.3.1.3.1.4 Age Groups

Table 56: Teachers' Attitudes toward Computers – Age Group Breakdown

		Category Breakdown				Totals	
Scenario	**Age groups**	Very Positive	Positive	Negative	Very Negative	Positive	Negative
Computers in General	21 - 30	50	50	0	0	100	0
	31 - 40	59	41	0	0	100	0
	41 - 50	54	43	0	4	96	4
	51 - 60	75	25	0	0	100	0
	Over 60	0	50	50	0	50	50
Computers in Schools	21 - 30	75	25	0	0	100	0
	31 - 40	69	31	0	0	100	0
	41 - 50	71	25	0	4	96	4
	51 - 60	88	13	0	0	100	0
	Over 60	50	50	0	0	100	0
Computers to Teach	21 - 30	38	63	0	0	100	0
	31 - 40	38	56	6	0	94	6
	41 - 50	46	46	4	4	93	7
	51 - 60	63	25	13	0	88	13
	Over 60	0	0	100	0	0	100

Teachers in age groups from 21 through to 60 feel very positive regarding computers in general, the use of computers in schools and using computers to teach. Teachers in the 51 to 60 age group score the highest across the board, and therefore indicate the highest levels of positivity. However, teachers in the over 60 age group report moderate levels of negativity towards computers in society in general. Although positive attitudes are shown for the use of computers in schools, teachers in the over 60 age group feel negative toward the use of computers to teach.

Figure 52



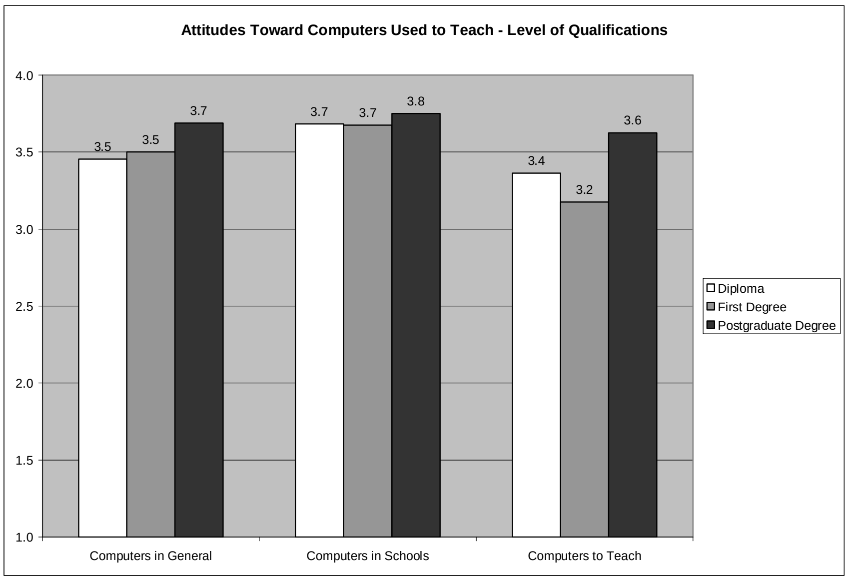
4.3.1.3.1.5 Level of Qualifications

Table 57: Teachers' Attitudes toward Computers – Level of Qualification Breakdown

Scenario	Level of Qualifications	Category Breakdown: Very Positive	Positive	Negative	Very Negative	Totals: Positive	Negative
Computers in General	Diploma	50	45	5	0	95	5
	First Degree	55	43	0	3	98	3
	Postgraduate Degree	69	31	0	0	100	0
Computers in Schools	Diploma	68	32	0	0	100	0
	First Degree	73	25	0	3	98	3
	Postgraduate Degree	75	25	0	0	100	0
Computers to Teach	Diploma	45	45	9	0	91	9
	First Degree	33	55	10	3	88	13
	Postgraduate Degree	63	38	0	0	100	0

Teachers with postgraduate degrees feel most positive about computers in society in general, in schools and as teaching tools. While teachers with diplomas and degrees have, on average, the same levels of very positive attitudes towards computers in general and the use of computers in schools, teachers with degrees are generally positive about the use of computers as teaching tools at a level of 3.2, while teachers with diplomas score very positive levels at 3.4.

Figure 53



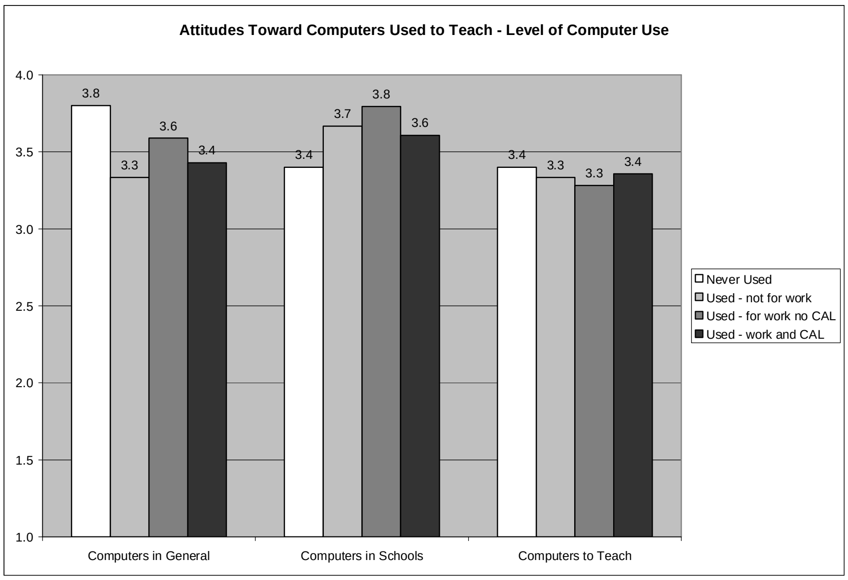
4.3.1.3.1.6 Level of Computer Use

Table 58: Teachers' Attitudes toward Computers – Level of Computer Use Breakdown

Scenario	Level of Computer Use	Category Breakdown: Very Positive	Positive	Negative	Very Negative	Totals: Positive	Negative
Computers in General	Never Used	80	20	0	0	100	0
	Used - not for work	50	33	17	0	83	17
	Used - for work no CAL	59	41	0	0	100	0
	Used - work and CAL	50	46	0	4	96	4
Computers in Schools	Never Used	40	60	0	0	100	0
	Used - not for work	67	33	0	0	100	0
	Used - for work no CAL	79	21	0	0	100	0
	Used - work and CAL	68	29	0	4	96	4
Computers to Teach	Never Used	40	60	0	0	100	0
	Used - not for work	50	33	17	0	83	17
	Used - for work no CAL	36	56	8	0	92	8
	Used - work and CAL	50	39	7	4	89	11

Teachers who have not used computers on average feel the most positive about computers in society on general, yet, though still at very positive levels, feel the least positive about computers in schools. Teachers who have used computers for work activities, but not to teach CAL, feel the most positive about computers in schools at a score of 79% at very positive levels. However, teachers who have not used computers, teachers who have used computers but not for school and those who have used computers for school activities on average score at similar very positive levels regarding the use of computers for teaching.

Figure 54



4.3.1.3.2 Attitudes to Computer Use in Education

This section reports on the general attitudes that teachers have toward the use of computers in education. Attitudes are sorted into the following categories:

- *The assimilation of computers*, including foresight, the necessity for computers, computer orientation and the change in method
- *Computer use*, including increased use and limited use of computers
- *Training*, including the need for training and the training timeframe

- *Pedagogical effects*, including improved skills, independence, interactivity and workload

- *Computer equipment*, including the availability of computers, the condition of computers and limitations.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly disagree, disagree, agree and strongly agree. A totals column is added to provide a summary of overall agreement and disagreement.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly disagree to 4 for strongly agree. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates strong disagreement
- 1.76 to 2.5 indicates general disagreement
- 2.51 to 3.25 indicates general agreement
- 3.26 to 4 indicates strong agreement.

4.3.1.3.2.1 Total Teacher Group

Table 59: Teachers' Attitudes toward the Assimilation of Computers in Education – Total Teacher Group

			Levels of Agreement				Totals	
Categories	**Groups**	**Items**	Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Assimilation	Foresight	Computers in Education inevitable	45	47	5	3	92	8
		Computers will replace teachers	0	6	38	55	6	94
	Necessity for Computers	No value in computers in schools	1	4	26	69	5	95
		Funding spent on other resources	1	3	62	34	4	96
	Computer Orientation	Teachers fear computers	4	45	45	6	49	51
		Teachers not computer-literate enough	14	50	29	6	64	36
		Not enough teachers would use computers	9	31	56	4	40	60
		Teachers do make an effort	8	42	46	4	50	50
	Change in Method	Smooth transition to CAL	5	40	45	9	45	55
		Teachers prefer traditional methods	7	63	30	0	70	30
		Changes the curriculum	14	40	45	1	54	46

The results demonstrate that there is strong consensus among teachers that:

- Computers in education are inevitable but will not replace teachers, as is supported in the literature (Brown, 1997; Loschert, 2003) and demonstrated here at 92% and 94% consensus respectively

- Computers in schools provide value, as supported by other studies reported in the literature (MacArthur *et al.*, 2003; NCETDE, 1998; Valdez *et al.,* 2004), and deserve to be budgeted into the finances, at 95% and 96% consensus respectively.

However, the results show that teachers are undecided regarding the following items:

- Half of teachers feel that teachers do make an effort to use computers, but have a fear of using computers or are not computer literate enough (64% agreement); also that if implemented, 40% of teachers feel that not enough teachers would use computers as indicated in the literature (NCETDE, 1998)

- Teachers are also split regarding whether the implementation of CAL would be a smooth process at 45% agreement, as concerns are that the use of CAL could change the curriculum (54% consensus), or that teachers would not be satisfied as 70% prefer traditional teaching methods to CAL.

Figure 55

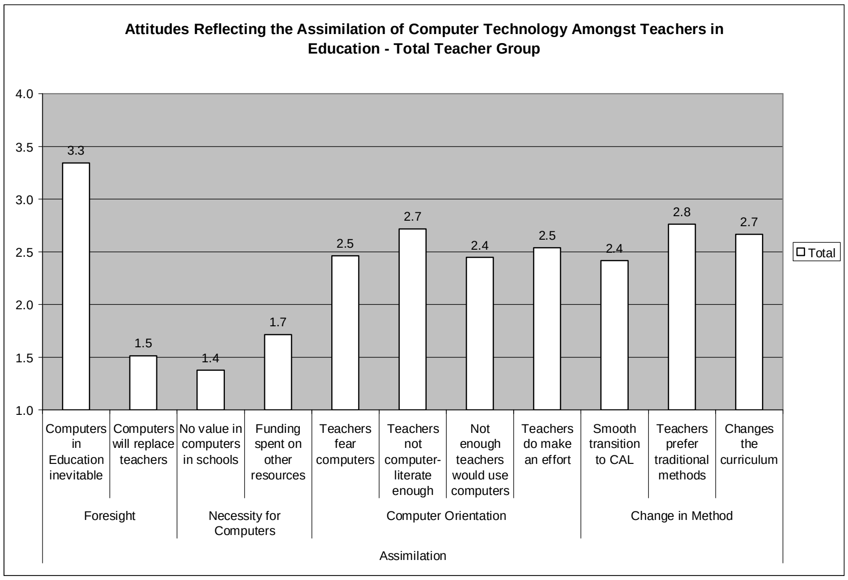


Table 60: Teachers' Attitudes toward Computer Use and Training in Education – Total Teacher Group

Categories	Groups	Items	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Use	Increased Use	Used to full capacity	22	43	31	4	65	35
		More use in school time	42	50	8	0	92	8
	Limited Use	Not Be Used Often	3	19	73	5	22	78
		No time for individual computer use	4	33	61	1	37	63
Training	Need for Training	Teachers are keen but need training	24	67	8	1	91	9
		Recent trainees more receptive to computers	35	58	8	0	92	8
	Training Timeframe	Extra time in ongoing training	14	65	19	1	79	21
		Take too long to learn	3	45	41	12	47	53

Teachers feel strongly that the implementation of CAL would mean that teachers would make more use of computers during school time at 92% agreement, but the majority of teachers at 65% feel that computers would not be used to full capacity or frequently enough (78% consensus) due to insufficient time for individual computer use (63% consensus). This is reflected in the literature (Johnson, 2003; Loschert, 2003).

At 91% agreement, teachers in general are keen for the implementation of CAL but feel that they need training, as recent trainees tend to be more receptive to computers (92% consensus). A majority of teachers also agree that they would need to spend extra time in ongoing training, as reflected in the literature (Brown *et al.*, 1996; Cousins *et al.*, 1993; Johnson, 2003), though are unsure at 47% agreement on whether it would take too long to learn how to use CAL systems.

Figure 56

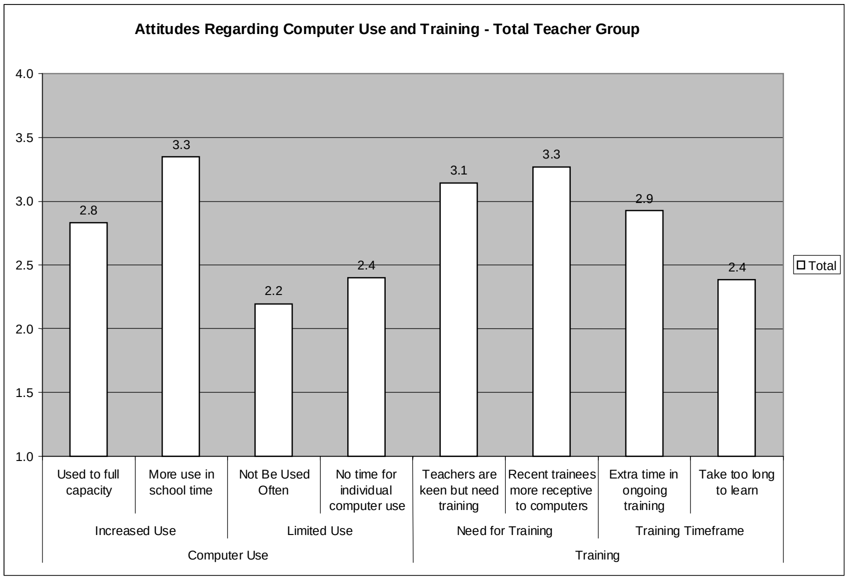


Table 61: Teachers' Attitudes toward the Pedagogical Effects of Computer Use in Education – Total Teacher Group

Categories	Groups	Items	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Pedagogical Effects	Improved Skills	Improves teacher skills	40	56	4	0	96	4
		Staff and learners improve comp skills	53	44	4	0	96	4
		Better job opportunities	55	41	4	0	96	4
		Professional presentation	49	47	3	1	96	4
	Independence	Makes learners independent	12	64	23	1	75	25
		Teach learners responsibility	29	51	20	0	80	20
		Access to information beyond school	45	52	3	0	97	3
	Interactivity	More interactive lessons	40	41	18	1	81	19
	Workload	Teachers will have heavier workload	3	4	79	14	6	94
		Saves time in lesson prep and admin	39	53	5	3	92	8

The teaching group as a whole, at 96% agreement, feel very strongly that the use of CAL systems would help improve teacher skills, help staff and learners improve computer skills, provide better job opportunities for learners and help develop a professional standard of work in schools, as illustrated in the literature (Forsyth, 2001; Heide *et al.*, 2001; Merrill *et al.*, 1996).

The majority of teachers feel that the use of computers will help teach learners to be independent and responsible, at 75% and 80% agreement respectively; a finding that is demonstrated in the literature (Baillie *et al.*, 2000; Christensen *et al.*, 1998; Lelouche, 1998). Also, there is large consensus at 81% agreement that lessons will become more interactive, reflected in the literature (Baillie *et al.*, 2000; Christensen *et al.*, 1998; Forsyth, 2001), while learners will easier be able access information beyond the school walls at 97% consensus, also echoed in the literature (Baillie *et al.*, 2000; Lelouche, 1998; MacArthur *et al.*, 2003; Wiley, 2001).

With regard to teaching workload, teachers as a group indicate that they do not expect a heavier workload after the implementation of CAL (94% consensus), and that CAL would save time in lesson preparation and administration (92% agreement).

Figure 57

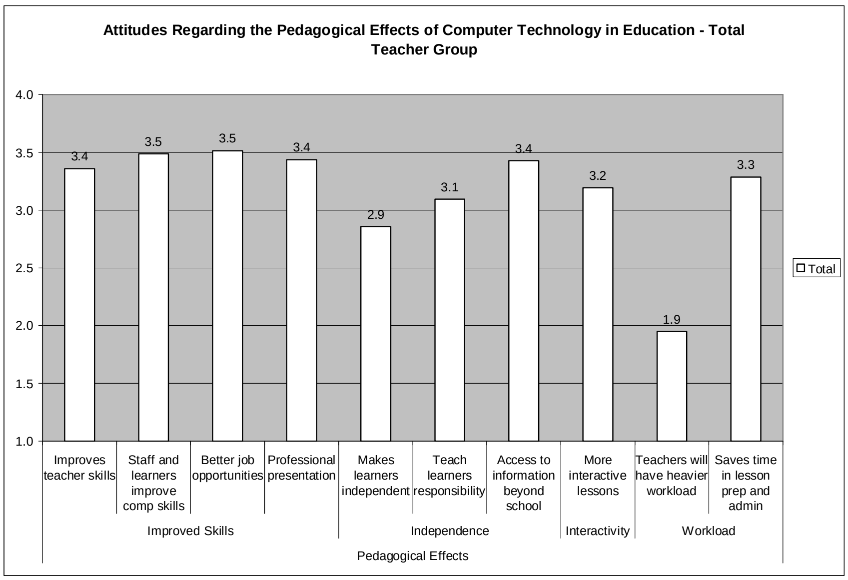
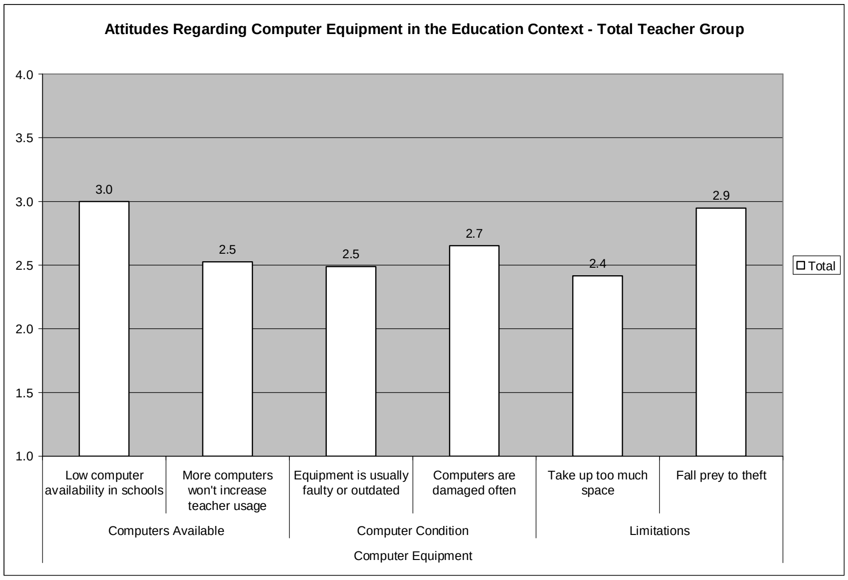


Table 62: Teachers' Attitudes toward Computer Equipment in the School Environment – Total Teacher Group

Categories	Groups	Items	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Equipment	Computers Available	Low computer availability in schools	14	73	12	1	87	13
		More computers won't increase teacher usage	12	40	38	10	51	49
	Computer Condition	Equipment is usually faulty or outdated	4	45	47	4	49	51
		Computers are damaged often	11	45	43	1	56	44
	Limitations	Take up too much space	8	34	51	8	42	58
		Fall prey to theft	20	57	22	1	76	24

There is strong agreement at 87% that there is currently a low availability of computers in schools, as demonstrated in the literature (Asmal, 2000), yet attitudes are mixed whether the implementation of more computers would increase teacher usage at 49% consensus, a statement the literature also claims as unproven (Balajthy, 2000). Teachers' attitudes are also undecided on the sustainability of computer equipment, as 49% feel that computer equipment is usually outdated or faulty in schools and 56% feel that computer equipment is damaged often, both reflected in the literature (Richards, 2003), while 42% of teachers feel that computer equipment takes up too much space. However, there is greater agreement at 76% that computer equipment in schools have a likelihood of falling prey to theft.

Figure 58



4.3.1.3.2.2 Gender Breakdown

Table 63: Teachers' Attitudes toward the Assimilation of Computers in Education – Gender Breakdown

Categories	Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Assimilation	Foresight	Computers in Education inevitable	Female	49	51	0	0	100	0
			Male	41	43	11	5	84	16
		Computers will replace teachers	Female	0	0	44	56	0	100
			Male	0	14	32	54	14	86
	Necessity for Computers	No value in computers in schools	Female	0	3	30	68	3	98
			Male	3	5	22	70	8	92
		Funding spent on other resources	Female	0	2	66	32	2	98
			Male	3	3	58	36	6	94
	Computer Orientation	Teachers fear computers	Female	2	39	51	7	41	59
			Male	5	51	38	5	57	43
		Teachers not computer-literate enough	Female	12	54	24	10	66	34
			Male	16	46	35	3	62	38
		Not enough teachers would use computers	Female	7	39	51	2	46	54
			Male	11	22	62	5	32	68
		Teachers do make an effort	Female	10	39	46	5	49	51
			Male	5	46	46	3	51	49
	Change in Method	Smooth transition to CAL	Female	0	33	58	10	33	68
			Male	11	49	32	8	59	41
		Teachers prefer traditional methods	Female	5	71	24	0	76	24
			Male	9	54	37	0	63	37
		Changes the curriculum	Female	17	34	46	2	51	49
			Male	11	46	43	0	57	43

On average, female teachers agree at stronger levels at 3.5 that computers in education are inevitable, than male teachers who have levels of general agreement at 3.2. However, female teachers are in general disagreement that the transition to CAL systems in schools will be smooth at 2.2, while male teachers are in general agreement at 2.6.

Figure 59

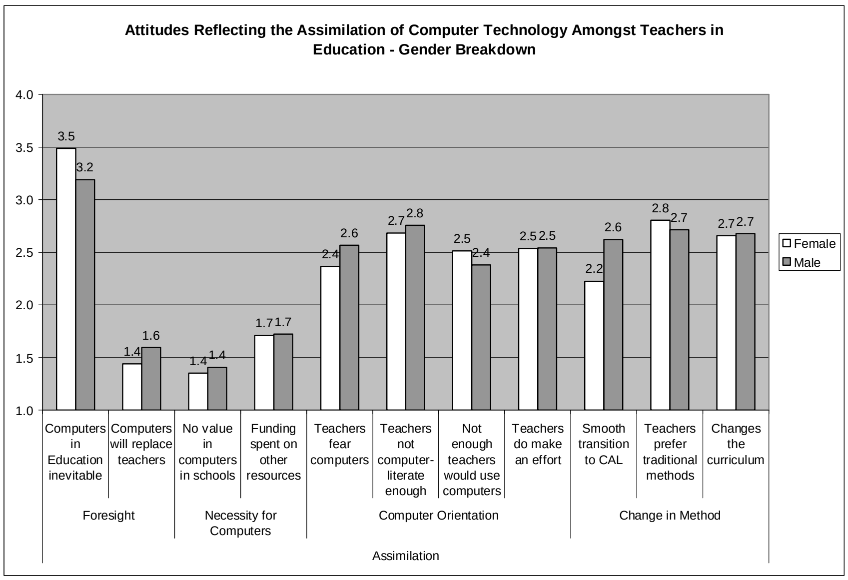


Table 64: Teachers' Attitudes toward Computer Use and Training in Education – Gender Breakdown

Categories	Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Use	Increased Use	Used to full capacity	Female	12	46	37	5	59	41
			Male	33	39	25	3	72	28
		More use in school time	Female	41	49	10	0	90	10
			Male	43	51	5	0	95	5
	Limited Use	Not Be Used Often	Female	5	22	71	2	27	73
			Male	0	17	75	8	17	83
		No time for individual computer use	Female	5	44	51	0	49	51
			Male	3	22	72	3	25	75
Training	Need for Training	Teachers are keen but need training	Female	27	59	12	2	85	15
			Male	22	76	3	0	97	3
		Recent trainees more receptive to computers	Female	37	56	7	0	93	7
			Male	32	59	8	0	92	8
	Training Timeframe	Extra time in ongoing training	Female	15	63	20	2	78	22
			Male	14	68	19	0	81	19
		Take too long to learn	Female	2	44	41	12	46	54
			Male	3	46	41	11	49	51

Male teachers seem to feel stronger at 72% that computers would be used to full capacity after the implementation of CAL systems. Female teachers, however, feel stronger at 49% than male teachers that computers would not be used often enough as there would not be enough time for individual computer use.

Figure 60

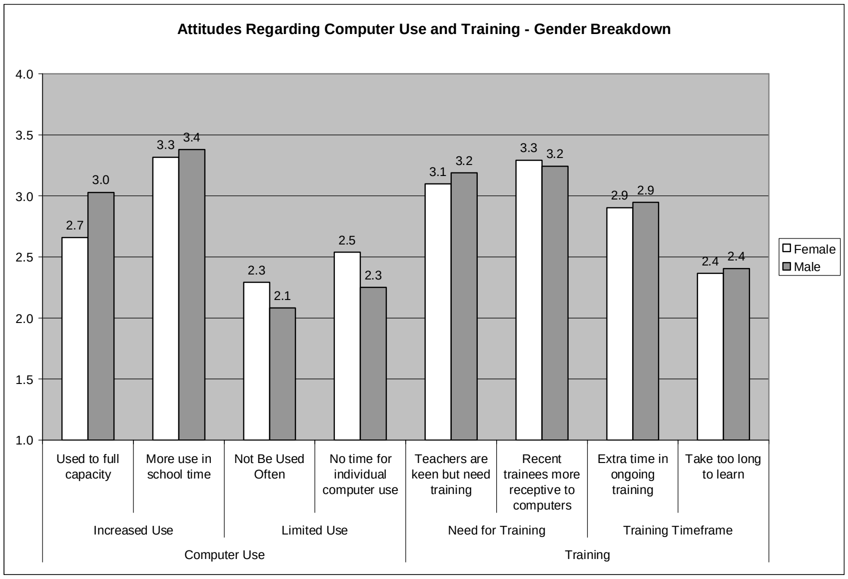


Table 65: Teachers' Attitudes toward the Pedagogical Effects of Computer Use in Education – Gender Breakdown

Categories	Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Pedagogical Effects	Improved Skills	Improves teacher skills	Female	34	61	5	0	95	5
			Male	46	51	3	0	97	3
		Staff and learners improve comp skills	Female	49	49	2	0	98	2
			Male	57	38	5	0	95	5
		Better job opportunities	Female	49	44	8	0	92	8
			Male	62	38	0	0	100	0
		Professional presentation	Female	51	41	5	2	93	7
			Male	46	54	0	0	100	0
	Independence	Makes learners independent	Female	15	63	20	3	78	23
			Male	8	65	27	0	73	27
		Teach learners responsibility	Female	26	50	24	0	76	24
			Male	32	51	16	0	84	16
		Access to information beyond school	Female	44	54	2	0	98	2
			Male	47	50	3	0	97	3
	Interactivity	More interactive lessons	Female	37	41	22	0	78	22
			Male	43	41	14	3	84	16
	Workload	Teachers will have heavier workload	Female	3	3	80	15	5	95
			Male	3	5	78	14	8	92
		Saves time in lesson prep and admin	Female	39	56	2	2	95	5
			Male	39	50	8	3	89	11

In general, female and male teachers have homogenous attitudes regarding the pedagogical effects of CAL implementation.

Figure 61

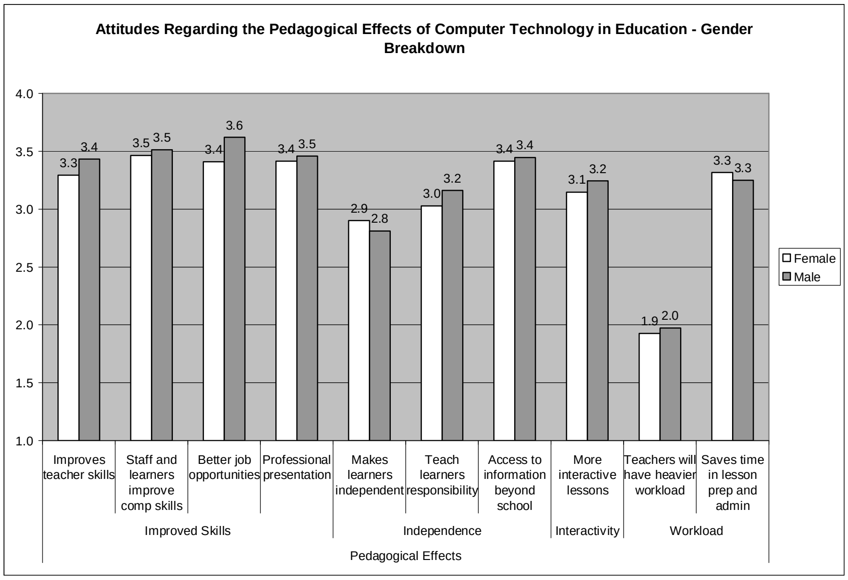
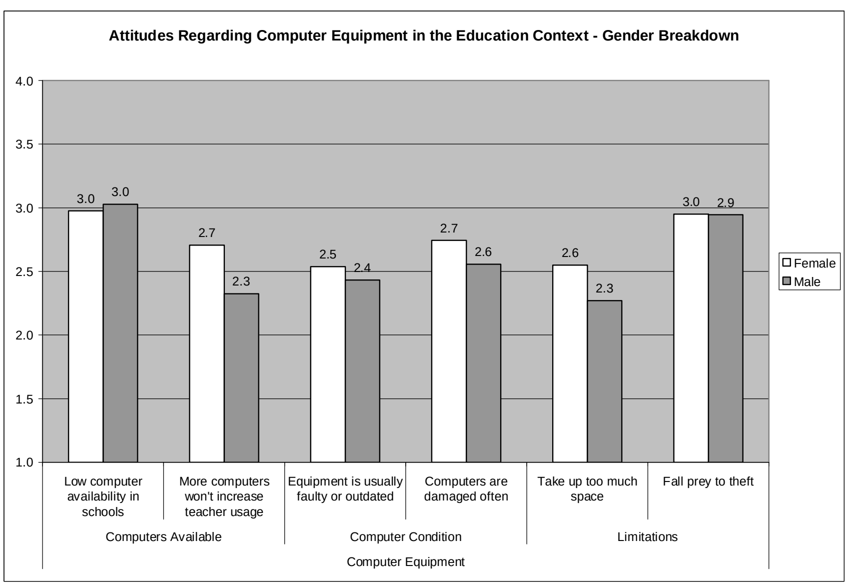


Table 66: Teachers' Attitudes toward Computer Equipment in the School Environment – Gender Breakdown

Categories	Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Equipment	Computers Available	Low computer availability in schools	Female	15	70	13	3	85	15
			Male	14	76	11	0	89	11
		More computers won't increase teacher usage	Female	17	46	27	10	63	37
			Male	5	32	51	11	38	62
	Computer Condition	Equipment is usually faulty or outdated	Female	2	51	44	2	54	46
			Male	5	38	51	5	43	57
		Computers are damaged often	Female	13	49	38	0	62	38
			Male	8	42	47	3	50	50
	Limitations	Take up too much space	Female	10	38	50	3	48	53
			Male	5	30	51	14	35	65
		Fall prey to theft	Female	23	50	28	0	73	28
			Male	17	64	17	3	81	19

Figure 62



At 63%, a majority of female teachers feel that the implementation of more computers will not increase computer use among teachers. In addition, on average, female teachers agree more strongly than male teachers that more computers in schools will be damaged often and take up too much space.

4.3.1.3.2.3 Demographic Breakdown

Table 67: Teachers' Attitudes toward the Assimilation of Computers in Education – Demographic Breakdown

Categories	Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Assimilation	Foresight	Computers in Education inevitable	Black	50	17	17	17	67	33
			Coloured	48	48	4	0	96	4
			White	41	56	3	0	97	3
		Computers will replace teachers	Black	0	15	23	62	15	85
			Coloured	0	8	40	52	8	92
			White	0	3	43	55	3	98
	Necessity for Computers	No value in computers in schools	Black	0	15	15	69	15	85
			Coloured	4	0	21	75	4	96
			White	0	3	33	65	3	98
		Funding spent on other resources	Black	0	0	67	33	0	100
			Coloured	0	4	56	40	4	96
			White	3	3	65	30	5	95
	Computer Orientation	Teachers fear computers	Black	0	62	31	8	62	38
			Coloured	0	40	44	16	40	60
			White	8	43	50	0	50	50
		Teachers not computer-literate enough	Black	8	85	8	0	92	8
			Coloured	20	36	36	8	56	44
			White	13	48	33	8	60	40
		Not enough teachers would use computers	Black	38	38	23	0	77	23
			Coloured	0	12	76	12	12	88
			White	5	40	55	0	45	55
		Teachers do make an effort	Black	8	46	46	0	54	46
			Coloured	16	56	24	4	72	28
			White	3	33	60	5	35	65
	Change in Method	Smooth transition to CAL	Black	8	62	31	0	69	31
			Coloured	8	40	40	12	48	52
			White	3	33	54	10	36	64
		Teachers prefer traditional methods	Black	8	46	46	0	54	46
			Coloured	4	57	39	0	61	39
			White	8	73	20	0	80	20
		Changes the curriculum	Black	0	46	54	0	46	54
			Coloured	20	40	40	0	60	40
			White	15	38	45	3	53	48

Teachers in the Black demographic group generally agree at lower levels that computers in education are inevitable and feel more strongly than other groups that teachers are not computer literate enough for computers, and therefore would not use computers sufficiently. However, teachers in the Black demographic group agree more strongly that there would be a smooth transition to CAL processes in schools. Teachers from the Coloured demographic group disagree that teachers fear computers and agree strongly that teachers do make an effort and that enough teachers would use computers if CAL systems were made available. Teachers from the White demographic group on average indicate more strongly that teachers fear computers and that teachers prefer traditional methods over CAL systems.

Figure 63

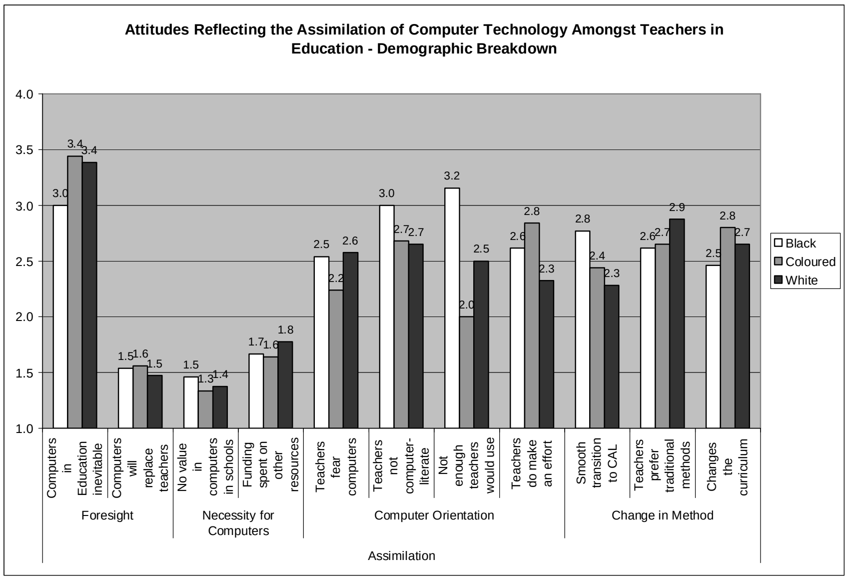


Table 68: Teachers' Attitudes toward Computer Use and Training in Education – Demographic Breakdown

Categories	Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Use	Increased Use	Used to full capacity	Black	58	42	0	0	100	0
			Coloured	24	44	28	4	68	32
			White	10	43	43	5	53	48
		More use in school time	Black	38	46	15	0	85	15
			Coloured	60	36	4	0	96	4
			White	33	60	8	0	93	8
	Limited Use	Not Be Used Often	Black	0	23	62	15	23	77
			Coloured	0	8	83	8	8	92
			White	5	25	70	0	30	70
		No time for individual computer use	Black	0	42	58	0	42	58
			Coloured	4	21	71	4	25	75
			White	5	38	56	0	44	56
Training	Need for Training	Teachers are keen but need training	Black	38	62	0	0	100	0
			Coloured	24	72	4	0	96	4
			White	20	65	13	3	85	15
		Recent trainees more receptive to computers	Black	23	62	15	0	85	15
			Coloured	28	68	4	0	96	4
			White	43	50	8	0	93	8
	Training Timeframe	Extra time in ongoing training	Black	8	92	0	0	100	0
			Coloured	24	56	20	0	80	20
			White	10	63	25	3	73	28
		Take too long to learn	Black	0	46	38	15	46	54
			Coloured	4	36	44	16	40	60
			White	3	50	40	8	53	48

Teachers from the Black demographic group have very strong levels of agreement that computers in a CAL system would be used to full capacity and that, despite teachers being very keen, intensive training would be required. Teachers from the Coloured demographic group on average agree strongly that there would be more computer use in school time, while teachers from the White demographic group have mixed feelings regarding whether computers would be used frequently and to full capacity.

Figure 64

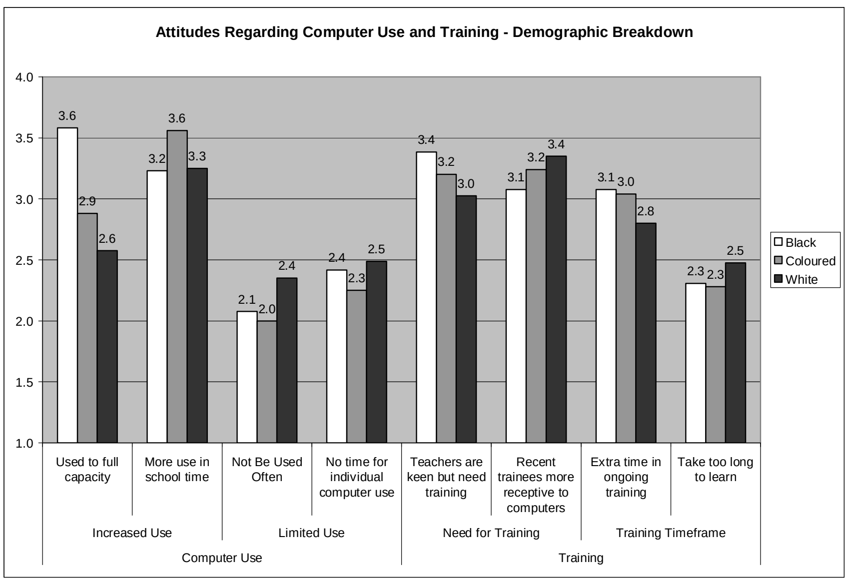


Table 69: Teachers' Attitudes toward the Pedagogical Effects of Computer Use in Education – Demographic Breakdown

Categories	Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Pedagogical Effects	Improved Skills	Improves teacher skills	Black	46	46	8	0	92	8
			Coloured	52	48	0	0	100	0
			White	30	65	5	0	95	5
		Staff and learners improve comp skills	Black	46	46	8	0	92	8
			Coloured	80	20	0	0	100	0
			White	38	58	5	0	95	5
		Better job opportunities	Black	62	38	0	0	100	0
			Coloured	75	25	0	0	100	0
			White	41	51	8	0	92	8
		Professional presentation	Black	46	54	0	0	100	0
			Coloured	60	36	4	0	96	4
			White	43	53	3	3	95	5
	Independence	Makes learners independent	Black	8	77	15	0	85	15
			Coloured	20	64	16	0	84	16
			White	8	59	31	3	67	33
		Teach learners responsibility	Black	31	54	15	0	85	15
			Coloured	44	56	0	0	100	0
			White	19	46	35	0	65	35
		Access to information beyond school	Black	42	58	0	0	100	0
			Coloured	56	40	4	0	96	4
			White	40	58	3	0	98	3
	Interactivity	More interactive lessons	Black	31	62	8	0	92	8
			Coloured	60	24	12	4	84	16
			White	30	45	25	0	75	25
	Workload	Teachers will have heavier workload	Black	0	8	69	23	8	92
			Coloured	0	0	84	16	0	100
			White	5	5	79	10	10	90
		Saves time in lesson prep and admin	Black	38	62	0	0	100	0
			Coloured	50	33	13	4	83	17
			White	33	63	3	3	95	5

Though teachers from all demographic groups generally demonstrate higher levels of agreement, teachers from the Coloured demographic group agree most strongly regarding the benefits of improved skills that the use of CAL systems provide. Teachers from the Coloured demographic group also agree at higher levels regarding the effects of CAL systems in providing independence and interactivity.

Figure 65

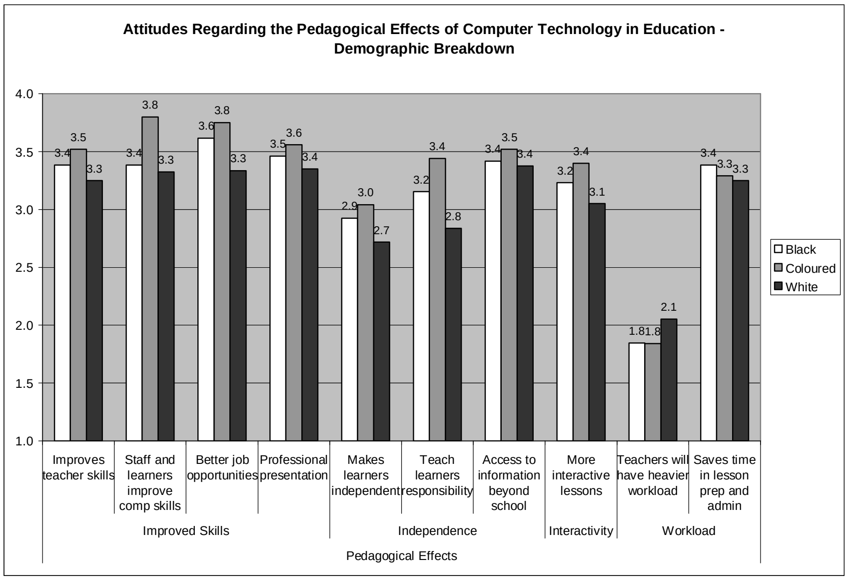
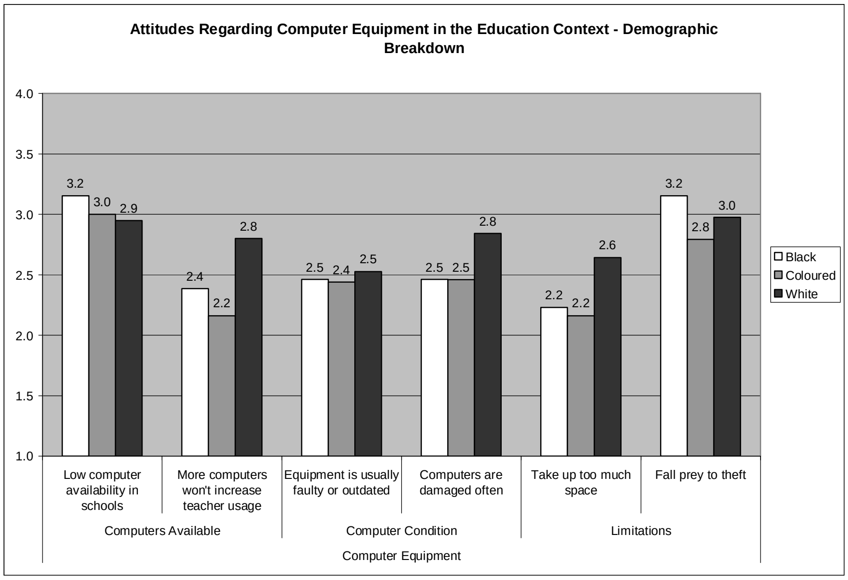


Table 70: Teachers' Attitudes toward Computer Equipment in the School Environment – Demographic Breakdown

Categories	Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Equipment	Computers Available	Low computer availability in schools	Black	15	85	0	0	100	0
			Coloured	16	68	16	0	84	16
			White	13	72	13	3	85	15
		More computers won't increase teacher usage	Black	8	31	54	8	38	62
			Coloured	4	28	48	20	32	68
			White	18	50	28	5	68	33
	Computer Condition	Equipment is usually faulty or outdated	Black	0	46	54	0	46	54
			Coloured	8	36	48	8	44	56
			White	3	50	45	3	53	48
		Computers are damaged often	Black	0	54	38	8	54	46
			Coloured	8	29	63	0	38	63
			White	16	53	32	0	68	32
	Limitations	Take up too much space	Black	0	38	46	15	38	62
			Coloured	8	16	60	16	24	76
			White	10	44	46	0	54	46
		Fall prey to theft	Black	23	69	8	0	92	8
			Coloured	17	50	29	4	67	33
			White	21	56	23	0	77	23

Teachers from the Black demographic group agree more strongly that there is a low availability of computers in schools and that computers in schools fall prey to theft, at 100% and 92% respectively. On average, teachers from the White demographic group feel more strongly at 68% that more computers in schools will not increase the use of computers and that computers take up too much space and are damaged often, at 54% and 68% respectively.

Figure 66



4.3.1.3.2.4 Age Groups

Table 71: Teachers' Attitudes toward the Assimilation of Computers in Education – Age Group Breakdown (*Continued Overleaf*)

Categories	Groups	Items	Age Groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Assimilation	Foresight	Computers in Education inevitable	21 - 30	38	50	0	13	88	13
			31 - 40	35	55	6	3	90	10
			41 - 50	52	41	7	0	93	7
			51 - 60	63	38	0	0	100	0
			Over 60	50	50	0	0	100	0
		Computers will replace teachers	21 - 30	0	13	25	63	13	88
			31 - 40	0	13	41	47	13	88
			41 - 50	0	0	32	68	0	100
			51 - 60	0	0	75	25	0	100
			Over 60	0	0	0	100	0	100
	Necessity for Computers	No value in computers in schools	21 - 30	0	0	38	63	0	100
			31 - 40	3	6	26	65	10	90
			41 - 50	0	0	25	75	0	100
			51 - 60	0	0	25	75	0	100
			Over 60	0	50	0	50	50	50
		Funding spent on other resources	21 - 30	0	0	71	29	0	100
			31 - 40	0	0	66	34	0	100
			41 - 50	0	7	61	32	7	93
			51 - 60	0	0	50	50	0	100
			Over 60	50	0	50	0	50	50
	Computer Orientation	Teachers fear computers	21 - 30	13	50	38	0	63	38
			31 - 40	0	44	47	9	44	56
			41 - 50	4	36	54	7	39	61
			51 - 60	0	88	13	0	88	13
			Over 60	50	0	50	0	50	50
		Teachers not computer-literate enough	21 - 30	13	38	50	0	50	50
			31 - 40	13	56	25	6	69	31
			41 - 50	18	43	32	7	61	39

			51 - 60	13	50	25	13	63	38
			Over 60	0	100	0	0	100	0
		Not enough teachers would use computers	21 - 30	13	50	38	0	63	38
			31 - 40	9	28	56	6	38	63
			41 - 50	11	36	50	4	46	54
			51 - 60	0	13	88	0	13	88
			Over 60	0	0	100	0	0	100
		Teachers do make an effort	21 - 30	0	63	25	13	63	38
			31 - 40	13	47	38	3	59	41
			41 - 50	7	39	50	4	46	54
			51 - 60	0	25	75	0	25	75
			Over 60	0	0	100	0	0	100
	Change in Method	Smooth transition to CAL	21 - 30	0	63	25	13	63	38
			31 - 40	6	34	47	13	41	59
			41 - 50	7	41	44	7	48	52
			51 - 60	0	38	63	0	38	63
			Over 60	0	50	50	0	50	50
		Teachers prefer traditional methods	21 - 30	13	63	25	0	75	25
			31 - 40	6	61	32	0	68	32
			41 - 50	4	67	30	0	70	30
			51 - 60	0	75	25	0	75	25
			Over 60	50	0	50	0	50	50
		Changes the curriculum	21 - 30	13	38	50	0	50	50
			31 - 40	16	41	44	0	56	44
			41 - 50	11	36	50	4	46	54
			51 - 60	25	50	25	0	75	25
			Over 60	0	50	50	0	50	50

In general, teachers from older age groups believe more strongly that computers in education are inevitable and that teachers generally fear computers. However, teachers from older age groups also believe that teachers generally do not make an effort to use computers, but that enough teachers would use computers if CAL systems were implemented.

Figure 67

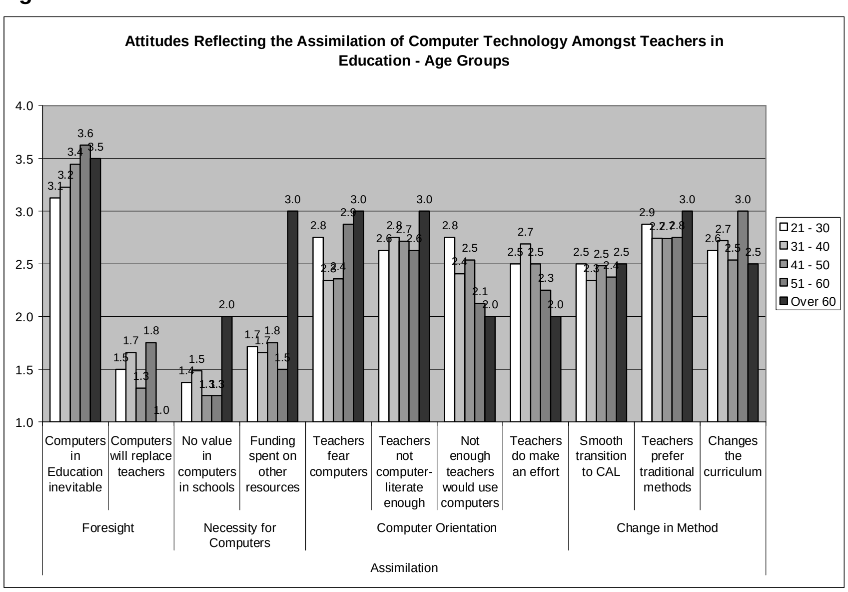
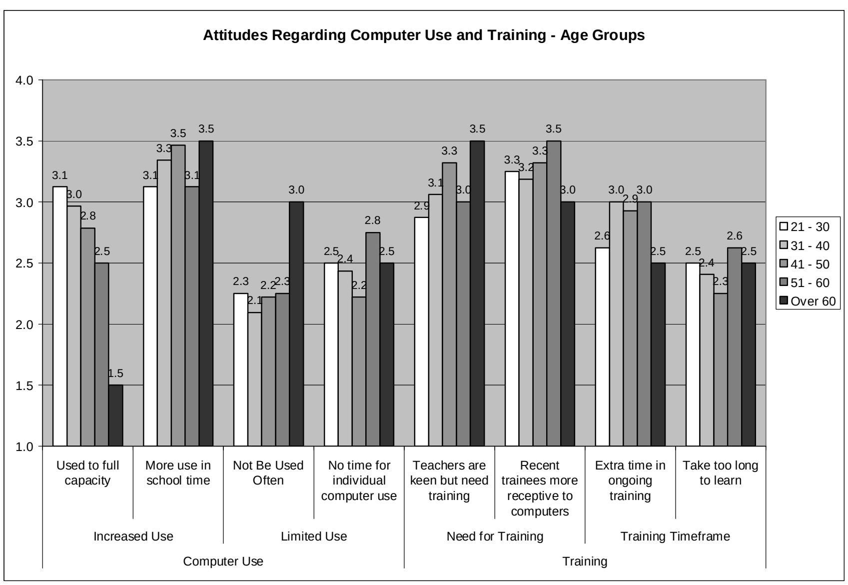


Table 72: Teachers' Attitudes toward Computer Use and Training in Education – Age Group Breakdown

				Levels of Agreement				Totals	
Categories	**Groups**	**Items**	**Age Groups**	Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Computer Use	Increased Use	Used to full capacity	21 - 30	25	63	13	0	88	13
			31 - 40	23	55	19	3	77	23
			41 - 50	25	32	39	4	57	43
			51 - 60	13	25	63	0	38	63
			Over 60	0	0	50	50	0	100
		More use in school time	21 - 30	25	63	13	0	88	13
			31 - 40	47	41	13	0	88	13
			41 - 50	50	46	4	0	96	4
			51 - 60	13	88	0	0	100	0
			Over 60	50	50	0	0	100	0
	Limited Use	Not Be Used Often	21 - 30	0	25	75	0	25	75
			31 - 40	0	13	84	3	13	88
			41 - 50	4	26	59	11	30	70
			51 - 60	0	25	75	0	25	75
			Over 60	50	0	50	0	50	50
		No time for individual computer use	21 - 30	13	25	63	0	38	63
			31 - 40	3	37	60	0	40	60
			41 - 50	0	26	70	4	26	74
			51 - 60	13	50	38	0	63	38
			Over 60	0	50	50	0	50	50
Training	Need for Training	Teachers are keen but need training	21 - 30	0	88	13	0	88	13
			31 - 40	22	66	9	3	88	13
			41 - 50	39	54	7	0	93	7
			51 - 60	0	100	0	0	100	0
			Over 60	50	50	0	0	100	0
		Recent trainees more receptive to computers	21 - 30	38	50	13	0	88	13
			31 - 40	25	69	6	0	94	6
			41 - 50	39	54	7	0	93	7
			51 - 60	50	50	0	0	100	0
			Over 60	50	0	50	0	50	50
	Training Timeframe	Extra time in ongoing training	21 - 30	0	63	38	0	63	38
			31 - 40	16	69	16	0	84	16
			41 - 50	18	61	18	4	79	21
			51 - 60	13	75	13	0	88	13
			Over 60	0	50	50	0	50	50
		Take too long to learn	21 - 30	0	63	25	13	63	38
			31 - 40	3	47	38	13	50	50
			41 - 50	0	36	54	11	36	64
			51 - 60	13	50	25	13	63	38
			Over 60	0	50	50	0	50	50

Figure 68



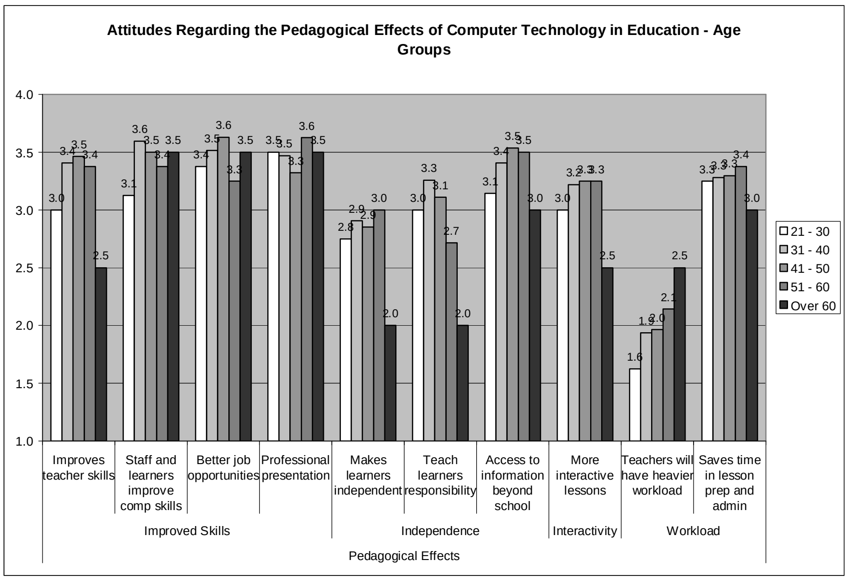
Teachers in younger age groups on average tend to agree more strongly that CAL systems in schools would be used to full capacity, while teachers in the over 60 age group agree that computers would not be used often enough. Teachers in older age groups tend to feel more strongly that teachers are keen for CAL systems, but need training.

Table 73: Teachers' Attitudes toward the Pedagogical Effects of Computer Use in Education – Age Group Breakdown

Categories	Groups	Items	Age Groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Pedagogical Effects	Improved Skills	Improves teacher skills	21 - 30	13	75	13	0	88	13
			31 - 40	41	59	0	0	100	0
			41 - 50	50	46	4	0	96	4
			51 - 60	38	63	0	0	100	0
			Over 60	0	50	50	0	50	50
		Staff and learners improve comp skills	21 - 30	25	63	13	0	88	13
			31 - 40	63	34	3	0	97	3
			41 - 50	54	43	4	0	96	4
			51 - 60	38	63	0	0	100	0
			Over 60	50	50	0	0	100	0
		Better job opportunities	21 - 30	38	63	0	0	100	0
			31 - 40	55	42	3	0	97	3
			41 - 50	67	30	4	0	96	4
			51 - 60	38	50	13	0	88	13
			Over 60	50	50	0	0	100	0
		Professional presentation	21 - 30	50	50	0	0	100	0
			31 - 40	50	47	3	0	97	3
			41 - 50	43	50	4	4	93	7
			51 - 60	63	38	0	0	100	0
			Over 60	50	50	0	0	100	0
	Independence	Makes learners independent	21 - 30	0	75	25	0	75	25
			31 - 40	16	63	19	3	78	22
			41 - 50	11	63	26	0	74	26
			51 - 60	13	75	13	0	88	13
			Over 60	0	0	100	0	0	100
		Teach learners responsibility	21 - 30	25	50	25	0	75	25
			31 - 40	35	55	10	0	90	10
			41 - 50	30	52	19	0	81	19
			51 - 60	14	43	43	0	57	43
			Over 60	0	0	100	0	0	100
		Access to information beyond school	21 - 30	14	86	0	0	100	0
			31 - 40	44	53	3	0	97	3
			41 - 50	54	46	0	0	100	0
			51 - 60	63	25	13	0	88	13
			Over 60	0	100	0	0	100	0
	Interactivity	More interactive lessons	21 - 30	25	50	25	0	75	25
			31 - 40	47	31	19	3	78	22
			41 - 50	39	46	14	0	86	14
			51 - 60	38	50	13	0	88	13
			Over 60	0	50	50	0	50	50
	Workload	Teachers will have heavier workload	21 - 30	0	0	63	38	0	100
			31 - 40	0	3	88	9	3	97
			41 - 50	4	4	79	14	7	93
			51 - 60	14	0	71	14	14	86
			Over 60	0	50	50	0	50	50
		Saves time in lesson prep and admin	21 - 30	25	75	0	0	100	0
			31 - 40	38	53	9	0	91	9
			41 - 50	44	48	0	7	93	7
			51 - 60	50	38	13	0	88	13
			Over 60	0	100	0	0	100	0

Teachers in the over 60 age group on average are undecided over whether the use of CAL systems would improve teachers' skills and provide interactive lessons, but overwhelmingly feel that CAL systems would not teach learners responsibility or help learners to be more independent. In addition, teachers in the over 60 age group feel most strongly that teachers will have a heavier workload after the implementation of CAL systems.

Figure 69

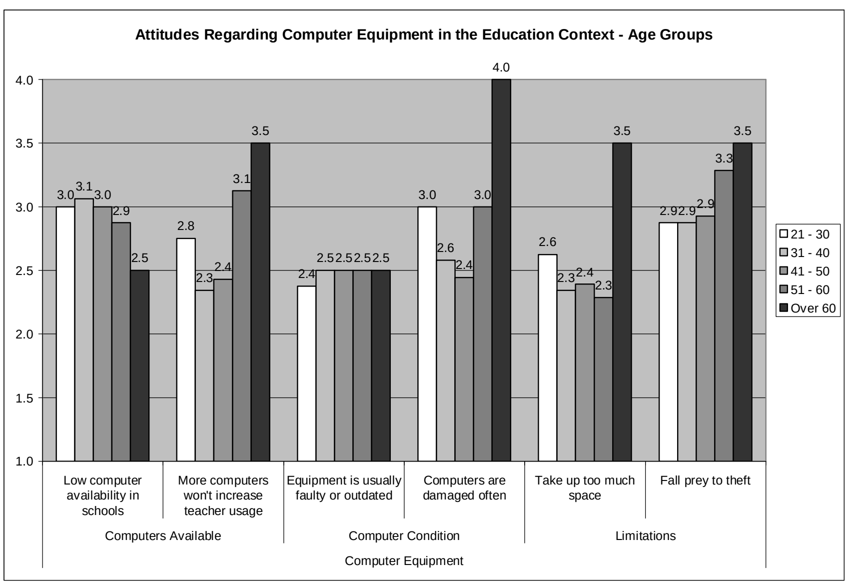


The results suggest that teachers in the older age groups feel that more computers in schools would not increase teacher computer usage and would fall prey to theft. Teachers in the over 60 age group feel very strongly that computers in schools are damaged often and that computer equipment take up take up too much space.

Table 74: Teachers' Attitudes toward Computer Equipment in the School Environment – Age Group Breakdown

Categories	Groups	Items	Age Groups	Levels of Agreement				Totals	
				Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Computer Equipment	Computers Available	Low computer availability in schools	21 - 30	13	75	13	0	88	13
			31 - 40	16	75	9	0	91	9
			41 - 50	19	67	11	4	85	15
			51 - 60	0	88	13	0	88	13
			Over 60	0	50	50	0	50	50
		More computers won't increase teacher usage	21 - 30	13	50	38	0	63	38
			31 - 40	6	34	47	13	41	59
			41 - 50	11	36	39	14	46	54
			51 - 60	25	63	13	0	88	13
			Over 60	50	50	0	0	100	0
	Computer Condition	Equipment is usually faulty or outdated	21 - 30	0	38	63	0	38	63
			31 - 40	6	44	44	6	50	50
			41 - 50	4	46	46	4	50	50
			51 - 60	0	50	50	0	50	50
			Over 60	0	50	50	0	50	50
		Computers are damaged often	21 - 30	13	75	13	0	88	13
			31 - 40	10	39	52	0	48	52
			41 - 50	4	41	52	4	44	56
			51 - 60	14	71	14	0	86	14
			Over 60	100	0	0	0	100	0
	Limitations	Take up too much space	21 - 30	0	63	38	0	63	38
			31 - 40	9	28	50	13	38	63
			41 - 50	7	32	54	7	39	61
			51 - 60	0	29	71	0	29	71
			Over 60	50	50	0	0	100	0
		Fall prey to theft	21 - 30	13	63	25	0	75	25
			31 - 40	19	53	25	3	72	28
			41 - 50	15	63	22	0	78	22
			51 - 60	43	43	14	0	86	14
			Over 60	50	50	0	0	100	0

Figure 70



4.3.1.3.2.5 Level of Qualifications

Table 75: Teachers' Attitudes toward the Assimilation of Computers in Education – Level of Qualification Breakdown

Categories	Groups	Items	Level of Qualifications	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Assimilation	Foresight	Computers in Education inevitable	Diploma	38	48	5	10	86	14
			First Degree	44	51	5	0	95	5
			Postgraduate Degree	56	38	6	0	94	6
		Computers will replace teachers	Diploma	0	14	45	41	14	86
			First Degree	0	5	28	68	5	95
			Postgraduate Degree	0	0	56	44	0	100
	Necessity for Computers	No value in computers in schools	Diploma	0	14	32	55	14	86
			First Degree	3	0	23	74	3	97
			Postgraduate Degree	0	0	25	75	0	100
		Funding spent on other resources	Diploma	5	0	67	29	5	95
			First Degree	0	5	68	28	5	95
			Postgraduate Degree	0	0	44	56	0	100
	Computer Orientation	Teachers fear computers	Diploma	5	32	55	9	36	64
			First Degree	5	53	35	8	58	43
			Postgraduate Degree	0	44	56	0	44	56
		Teachers not computer-literate enough	Diploma	14	50	32	5	64	36
			First Degree	18	53	28	3	70	30
			Postgraduate Degree	6	44	31	19	50	50
		Not enough teachers would use computers	Diploma	14	23	59	5	36	64
			First Degree	10	35	50	5	45	55
			Postgraduate Degree	0	31	69	0	31	69
		Teachers do make an effort	Diploma	18	41	36	5	59	41
			First Degree	5	45	48	3	50	50
			Postgraduate Degree	0	38	56	6	38	63
	Change in Method	Smooth transition to CAL	Diploma	5	45	50	0	50	50
			First Degree	8	33	44	15	41	59
			Postgraduate Degree	0	50	44	6	50	50
		Teachers prefer traditional methods	Diploma	9	50	41	0	59	41
			First Degree	8	66	26	0	74	26
			Postgraduate Degree	0	75	25	0	75	25
		Changes the curriculum	Diploma	14	27	59	0	41	59
			First Degree	15	43	40	3	58	43
			Postgraduate Degree	13	50	38	0	63	38

Teachers with postgraduate degrees on average feel more strongly, at 3.5, that the integration of computers in the education system is inevitable. The results also demonstrate that teachers in the postgraduate degree qualifications feel more strongly that funding for computers systems should not be spent on other resources, that enough teachers would use computers and that teachers do generally make an effort.

Figure 71

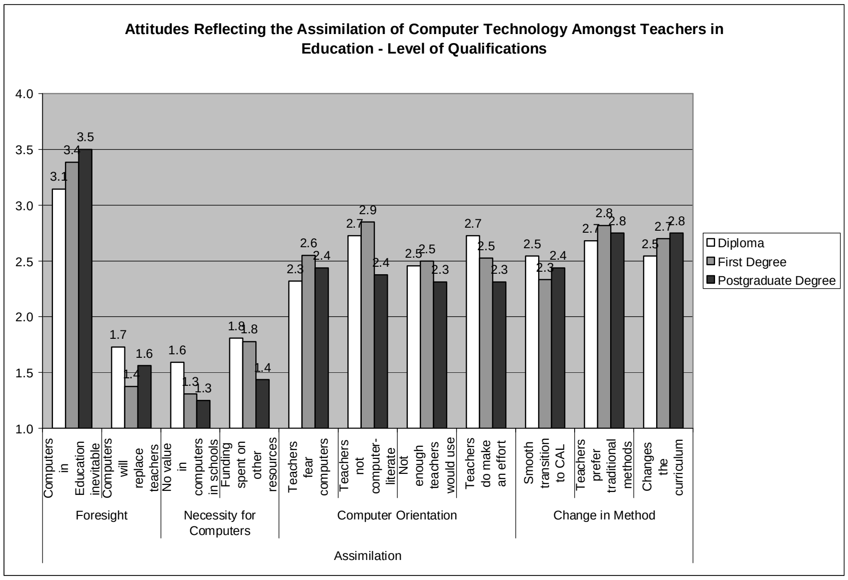
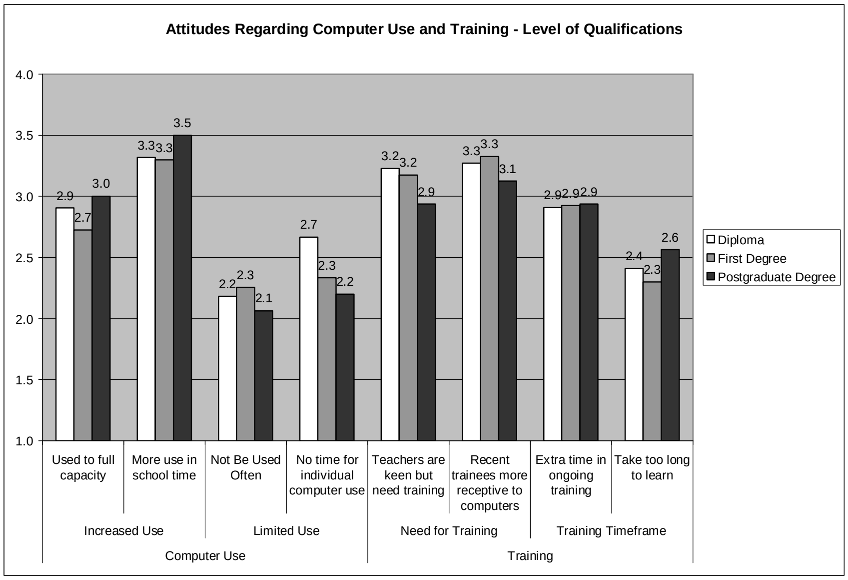


Table 76: Teachers' Attitudes toward Computer Use and Training Education – Level of Qualification Breakdown

Categories	Groups	Items	Level of Qualifications	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Use	Increased Use	Used to full capacity	Diploma	29	33	38	0	62	38
			First Degree	18	45	30	8	63	38
			Postgraduate Degree	25	50	25	0	75	25
		More use in school time	Diploma	36	59	5	0	95	5
			First Degree	40	50	10	0	90	10
			Postgraduate Degree	56	38	6	0	94	6
	Limited Use	Not Be Used Often	Diploma	5	18	68	9	23	77
			First Degree	3	26	67	5	28	72
			Postgraduate Degree	0	6	94	0	6	94
		No time for individual computer use	Diploma	5	57	38	0	62	38
			First Degree	5	26	67	3	31	69
			Postgraduate Degree	0	20	80	0	20	80
Training	Need for Training	Teachers are keen but need training	Diploma	27	68	5	0	95	5
			First Degree	28	65	5	3	93	8
			Postgraduate Degree	13	69	19	0	81	19
		Recent trainees more receptive to computers	Diploma	32	64	5	0	95	5
			First Degree	40	53	8	0	93	8
			Postgraduate Degree	25	63	13	0	88	13
	Training Timeframe	Extra time in ongoing training	Diploma	14	68	14	5	82	18
			First Degree	15	63	23	0	78	23
			Postgraduate Degree	13	69	19	0	81	19
		Take too long to learn	Diploma	5	45	36	14	50	50
			First Degree	0	45	40	15	45	55
			Postgraduate Degree	6	44	50	0	50	50

The majority of teachers with postgraduate qualifications disagree that computers in schools would not be used often, and agree that computers would be used to full capacity in a CAL system. However, teachers in the diploma qualifications group feel, at 62% consensus, that there would not be enough time for individualised computer use.

Figure 72



On average, teachers in the diploma qualification group agree at stronger levels that the use of CAL systems would help teach learners responsibility and help save teachers' lesson preparation and administration time. Teachers with postgraduate degrees agree more strongly on average that the use of CAL systems would improve staff and learners improve skills, help make learners independent, provide better access to resources outside of school and present learners with better job opportunities after school.

Table 77: Teachers' Attitudes toward the Pedagogical Effects of Computer Use in Education – Level of Qualification Breakdown

				Levels of Agreement				Totals	
Categories	**Groups**	**Items**	**Level of Qualifications**	Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Pedagogical Effects	Improved Skills	Improves teacher skills	Diploma	45	50	5	0	95	5
			First Degree	33	63	5	0	95	5
			Postgraduate Degree	50	50	0	0	100	0
		Staff and learners improve comp skills	Diploma	50	45	5	0	95	5
			First Degree	50	48	3	0	98	3
			Postgraduate Degree	63	31	6	0	94	6
		Better job opportunities	Diploma	43	57	0	0	100	0
			First Degree	59	33	8	0	92	8
			Postgraduate Degree	63	38	0	0	100	0
		Professional presentation	Diploma	59	36	5	0	95	5
			First Degree	43	53	3	3	95	5
			Postgraduate Degree	50	50	0	0	100	0
	Independence	Makes learners independent	Diploma	14	55	32	0	68	32
			First Degree	10	64	23	3	74	26
			Postgraduate Degree	13	75	13	0	88	13
		Teach learners responsibility	Diploma	36	55	9	0	91	9
			First Degree	21	55	24	0	76	24
			Postgraduate Degree	40	33	27	0	73	27
		Access to information beyond school	Diploma	43	52	5	0	95	5
			First Degree	43	55	3	0	98	3
			Postgraduate Degree	56	44	0	0	100	0
	Interactivity	More interactive lessons	Diploma	45	41	14	0	86	14
			First Degree	30	48	20	3	78	23
			Postgraduate Degree	56	25	19	0	81	19
	Workload	Teachers will have heavier workload	Diploma	0	14	77	9	14	86
			First Degree	3	0	82	15	3	97
			Postgraduate Degree	6	0	75	19	6	94
		Saves time in lesson prep and admin	Diploma	50	45	5	0	95	5
			First Degree	33	59	5	3	92	8
			Postgraduate Degree	38	50	6	6	88	13

Table 73

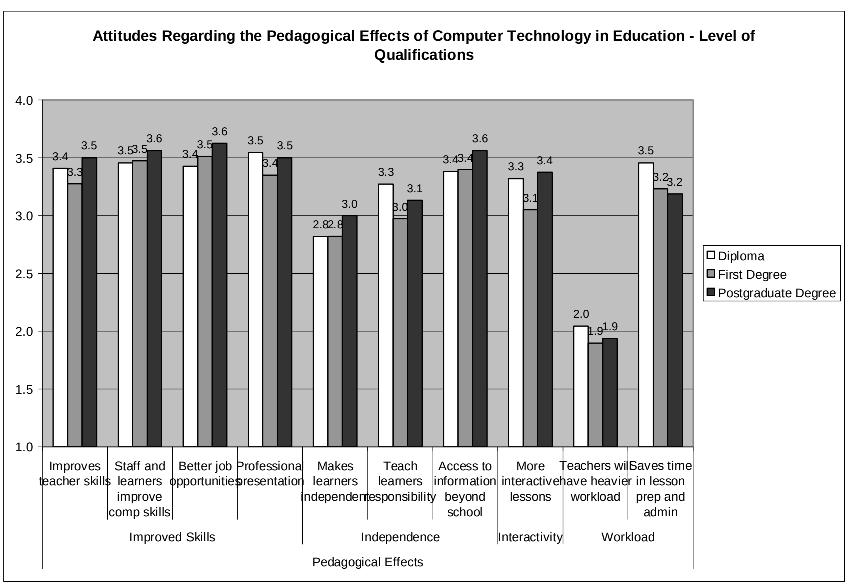
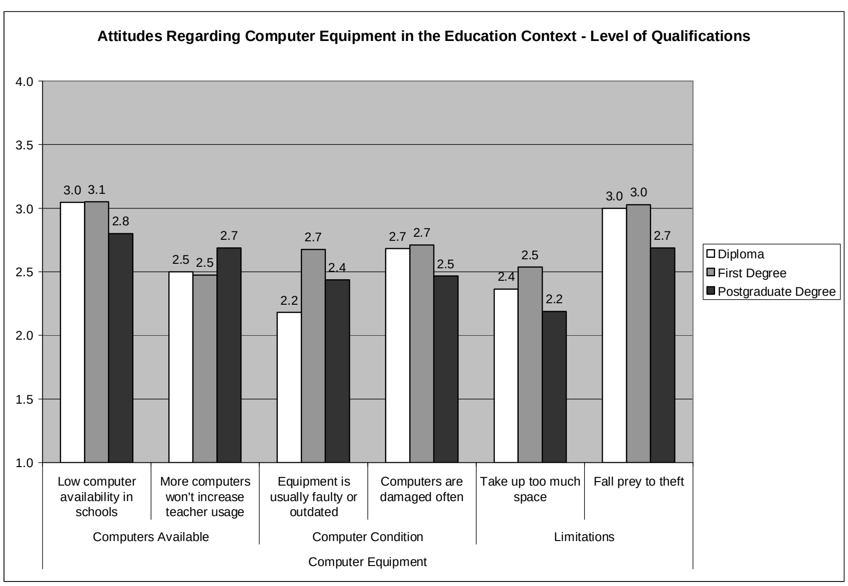


Table 78: Teachers' Attitudes toward Computer Equipment in the School Environment – Level of Qualification Breakdown

Categories	Groups	Items	Level of Qualifications	Levels of Agreement				Totals	
				Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Computer Equipment	Computers Available	Low computer availability in schools	Diploma	14	77	9	0	91	9
			First Degree	18	73	8	3	90	10
			Postgraduate Degree	7	67	27	0	73	27
		More computers won't increase teacher usage	Diploma	9	45	32	14	55	45
			First Degree	13	33	45	10	45	55
			Postgraduate Degree	13	50	31	6	63	38
	Computer Condition	Equipment is usually faulty or outdated	Diploma	0	23	73	5	23	77
			First Degree	8	58	30	5	65	35
			Postgraduate Degree	0	44	56	0	44	56
		Computers are damaged often	Diploma	5	59	36	0	64	36
			First Degree	16	42	39	3	58	42
			Postgraduate Degree	7	33	60	0	40	60
	Limitations	Take up too much space	Diploma	0	45	45	9	45	55
			First Degree	15	33	41	10	49	51
			Postgraduate Degree	0	19	81	0	19	81
		Fall prey to theft	Diploma	23	55	23	0	77	23
			First Degree	21	63	13	3	84	16
			Postgraduate Degree	13	44	44	0	56	44

Teachers in the postgraduate qualifications group agree at lesser levels that there is low computer availability in schools, and more strongly that placing more computers in schools will not increase teacher usage. In addition, teachers with postgraduate degrees on average feel that computers are not damaged often at schools, that computer equipment does not take up too much space and that computers in schools would not fall prey to theft.

Figure 74



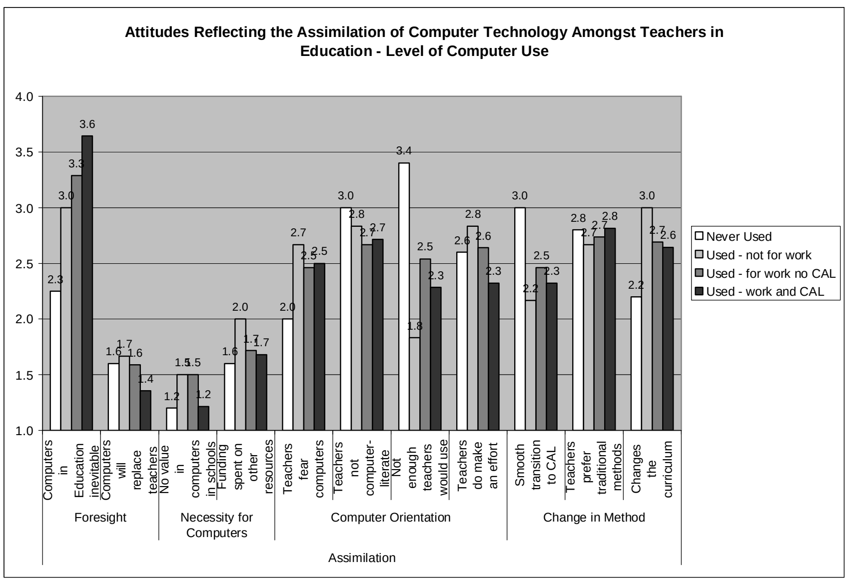
4.3.1.3.2.6 Level of Computer Use

Table 79: Teachers' Attitudes toward the Assimilation of Computers in Education – Level of Computer Use Breakdown

Categories	Groups	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Assimilation	Foresight	Computers in Education inevitable	Never Used	25	0	50	25	25	75
			Used - not for work	33	50	0	17	83	17
			Used - for work no CAL	32	66	3	0	97	3
			Used - work and CAL	68	29	4	0	96	4
		Computers will replace teachers	Never Used	0	20	20	60	20	80
			Used - not for work	0	17	33	50	17	83
			Used - for work no CAL	0	5	49	46	5	95
			Used - work and CAL	0	4	29	68	4	96
	Necessity for Computers	No value in computers in schools	Never Used	0	0	20	80	0	100
			Used - not for work	0	17	17	67	17	83
			Used - for work no CAL	3	5	32	61	8	92
			Used - work and CAL	0	0	21	79	0	100
		Funding spent on other resources	Never Used	0	0	60	40	0	100
			Used - not for work	20	0	40	40	20	80
			Used - for work no CAL	0	0	72	28	0	100
			Used - work and CAL	0	7	54	39	7	93
	Computer Orientation	Teachers fear computers	Never Used	0	20	60	20	20	80
			Used - not for work	17	50	17	17	67	33
			Used - for work no CAL	5	38	54	3	44	56
			Used - work and CAL	0	57	36	7	57	43
		Teachers not computer-literate enough	Never Used	20	60	20	0	80	20
			Used - not for work	33	33	17	17	67	33
			Used - for work no CAL	8	54	36	3	62	38
			Used - work and CAL	18	46	25	11	64	36
		Not enough teachers would use computers	Never Used	40	60	0	0	100	0
			Used - not for work	0	0	83	17	0	100
			Used - for work no CAL	13	31	54	3	44	56
			Used - work and CAL	0	32	64	4	32	68
		Teachers do make an effort	Never Used	20	40	20	20	60	40
			Used - not for work	17	50	33	0	67	33
			Used - for work no CAL	8	49	44	0	56	44
			Used - work and CAL	4	32	57	7	36	64
	Change in Method	Smooth transition to CAL	Never Used	25	50	25	0	75	25
			Used - not for work	0	33	50	17	33	67
			Used - for work no CAL	5	44	44	8	49	51
			Used - work and CAL	4	36	50	11	39	61
		Teachers prefer traditional methods	Never Used	20	40	40	0	60	40
			Used - not for work	17	33	50	0	50	50
			Used - for work no CAL	3	68	29	0	71	29
			Used - work and CAL	7	67	26	0	74	26
		Changes the curriculum	Never Used	0	20	80	0	20	80
			Used - not for work	33	33	33	0	67	33
			Used - for work no CAL	18	33	49	0	51	49
			Used - work and CAL	7	54	36	4	61	39

On the continuum, teachers who have never used computers on average disagree that computers in education are inevitable, while teachers who have used computers for both work and CAL agree strongly to the contrary. In addition, teachers who have never used computers feel more strongly that despite there being a smooth transition to CAL systems, teachers are generally not computer literate enough and would therefore not sufficiently use the CAL systems. Teachers who have used computers but not for work activities, believe more strongly that teachers would make an effort to use the CAL systems, but that teachers fear computers and that CAL systems would influence and change the current curricula.

Figure 75



Teachers who have not used computers agree very strongly that CAL systems would be used to full capacity, while all teachers who have not used computers, or have not used computers for work activities, strongly agree that teachers are keen to use CAL systems but need training to do so. Teachers who have not used computers for work activities feel strongly that it would not take a long time to learn the use of CAL systems.

Table 80: Teachers' Attitudes toward Computer Use and Training Education – Level of Computer Use Breakdown

Categories	Groups	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Use	Increased Use	Used to full capacity	Never Used	60	20	20	0	80	20
			Used - not for work	17	50	17	17	67	33
			Used - for work no CAL	18	39	39	3	58	42
			Used - work and CAL	21	50	25	4	71	29
		More use in school time	Never Used	60	20	20	0	80	20
			Used - not for work	33	67	0	0	100	0
			Used - for work no CAL	46	46	8	0	92	8
			Used - work and CAL	36	57	7	0	93	7
	Limited Use	Not Be Used Often	Never Used	0	20	80	0	20	80
			Used - not for work	0	17	83	0	17	83
			Used - for work no CAL	5	18	69	8	23	77
			Used - work and CAL	0	22	74	4	22	78
		No time for individual computer use	Never Used	0	40	60	0	40	60
			Used - not for work	17	33	50	0	50	50
			Used - for work no CAL	0	38	59	3	38	62
			Used - work and CAL	7	26	67	0	33	67
Training	Need for Training	Teachers are keen but need training	Never Used	40	60	0	0	100	0
			Used - not for work	50	50	0	0	100	0
			Used - for work no CAL	18	74	8	0	92	8
			Used - work and CAL	25	61	11	4	86	14
		Recent trainees more receptive to computers	Never Used	20	60	20	0	80	20
			Used - not for work	50	33	17	0	83	17
			Used - for work no CAL	31	62	8	0	92	8
			Used - work and CAL	39	57	4	0	96	4
	Training Timeframe	Extra time in ongoing training	Never Used	20	80	0	0	100	0
			Used - not for work	17	67	17	0	83	17
			Used - for work no CAL	13	67	18	3	79	21
			Used - work and CAL	14	61	25	0	75	25
		Take too long to learn	Never Used	0	40	40	20	40	60
			Used - not for work	0	33	0	67	33	67
			Used - for work no CAL	0	44	51	5	44	56
			Used - work and CAL	7	50	36	7	57	43

Figure 76

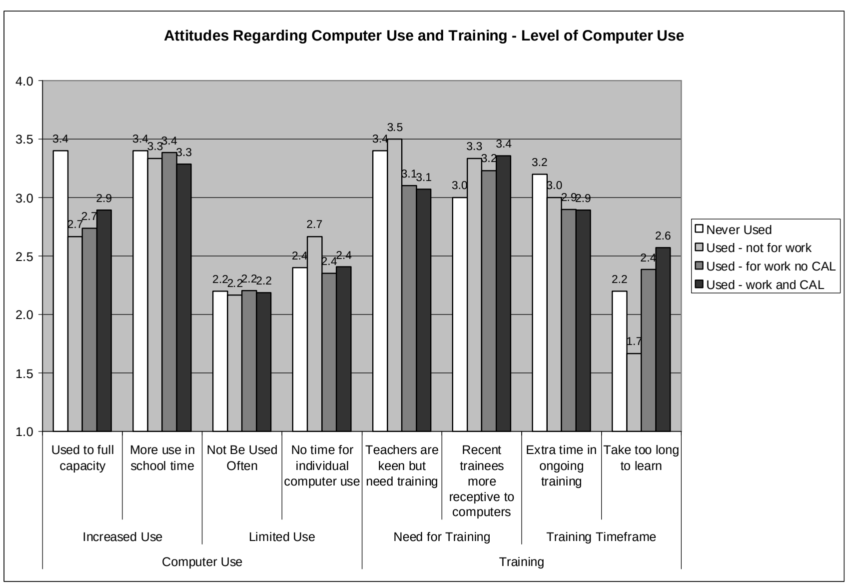


Table 81: Teachers' Attitudes toward the Pedagogical Effects of Computer Use in Education – Level of Computer Use Breakdown

Categories	Groups	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Pedagogical Effects	Improved Skills	Improves teacher skills	Never Used	60	20	20	0	80	20
			Used - not for work	33	50	17	0	83	17
			Used - for work no CAL	28	69	3	0	97	3
			Used - work and CAL	54	46	0	0	100	0
		Staff and learners improve comp skills	Never Used	100	0	0	0	100	0
			Used - not for work	67	33	0	0	100	0
			Used - for work no CAL	49	44	8	0	92	8
			Used - work and CAL	46	54	0	0	100	0
		Better job opportunities	Never Used	75	25	0	0	100	0
			Used - not for work	40	60	0	0	100	0
			Used - for work no CAL	41	56	3	0	97	3
			Used - work and CAL	75	18	7	0	93	7
		Professional presentation	Never Used	60	20	20	0	80	20
			Used - not for work	83	17	0	0	100	0
			Used - for work no CAL	41	56	3	0	97	3
			Used - work and CAL	50	46	0	4	96	4
	Independence	Makes learners independent	Never Used	0	75	25	0	75	25
			Used - not for work	17	67	17	0	83	17
			Used - for work no CAL	10	56	33	0	67	33
			Used - work and CAL	14	71	11	4	86	14
		Teach learners responsibility	Never Used	80	0	20	0	80	20
			Used - not for work	40	40	20	0	80	20
			Used - for work no CAL	28	51	21	0	79	21
			Used - work and CAL	19	62	19	0	81	19
		Access to information beyond school	Never Used	80	20	0	0	100	0
			Used - not for work	60	20	20	0	80	20
			Used - for work no CAL	31	67	3	0	97	3
			Used - work and CAL	57	43	0	0	100	0
	Interactivity	More interactive lessons	Never Used	40	60	0	0	100	0
			Used - not for work	33	50	0	17	83	17
			Used - for work no CAL	38	49	13	0	87	13
			Used - work and CAL	43	25	32	0	68	32
	Workload	Teachers will have heavier workload	Never Used	0	0	80	20	0	100
			Used - not for work	0	17	67	17	17	83
			Used - for work no CAL	3	3	79	16	5	95
			Used - work and CAL	4	4	82	11	7	93
		Saves time in lesson prep and admin	Never Used	60	40	0	0	100	0
			Used - not for work	33	67	0	0	100	0
			Used - for work no CAL	31	59	8	3	90	10
			Used - work and CAL	48	44	4	4	93	7

Teachers who have never used computers on average strongly agree that the use of CAL systems would: help staff and learners improve their computer skills; help teach learners responsibility; provide learners with better job opportunities; help save teachers' administration and lesson preparation time and provide better access to resources outside of school boundaries. Of teachers who have used computers for both work and CAL, 100% are convinced that the use of CAL systems would improve teachers' general skills.

Figure 77

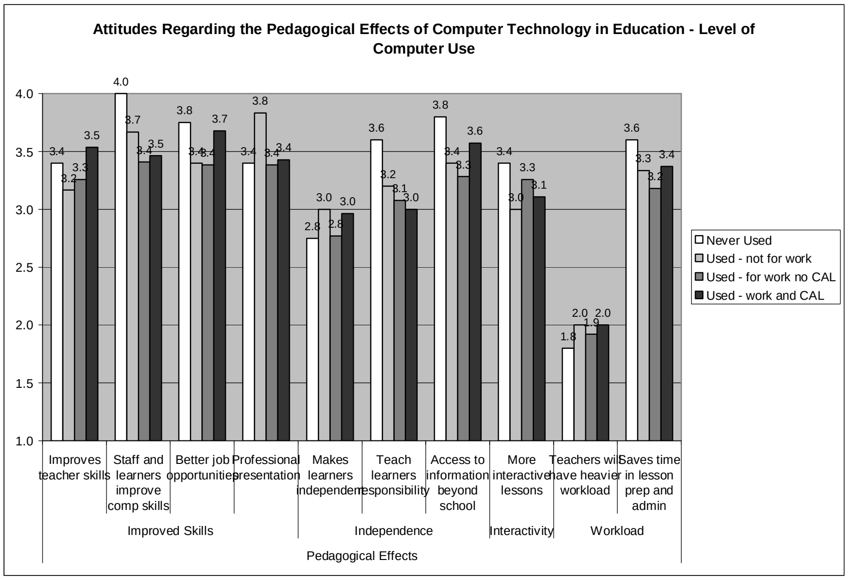
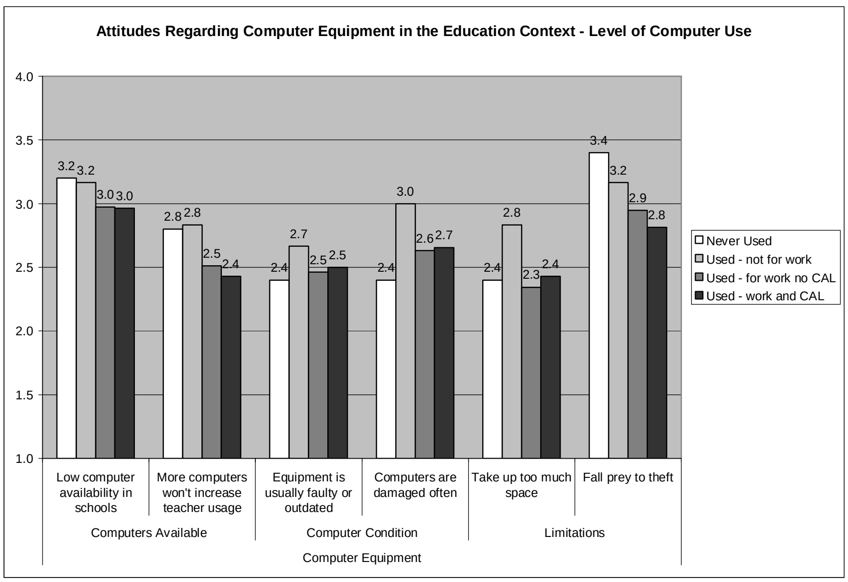


Table 82: Teachers' Attitudes toward Computer Equipment in the School Environment – Level of Computer Use Breakdown

Categories	Groups	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Computer Equipment	Computers Available	Low computer availability in schools	Never Used	20	80	0	0	100	0
			Used - not for work	17	83	0	0	100	0
			Used - for work no CAL	16	68	13	3	84	16
			Used - work and CAL	11	75	14	0	86	14
		More computers won't increase teacher usage	Never Used	20	40	40	0	60	40
			Used - not for work	17	50	33	0	67	33
			Used - for work no CAL	8	44	41	8	51	49
			Used - work and CAL	14	32	36	18	46	54
	Computer Condition	Equipment is usually faulty or outdated	Never Used	0	40	60	0	40	60
			Used - not for work	17	33	50	0	50	50
			Used - for work no CAL	3	44	51	3	46	54
			Used - work and CAL	4	50	39	7	54	46
		Computers are damaged often	Never Used	0	40	60	0	40	60
			Used - not for work	33	33	33	0	67	33
			Used - for work no CAL	8	50	39	3	58	42
			Used - work and CAL	12	42	46	0	54	46
	Limitations	Take up too much space	Never Used	20	20	40	20	40	60
			Used - not for work	17	50	33	0	67	33
			Used - for work no CAL	8	26	58	8	34	66
			Used - work and CAL	4	43	46	7	46	54
		Fall prey to theft	Never Used	40	60	0	0	100	0
			Used - not for work	33	50	17	0	83	17
			Used - for work no CAL	13	68	18	0	82	18
			Used - work and CAL	22	41	33	4	63	37

Teachers who have used computers for both work and CAL on average feel that more computers would increase teacher usage. Teachers who have used computers but not for work activities demonstrate the most concern that computer equipment in schools would often be outdated, damaged, faulty or would take up too much space. Concerns about the level of computer theft in schools is highest for teachers who have never used computers and lowest for teachers who have used computers for both general work activities and CAL.

Figure 78



4.3.1.4 Perceived Benefits of Computers in Education

4.3.1.4.1 General Benefits of Computers in Education

In this item, teachers were presented with a list of benefits and asked to rate how strongly they agree with each individual benefit statement. Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly disagree, disagree, agree and strongly agree. A totals column has been added to provide a summary of overall agreement and disagreement.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly disagree to 4 for strongly agree. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates strong disagreement
- 1.76 to 2.5 indicates general disagreement
- 2.51 to 3.25 indicates general agreement
- 3.26 to 4 indicates strong agreement.

4.3.1.4.1.1 Total Teacher Group

Table 83: The Benefits of Computers in Education – Total Teacher Group

Groups	Items	Levels of Agreement				Totals	
		Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Interactivity	More interactive learning	16	66	16	1	82	18
	Communication between learners	12	55	33	0	67	33
	More individual attention	22	59	18	1	81	19
Learner - Centred	Self-directed learning	25	63	11	1	88	12
	Work at Own Pace	20	78	3	0	97	3
Multimedia	Better information access	47	53	0	0	100	0
	Extra learning resources	37	63	0	0	100	0
	Visual presentations	23	77	0	0	100	0
Attention	Fun learning experience	32	62	5	0	95	5
	Improves motivation	21	67	10	3	88	12
	Maintains interest	34	54	11	1	88	12
Skills	Gives learners job-related skills	42	56	1	0	99	1
	Improves written skills	29	53	9	8	83	17
	Practical experience	27	64	7	1	91	9
Learning	Accelerates learning	19	57	21	3	76	24
	Increases productivity	22	57	14	7	79	21
	Quicker assimilation of data	28	67	4	1	95	5
Teachers	Free up teacher's time	20	68	9	3	88	12

Teachers largely feel positive about the benefits that the use of CAL systems provides. On average, teachers agree more strongly with the following benefits:

- At an average of 3.5, teachers view having better access to information as the biggest benefit of CAL systems, a benefit that allows for quicker collection, assimilation and analysis of data (Baillie *et al.*, 2000; Lelouche, 1998; Valdez *et al.,* 2004; Wiley, 2001)
- Both at averages of 3.4, teachers strongly agree that CAL systems provide better learning resources and help learners develop job related

skills, as supported in the literature to convey real life and professional working contexts (Baillie *et al.*, 2000; Heide *et al.*, 2001)

- Teachers feel, at an average of 3.3, that the use of CAL systems would provide learners with 'fun' learning experiences, that the literature indicates provides learners with satisfactory and positive learning experiences (Forsyth, 2001; Lelouche, 1998; Owen *et al.*, 1998) and helps to maintain learner interest (Christensen *et al.*, 1998).

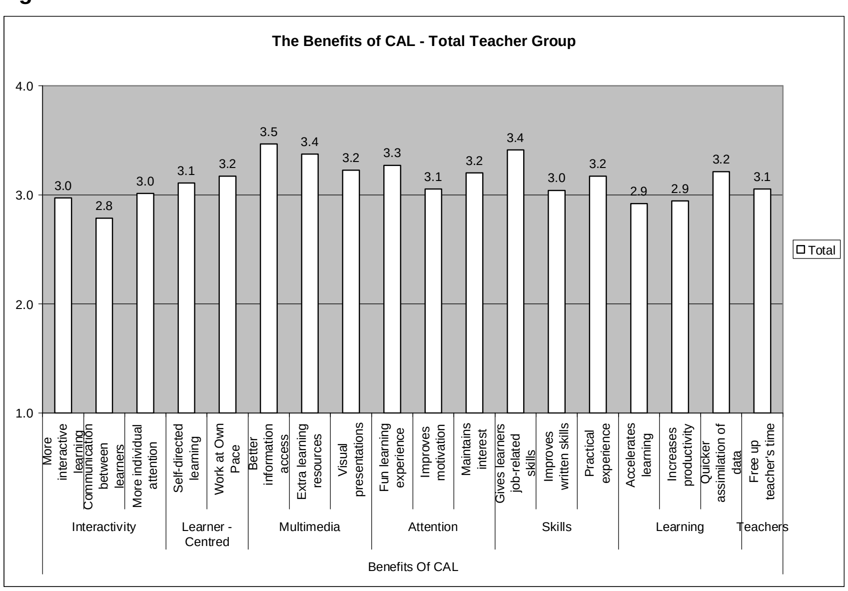
Though not at stronger levels, the following benefits received larger consensus amongst teachers:

- At 97% agreement, teachers feel that CAL systems allow learners to work at their own pace, a facet of learner centred learning contexts (Christensen *et al.*, 1998; Eom *et al.*, 2000; Wiley *et al.*, 2001)

- Of all the teachers, 95% believe that the use of CAL systems allow for quicker assimilation of data, as echoed in the literature (Baillie *et al.*, 2000; Lelouche, 1998; Valdez *et al.,* 2004; Wiley, 2001)

- At 91% agreement, teachers feel that the use of CAL systems allow learners to receive practical experience during lessons, that enables learners to develop relevant skills (Bloom *et al.*, 2002; Forsyth, 2001; Heide *et al.*, 2001; Merrill *et al.*, 1996).

Figure 79



Teachers therefore generally agree with all stated benefits, but feel that the benefits that involve the provision and synthesis of better information and learning resources, the development of practical and professional skills, the ability for learners to work at their pace and the use of tools that present learners with ‘fun’ and positive learning experiences are the most relevant.

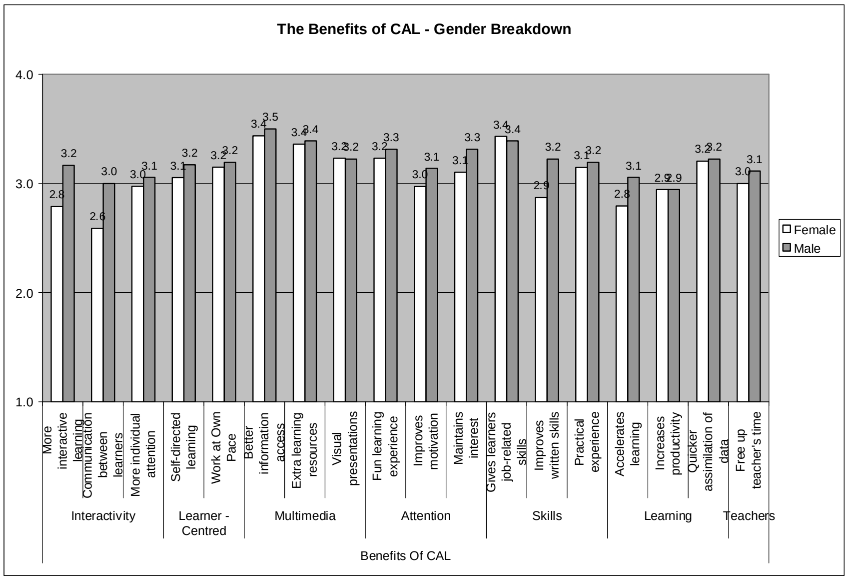
4.3.1.4.1.2 Gender Breakdown

Table 84: The Benefits of Computers in Education – Gender Breakdown

Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	More interactive learning	Female	11	58	32	0	68	32
		Male	22	75	0	3	97	3
	Communication between learners	Female	10	38	51	0	49	51
		Male	14	72	14	0	86	14
	More individual attention	Female	24	53	21	3	76	24
		Male	19	67	14	0	86	14
Learner - Centred	Self-directed learning	Female	26	55	16	3	82	18
		Male	23	71	6	0	94	6
	Work at Own Pace	Female	20	75	5	0	95	5
		Male	19	81	0	0	100	0
Multimedia	Better information access	Female	44	56	0	0	100	0
		Male	50	50	0	0	100	0
	Extra learning resources	Female	36	64	0	0	100	0
		Male	39	61	0	0	100	0
	Visual presentations	Female	23	77	0	0	100	0
		Male	22	78	0	0	100	0
Attention	‘Fun’ learning experience	Female	31	62	8	0	92	8
		Male	34	63	3	0	97	3
	Improves motivation	Female	19	62	16	3	81	19
		Male	22	72	3	3	94	6
	Maintains interest	Female	31	49	21	0	79	21
		Male	37	60	0	3	97	3
Skills	Gives learners job-related skills	Female	43	57	0	0	100	0
		Male	42	56	3	0	97	3
	Improves written skills	Female	28	44	15	13	72	28
		Male	31	64	3	3	94	6
	Practical experience	Female	26	65	6	3	91	9
		Male	28	64	8	0	92	8
Learning	Accelerates learning	Female	15	51	31	3	67	33
		Male	22	64	11	3	86	14
	Increases productivity	Female	25	53	14	8	78	22
		Male	19	61	14	6	81	19
	Quicker assimilation of data	Female	31	62	5	3	92	8
		Male	25	72	3	0	97	3
Teachers	Free up teacher's time	Female	23	58	18	3	80	20
		Male	17	80	0	3	97	3

The results suggest that male teachers agree more strongly than female teachers that CAL systems provide more interactive learning experiences that maintain learner interest, provide better communication between learners, improve written skills and accelerate learning. Female teachers are divided regarding whether the use of CAL would improve the communication between learners.

Figure 80



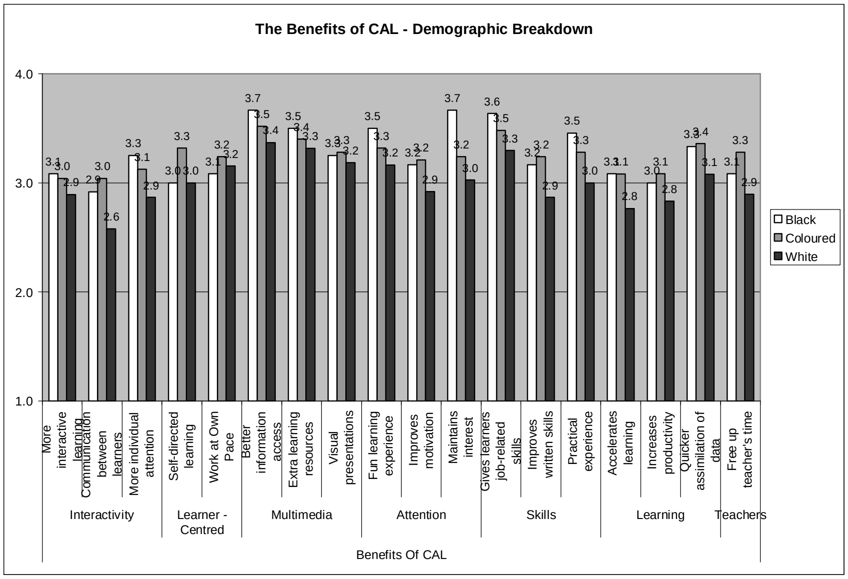
4.3.1.4.1.3 Demographic Breakdown

The results suggest that teachers who belong to the Black demographic group agree on average more strongly that CAL systems provide more individual attention to learners, present learners with a ‘fun’ learning experience, maintain learner interest and provide learners with practical experience and job related skills. Teachers from the Coloured demographic group agree at stronger levels that CAL systems would provide learners with more self directed learning opportunities and therefore free up some time for teachers. Of the White demographic group, 50% of teachers feel that the use of CAL systems would provide better communication between learners. In general, though all in agreement, the agreement levels of teachers in the White demographic group generally fall at lower levels than teachers from other demographic groups.

Table 85: The Benefits of Computers in Education – Demographic Breakdown

Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	More interactive learning	Black	8	92	0	0	100	0
		Coloured	28	52	16	4	80	20
		White	11	68	22	0	78	22
	Communication between learners	Black	8	75	17	0	83	17
		Coloured	20	64	16	0	84	16
		White	8	42	50	0	50	50
	More individual attention	Black	33	58	8	0	92	8
		Coloured	25	63	13	0	88	13
		White	16	58	24	3	74	26
Learner - Centred	Self-directed learning	Black	17	67	17	0	83	17
		Coloured	36	60	4	0	96	4
		White	19	64	14	3	83	17
	Work at Own Pace	Black	8	92	0	0	100	0
		Coloured	28	68	4	0	96	4
		White	18	79	3	0	97	3
Multimedia	Better information access	Black	67	33	0	0	100	0
		Coloured	52	48	0	0	100	0
		White	37	63	0	0	100	0
	Extra learning resources	Black	50	50	0	0	100	0
		Coloured	40	60	0	0	100	0
		White	32	68	0	0	100	0
	Visual presentations	Black	25	75	0	0	100	0
		Coloured	28	72	0	0	100	0
		White	18	82	0	0	100	0
Attention	'Fun' learning experience	Black	50	50	0	0	100	0
		Coloured	36	60	4	0	96	4
		White	24	68	8	0	92	8
	Improves motivation	Black	25	67	8	0	92	8
		Coloured	29	67	0	4	96	4
		White	14	68	16	3	81	19
	Maintains interest	Black	67	33	0	0	100	0
		Coloured	36	56	4	4	92	8
		White	22	59	19	0	81	19
Skills	Gives learners job-related skills	Black	64	36	0	0	100	0
		Coloured	48	52	0	0	100	0
		White	32	65	3	0	97	3
	Improves written skills	Black	33	58	0	8	92	8
		Coloured	36	56	4	4	92	8
		White	24	50	16	11	74	26
	Practical experience	Black	45	55	0	0	100	0
		Coloured	28	72	0	0	100	0
		White	21	62	15	3	82	18
Learning	Accelerates learning	Black	17	75	8	0	92	8
		Coloured	28	56	12	4	84	16
		White	13	53	32	3	66	34
	Increases productivity	Black	17	75	0	8	92	8
		Coloured	29	54	13	4	83	17
		White	19	53	19	8	72	28
	Quicker assimilation of data	Black	33	67	0	0	100	0
		Coloured	36	64	0	0	100	0
		White	21	68	8	3	89	11
Teachers	Free up teacher's time	Black	8	92	0	0	100	0
		Coloured	32	64	4	0	96	4
		White	16	63	16	5	79	21

Figure 81



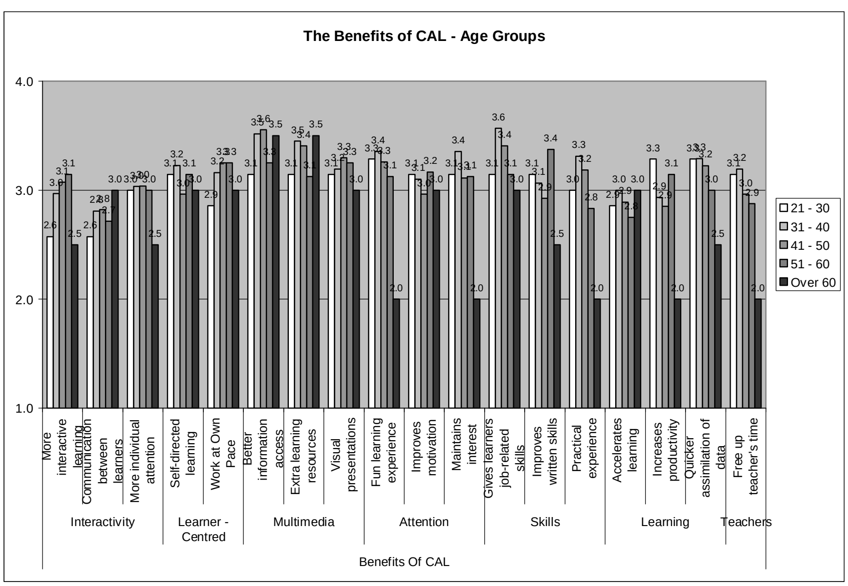
4.3.1.4.1.4 Age Groups

Table 86: The Benefits of Computers in Education – Age Group Breakdown (*Continued Overleaf*)

Groups	Items	Age Groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	More interactive learning	21 - 30	0	57	43	0	57	43
		31 - 40	16	68	13	3	84	16
		41 - 50	19	70	11	0	89	11
		51 - 60	29	57	14	0	86	14
		Over 60	0	50	50	0	50	50
	Communication between learners	21 - 30	0	57	43	0	57	43
		31 - 40	13	55	32	0	68	32
		41 - 50	14	54	32	0	68	32
		51 - 60	0	71	29	0	71	29
		Over 60	50	0	50	0	50	50
	More individual attention	21 - 30	29	43	29	0	71	29
		31 - 40	23	57	20	0	80	20
		41 - 50	26	56	15	4	81	19
		51 - 60	0	100	0	0	100	0
		Over 60	0	50	50	0	50	50
Learner - Centred	Self-directed learning	21 - 30	29	57	14	0	86	14
		31 - 40	29	65	6	0	94	6
		41 - 50	22	56	19	4	78	22
		51 - 60	14	86	0	0	100	0
		Over 60	0	100	0	0	100	0
	Work at Own Pace	21 - 30	0	86	14	0	86	14
		31 - 40	19	77	3	0	97	3
		41 - 50	25	75	0	0	100	0
		51 - 60	25	75	0	0	100	0
		Over 60	0	100	0	0	100	0
Multimedia	Better information access	21 - 30	14	86	0	0	100	0
		31 - 40	52	48	0	0	100	0
		41 - 50	56	44	0	0	100	0
		51 - 60	25	75	0	0	100	0
		Over 60	50	50	0	0	100	0
	Extra learning resources	21 - 30	14	86	0	0	100	0
		31 - 40	45	55	0	0	100	0
		41 - 50	41	59	0	0	100	0
		51 - 60	13	88	0	0	100	0
		Over 60	50	50	0	0	100	0
	Visual presentations	21 - 30	14	86	0	0	100	0
		31 - 40	19	81	0	0	100	0
		41 - 50	30	70	0	0	100	0
		51 - 60	25	75	0	0	100	0
		Over 60	0	100	0	0	100	0
Attention	'Fun' learning experience	21 - 30	29	71	0	0	100	0
		31 - 40	39	58	3	0	97	3

		41 - 50	33	59	7	0	93	7
		51 - 60	13	88	0	0	100	0
		Over 60	0	0	100	0	0	100
	Improves motivation	21 - 30	14	86	0	0	100	0
		31 - 40	23	67	7	3	90	10
		41 - 50	18	64	14	4	82	18
		51 - 60	17	83	0	0	100	0
		Over 60	50	0	50	0	50	50
	Maintains interest	21 - 30	14	86	0	0	100	0
		31 - 40	45	48	3	3	94	6
		41 - 50	30	52	19	0	81	19
		51 - 60	25	63	13	0	88	13
		Over 60	0	0	100	0	0	100
Skills	Gives learners job-related skills	21 - 30	14	86	0	0	100	0
		31 - 40	57	43	0	0	100	0
		41 - 50	44	52	4	0	96	4
		51 - 60	14	86	0	0	100	0
		Over 60	0	100	0	0	100	0
	Improves written skills	21 - 30	29	57	14	0	86	14
		31 - 40	32	52	6	10	84	16
		41 - 50	26	52	11	11	78	22
		51 - 60	38	63	0	0	100	0
		Over 60	0	50	50	0	50	50
	Practical experience	21 - 30	14	71	14	0	86	14
		31 - 40	31	69	0	0	100	0
		41 - 50	33	56	7	4	89	11
		51 - 60	0	83	17	0	83	17
		Over 60	0	0	100	0	0	100
Learning	Accelerates learning	21 - 30	14	57	29	0	71	29
		31 - 40	23	58	16	3	81	19
		41 - 50	19	56	22	4	74	26
		51 - 60	0	75	25	0	75	25
		Over 60	50	0	50	0	50	50
	Increases productivity	21 - 30	29	71	0	0	100	0
		31 - 40	23	53	17	7	77	23
		41 - 50	19	59	11	11	78	22
		51 - 60	29	57	14	0	86	14
		Over 60	0	0	100	0	0	100
	Quicker assimilation of data	21 - 30	29	71	0	0	100	0
		31 - 40	32	65	3	0	97	3
		41 - 50	33	59	4	4	93	7
		51 - 60	0	100	0	0	100	0
		Over 60	0	50	50	0	50	50
Teachers	Free up teacher's time	21 - 30	29	57	14	0	86	14
		31 - 40	23	74	3	0	97	3
		41 - 50	18	64	14	4	82	18
		51 - 60	13	75	0	13	88	13
		Over 60	0	0	100	0	0	100

Figure 82



In general, teachers in all age groups from ages 21 to 60 on average show general to strong levels of agreement to all stated benefits to the use of CAL. However, teachers in the over 60 age group on average feel that: CAL systems would not present learners with a ‘fun’ learning experience; maintain learner interest; provide practical experience; increase productivity or free up teachers’ time.

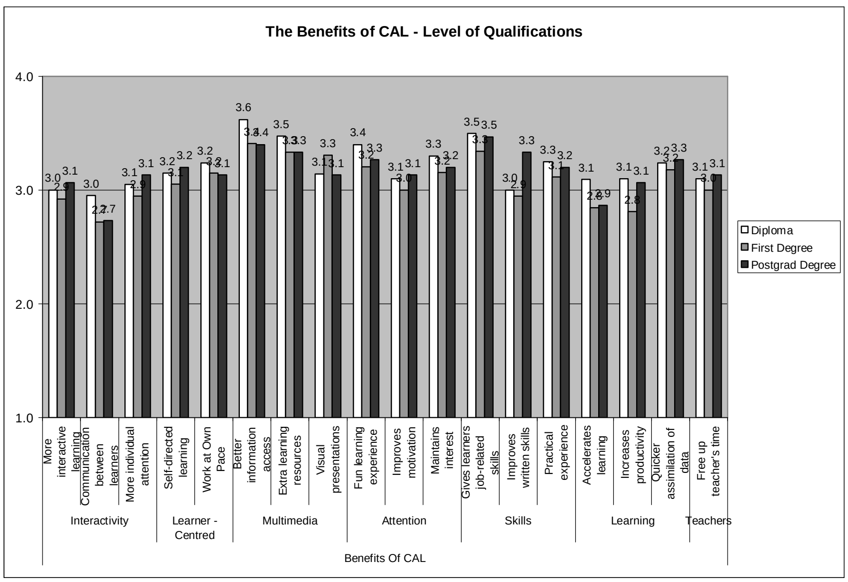
4.3.1.4.1.5 Level of Qualifications

Table 87: The Benefits of Computers in Education – Level of Qualification Breakdown

			Levels of Agreement				Totals	
Groups	**Items**	**Level of Qualifications**	Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Interactivity	More interactive learning	Diploma	24	52	24	0	76	24
		First Degree	16	63	18	3	79	21
		Postgraduate Degree	7	93	0	0	100	0
	Communication between learners	Diploma	14	67	19	0	81	19
		First Degree	13	46	41	0	59	41
		Postgraduate Degree	7	60	33	0	67	33
	More individual attention	Diploma	20	65	15	0	85	15
		First Degree	21	56	21	3	77	23
		Postgraduate Degree	27	60	13	0	87	13
Learner - Centred	Self-directed learning	Diploma	30	55	15	0	85	15
		First Degree	21	66	11	3	87	13
		Postgraduate Degree	27	67	7	0	93	7
	Work at Own Pace	Diploma	29	67	5	0	95	5
		First Degree	18	80	3	0	98	3
		Postgraduate Degree	13	87	0	0	100	0
Multimedia	Better information access	Diploma	62	38	0	0	100	0
		First Degree	41	59	0	0	100	0
		Postgraduate Degree	40	60	0	0	100	0
	Extra learning resources	Diploma	48	52	0	0	100	0
		First Degree	33	67	0	0	100	0
		Postgraduate Degree	33	67	0	0	100	0
	Visual presentations	Diploma	14	86	0	0	100	0
		First Degree	31	69	0	0	100	0
		Postgraduate Degree	13	87	0	0	100	0
Attention	‘Fun’ learning experience	Diploma	45	50	5	0	95	5
		First Degree	28	64	8	0	92	8
		Postgraduate Degree	27	73	0	0	100	0
	Improves motivation	Diploma	25	60	15	0	85	15
		First Degree	18	68	8	5	87	13
		Postgraduate Degree	20	73	7	0	93	7
	Maintains interest	Diploma	45	40	15	0	85	15
		First Degree	31	56	10	3	87	13
		Postgraduate Degree	27	67	7	0	93	7
Skills	Gives learners job-related skills	Diploma	50	50	0	0	100	0
		First Degree	37	61	3	0	97	3
		Postgraduate Degree	47	53	0	0	100	0
	Improves written skills	Diploma	33	43	14	10	76	24
		First Degree	23	59	8	10	82	18
		Postgraduate Degree	40	53	7	0	93	7
	Practical experience	Diploma	35	55	10	0	90	10
		First Degree	23	69	6	3	91	9
		Postgraduate Degree	27	67	7	0	93	7
Learning	Accelerates learning	Diploma	29	52	19	0	81	19
		First Degree	18	54	23	5	72	28
		Postgraduate Degree	7	73	20	0	80	20
	Increases productivity	Diploma	30	50	20	0	80	20
		First Degree	16	62	8	14	78	22
		Postgraduate Degree	27	53	20	0	80	20
	Quicker assimilation of data	Diploma	33	57	10	0	90	10
		First Degree	26	69	3	3	95	5
		Postgraduate Degree	27	73	0	0	100	0
Teachers	Free up teacher's time	Diploma	25	60	15	0	85	15
		First Degree	20	65	10	5	85	15
		Postgraduate Degree	13	87	0	0	100	0

Though all levels of agreement are at higher levels, in most cases, teachers with postgraduate qualifications agree to the stated benefits of CAL with greater consensus than teachers from other qualifications groups. Teachers with postgraduate qualifications agree more strongly that the use of CAL systems would provide teaching environments that are more interactive, would improve learners' written skills and free up teachers' time. Teachers in the diploma qualification group feel at a greater level that CAL systems would improve communication between learners.

Figure 83



4.3.1.4.1.6 Level of Computer Use

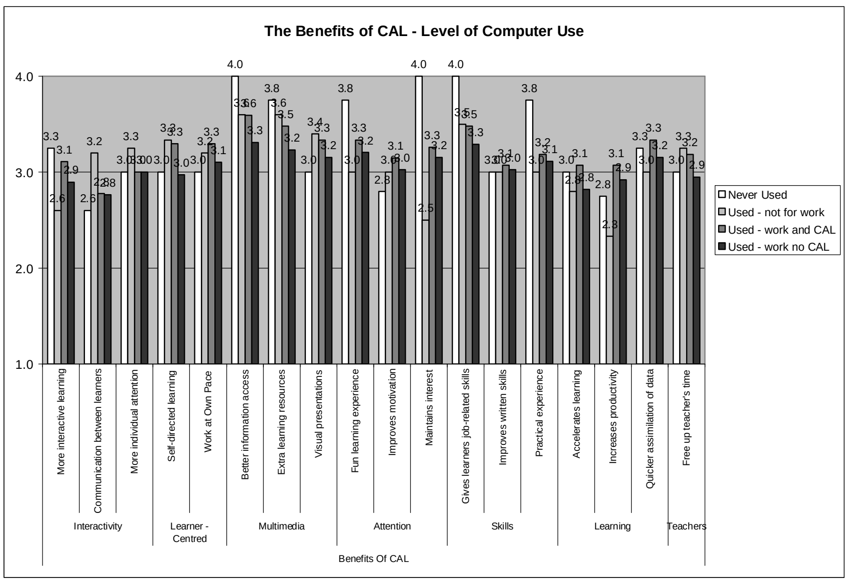
Teachers who have never used computers agree with more consensus than teachers who have used computers at various levels that the use of computers would enhance lessons by being more interactive, that the use of computers would provide 'fun' learning experiences that also maintain learner interest, that the use of CAL systems provide learners with practical experience and allow for quicker assimilation of information.

Table 88: The Benefits of Computers in Education – Level of Computer Use Breakdown

			Levels of Agreement				**Totals**	
Groups	**Items**	**Level of Computer Use**	Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Interactivity	More interactive learning	Never Used	25	75	0	0	**100**	0
		Used - not for work	20	40	20	20	60	40
		Used - for work no CAL	8	74	18	0	82	18
		Used - work and CAL	26	59	15	0	85	15
	Communication between learners	Never Used	0	60	40	0	60	40
		Used - not for work	40	40	20	0	**80**	20
		Used - for work no CAL	8	61	32	0	68	32
		Used - work and CAL	15	48	37	0	63	37
	More individual attention	Never Used	0	100	0	0	**100**	0
		Used - not for work	25	75	0	0	**100**	0
		Used - for work no CAL	21	59	21	0	79	21
		Used - work and CAL	26	52	19	4	78	22
Learner - Centred	Self-directed learning	Never Used	25	50	25	0	75	25
		Used - not for work	33	67	0	0	**100**	0
		Used - for work no CAL	13	72	15	0	85	15
		Used - work and CAL	41	52	4	4	93	7
	Work at Own Pace	Never Used	0	100	0	0	100	0
		Used - not for work	20	80	0	0	100	0
		Used - for work no CAL	15	79	5	0	95	5
		Used - work and CAL	30	70	0	0	100	0
Multimedia	Better information access	Never Used	100	0	0	0	100	0
		Used - not for work	60	40	0	0	100	0
		Used - for work no CAL	31	69	0	0	100	0
		Used - work and CAL	59	41	0	0	100	0
	Extra learning resources	Never Used	75	25	0	0	100	0
		Used - not for work	60	40	0	0	100	0
		Used - for work no CAL	23	77	0	0	100	0
		Used - work and CAL	48	52	0	0	100	0
	Visual presentations	Never Used	0	100	0	0	100	0
		Used - not for work	40	60	0	0	100	0
		Used - for work no CAL	15	85	0	0	100	0
		Used - work and CAL	33	67	0	0	100	0
Attention	'Fun' learning experience	Never Used	75	25	0	0	**100**	0
		Used - not for work	25	50	25	0	75	25
		Used - for work no CAL	26	69	5	0	95	5
		Used - work and CAL	37	59	4	0	96	4
	Improves motivation	Never Used	0	80	20	0	80	20
		Used - not for work	67	0	0	33	67	33
		Used - for work no CAL	13	76	11	0	89	11
		Used - work and CAL	30	59	7	4	89	11
	Maintains interest	Never Used	100	0	0	0	**100**	0
		Used - not for work	25	25	25	25	50	50
		Used - for work no CAL	26	64	10	0	90	10
		Used - work and CAL	37	52	11	0	89	11
Skills	Gives learners job-related skills	Never Used	100	0	0	0	100	0
		Used - not for work	50	50	0	0	100	0
		Used - for work no CAL	29	71	0	0	100	0
		Used - work and CAL	52	44	4	0	96	4
	Improves written skills	Never Used	50	25	0	25	75	25
		Used - not for work	60	0	20	20	60	40
		Used - for work no CAL	18	69	10	3	**87**	13
		Used - work and CAL	37	44	7	11	**81**	19
	Practical experience	Never Used	75	25	0	0	**100**	0
		Used - not for work	25	50	25	0	75	25
		Used - for work no CAL	17	77	6	0	94	6
		Used - work and CAL	33	56	7	4	89	11
Learning	Accelerates learning	Never Used	25	50	25	0	75	25
		Used - not for work	40	20	20	20	60	40
		Used - for work no CAL	10	62	28	0	72	28
		Used - work and CAL	26	59	11	4	**85**	15
	Increases productivity	Never Used	25	50	0	25	75	25
		Used - not for work	33	0	33	33	**33**	67
		Used - for work no CAL	13	68	16	3	82	18
		Used - work and CAL	33	48	11	7	81	19
	Quicker assimilation of data	Never Used	25	75	0	0	**100**	0
		Used - not for work	20	60	20	0	80	20
		Used - for work no CAL	21	74	5	0	95	5
		Used - work and CAL	41	56	0	4	96	4
Teachers	Free up teacher's time	Never Used	0	100	0	0	**100**	0
		Used - not for work	25	75	0	0	**100**	0
		Used - for work no CAL	13	72	13	3	85	15
		Used - work and CAL	33	56	7	4	89	11

Both groups of teachers who have not used computers and teachers who have used computers exclusive of work activities agree to a greater degree that CAL systems would allow more individual attention to learners, while freeing up teachers' time. Teachers who have used computers for both general work activities and CAL mostly agree that CAL systems accelerate learners' learning rates. However, teachers who have used computers exclusive of work activities in general do not agree that the use of CAL systems would increase productivity.

Figure 84

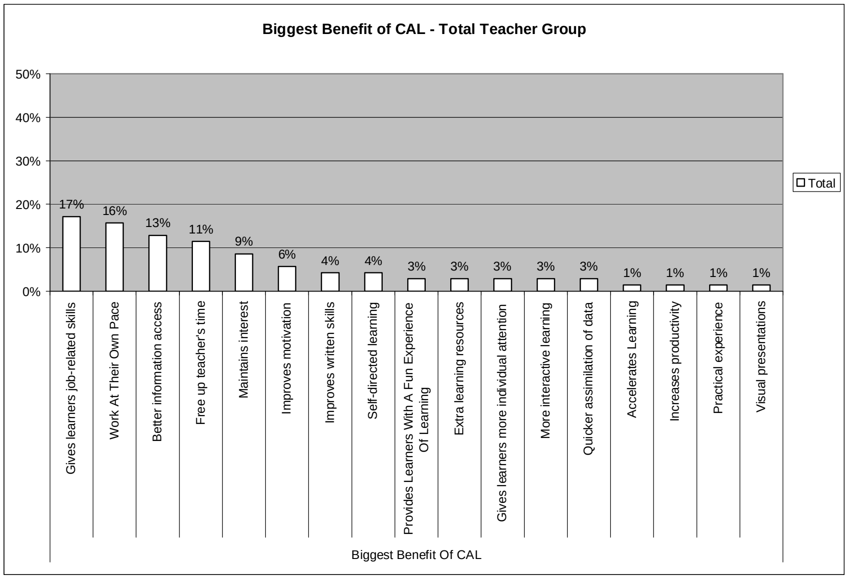


4.3.1.4.2 The Biggest Benefit of Computers in Education

This item explores which single benefit statement teacher agrees with most. The results are indicated in a proportional percentage breakdown of the total answers provided and presented in a graph format.

4.3.1.4.2.1 Total Teacher Group

Figure 85



In general, teachers value most of the stated benefits of CAL use, and no single benefit receives an overriding majority of agreement. As a group, teachers feel that the following are the biggest benefits of the use of CAL systems in schools, placed in descending order of consensus:

- At 17% agreement, teachers feel that the use of CAL systems would provide learners with job-related skills, as supported in the literature (Baillie *et al.*, 2000; Heide *et al.*, 2001)

- 16% of teachers agree that the use of CAL allows learners to work at their own individual pace, a function of learner centred learning principles (Christensen *et al.*, 1998; Eom *et al.*, 2000; Wiley *et al.*, 2001)

- 13% of teachers feel that having access to greater information resources is the biggest benefit of CAL systems, as reflected in the literature (Baillie *et al.*, 2000; Lelouche, 1998; Valdez *et al.,* 2004; Wiley, 2001)

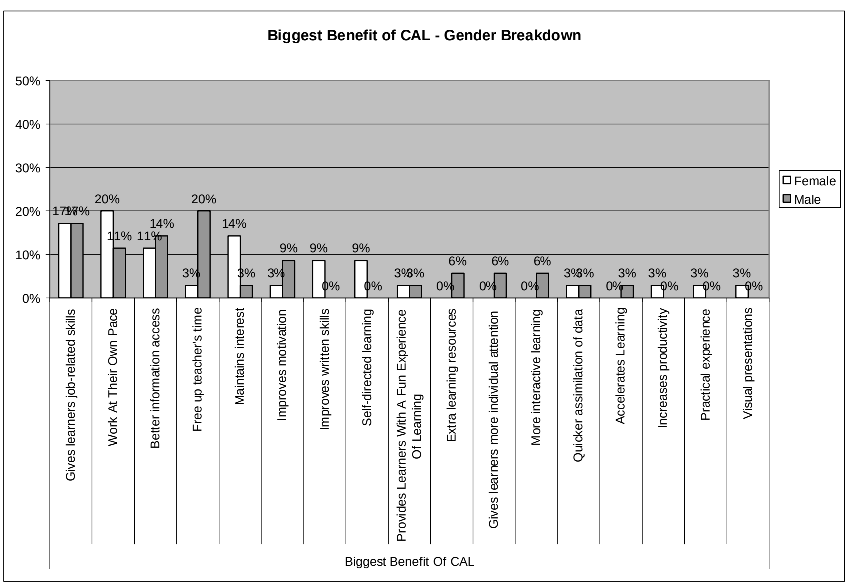
- 11% of teachers agree that being able to free up teachers' time is the greatest benefit of CAL systems, a function of greater automation of repetitive and labour intensive tasks (Baillie *et al.*, 2000; Hitchcock, 2000; Johnson, 2003; Valdez *et al.,* 2004)

- 9% of teachers feel that the capability of CAL systems to maintain learner interest is the greatest benefit of CAL systems, as supported by the literature (Christensen *et al.*, 1998).

4.3.1.4.2.2 Gender Breakdown

Female teachers agree more strongly that the opportunity for learners to learn at their own pace is the greatest benefit of CAL systems at 20%, that the use of CAL systems provide learners with job-related skills at 17% and that CAL systems help maintain learner interest at 14%. Male teachers as a group agree more strongly that CAL systems can free up teachers' time at 20%, that the use of CAL systems provide learners with job-related skills at 17% and that CAL systems provide greater access to information resources at 14%.

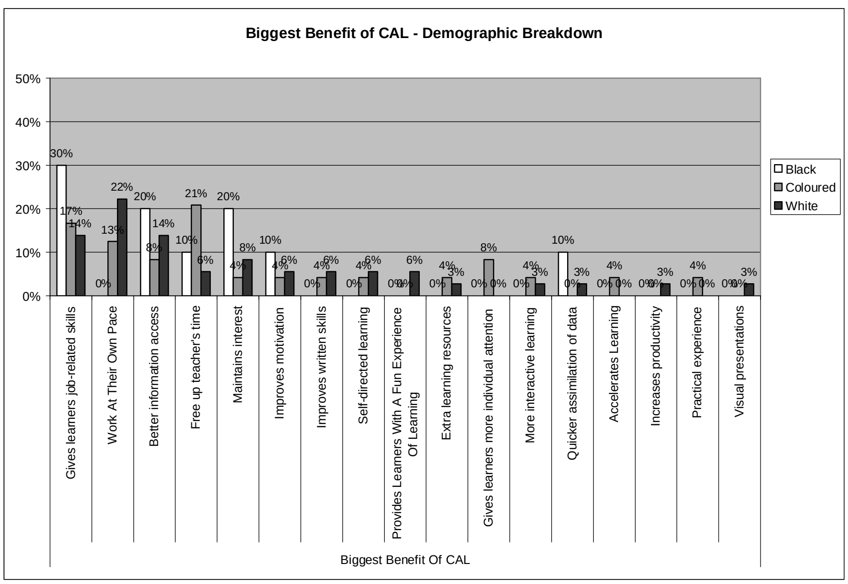
Figure 86



4.3.1.4.2.3 Demographic Breakdown

Teachers from the Black demographic group feel most strongly that CAL systems provide learners with job related skills, help maintain learners' interest and create better access to information resources, at 30%, 20% and 20% agreement respectively. Teachers from the Coloured demographic group agree at greater levels that the ability of CAL systems to free up teachers time is the biggest benefit of CAL systems at 21%, while teachers from the White demographic group feel the capability of CAL systems to allow learners to learn at their own pace at 22% agreement is the biggest contribution of CAL systems.

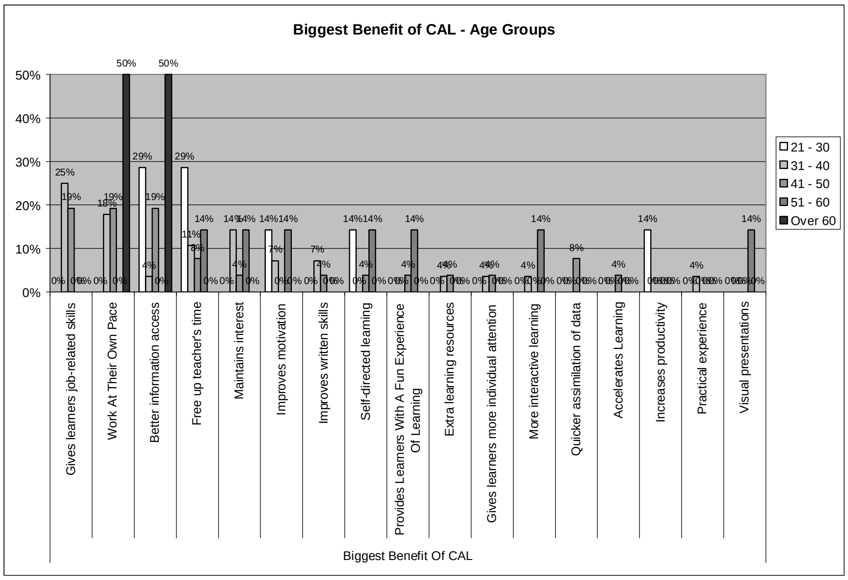
Figure 87



4.3.1.4.2.4 Age Groups

Teachers in the 21 to 30 age group feel that having better access to information resources and being able to free up teachers' time, both at 29%, are the greatest benefits of CAL systems. Teachers in the 31 to 40 age group feel that the biggest benefit to the use of CAL systems is that learners develop job related skills while using the systems. Teachers in the 41 to 50 age group feel equally strong at 19% that the benefits of have better access to better information resources, allowing workers to work at their own pace and helping learners develop job related skills are the most important. Teachers in the 51 to 60 age groups are mixed with regards to the biggest benefit of CAL use, while teachers in the over 60 age group feel very strongly at 50% that having better access to information and allowing learners to work at their own pace are the biggest benefits of CAL systems.

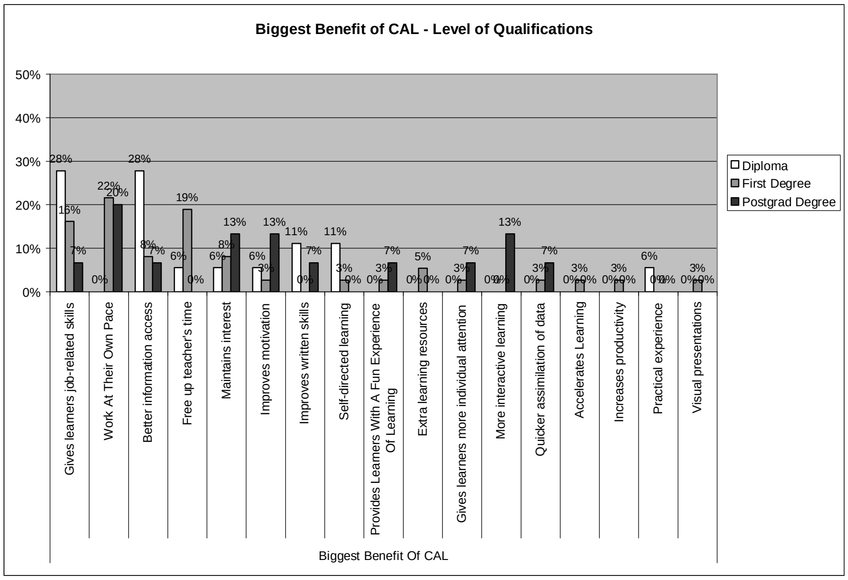
Figure 88



4.3.1.4.2.5 Level of Qualifications

Teachers in the diploma qualification group feel most strongly at 28% that the capability of CAL systems to develop job related skills among learners and to provide better access to information resources are the biggest benefits of CAL systems. Teachers in the graduate degree group feel more strongly that allowing learners to work at their own pace at 22% consensus, freeing up teachers' time at 19% agreement and developing learners' job related skills at 16% agreement are the more relevant benefits of CAL use. Teachers in the postgraduate degree group feel more strongly at 20% that learners being able to work at their own pace is the biggest benefit to the use of CAL systems.

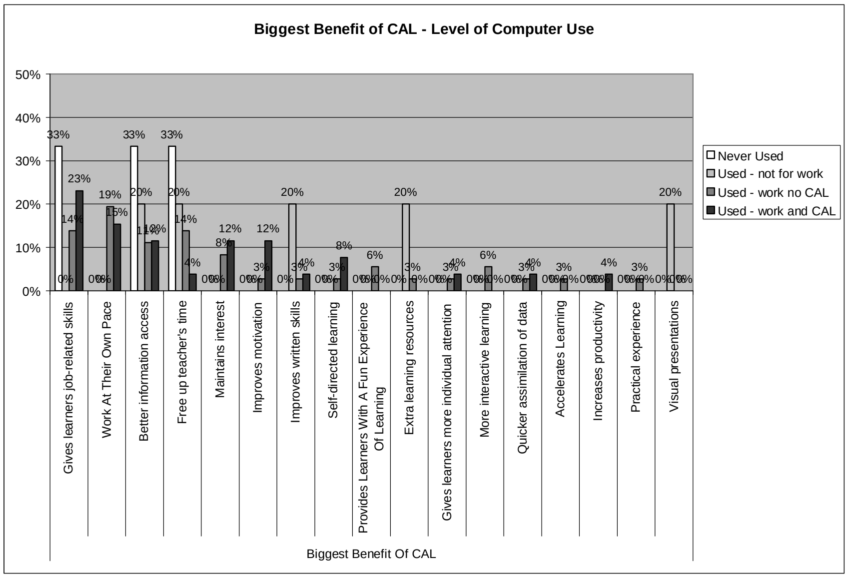
Figure 89



4.3.1.4.2.6 Level of Computer Use

Teachers who have never used computers feel equally at 33% that the biggest benefits to the use of CAL systems are that learners are able to acquire job related skills, CAL systems are able to free up teachers' time and that CAL systems provide better access to information. Teachers who have used computers but not for work purposes are generally more undecided regarding the biggest benefit of CAL use. Teachers who have used computers for work activities exclusive of CAL feel that learners being able to work at their own pace, learners acquiring job related skills and the capability of CAL systems to free up teachers' time are the greater benefits to the use of CAL systems. Teachers who have used computers for general work activities and CAL feel more strongly at 23% that learners acquiring job related skills and at 15% that learners being able to work at their own pace are the biggest benefits to the use of CAL methods.

Figure 90



4.3.1.5 Perceived Disadvantages of Computers in Education

4.3.1.5.1 General Disadvantages of Computers in Education

In this item, teachers were presented with a list of disadvantages to the use of CAL systems, and asked to rate how strongly they agree with each individual statement.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly disagree, disagree, agree and strongly agree. A totals column has been added to provide a summary of overall agreement and disagreement.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly disagree to 4 for strongly agree. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates strong disagreement
- 1.76 to 2.5 indicates general disagreement
- 2.51 to 3.25 indicates general agreement

- 3.26 to 4 indicates strong agreement.

4.3.1.5.1.1 Total Teacher Group

Table 89: The Disadvantages of Computers in Education – Total Teacher Group

Groups	Items	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	Computers not always available	11	76	12	1	86	14
	Limited interaction between learner and teacher	4	33	58	5	37	63
Attention	Computer dictates lesson, not content	0	49	48	3	49	51
	Creates distractions	1	37	55	7	38	62
Teachers	Teachers obsolete	1	22	66	11	23	77
Social	Favours boys	4	14	66	16	18	82
	Pressure to be advanced	8	54	32	6	63	38
Resources	Expensive to implement and maintain	25	64	8	3	89	11
	Time consuming	4	34	56	5	38	62
Technology	Computer technology changes cause disruptions	5	30	58	7	35	65
	Unpredictable disruptions	12	55	27	5	68	32
Learning Style	Not suited to all learning styles	8	62	24	5	70	30
	Only suits computer-literate learners	19	67	13	1	85	15
	Won't suit learners who need structure	7	55	36	3	62	38
Pedagogics	Compromises curriculum	4	36	56	4	40	60
	Computer has limited activities	4	48	44	4	52	48
	Focus on tool, not content	7	29	58	7	36	64
	Not pedagogically sound	6	34	53	7	40	60

As a group, teachers agree more strongly that:

- computer resources are costly to implement and to maintain at 89% agreement, as the literature illustrates with the consequence of rising tuition fees, faulty equipment and insufficient technical support (Baillie *et al.*, 2000; Brabazon, 2000; Heide *et al.*, 2001; Richard, 2003) and concerns are expressed regarding whether the educational return on the investment is valid (Draper *et al.*, 2002; Mayer, 2000)

- computer resources are not always available for teachers and learners to use at 86% agreement, as usually a result of budget constraints (Johnson, 2003; Loschert, 2003)

- CAL systems only suit computer literate learners at 85% agreement, and the literature supports that learners with greater levels of computer abilities tend to perform better on CAL systems (Desai, 2000)

- CAL systems are not suited to all learning styles at 70% agreement, particularly to those learners who need higher degrees of structure and guidance (Boles e*t al.*, 1999; Brabazon, 2000) or have lower levels of meta-cognitive information processing abilities (Bussey *et al.*, 1997; Forsyth, 2001).

At lower levels of agreement, teachers feel that CAL systems would:

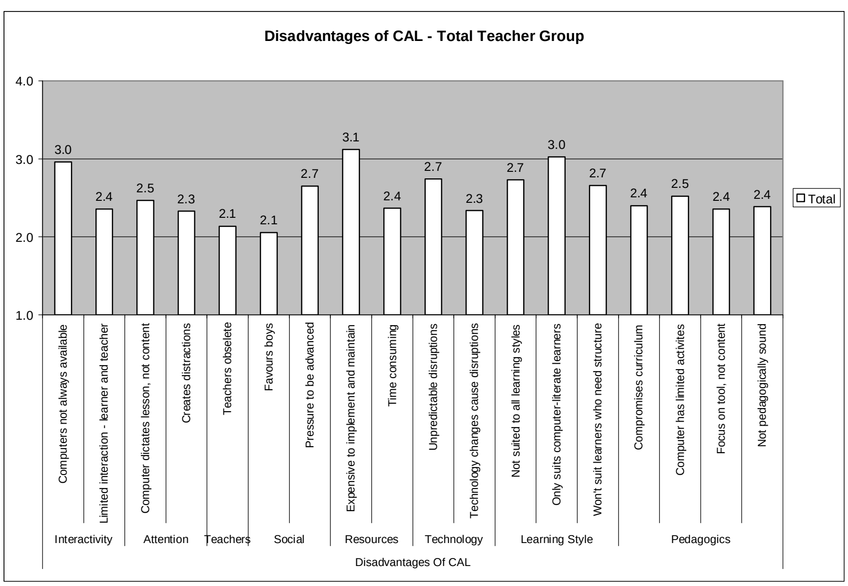
- create unpredictable disruptions in classroom activities at 68% agreement, as indicated in the literature to be a product of information navigation challenges, software malfunctions, higher levels of distractions or technical difficulties (Brown, 1997; Christensen *et al.*, 1998; Cousins *et al.*, 1993; Loschert, 2003)

- place pressure on schools to be technologically advanced at 63% agreement, as echoed in the literature (Hitchcock, 2000; Hobson *et al.*, 1998)

- not suit learners who need structure to learn effectively at 62% agreement, as supported in the literature (Boles *et al.*, 1999; Brabazon, 2000).

As a weighted average, no items demonstrate strong agreement or strong disagreement.

Figure 91

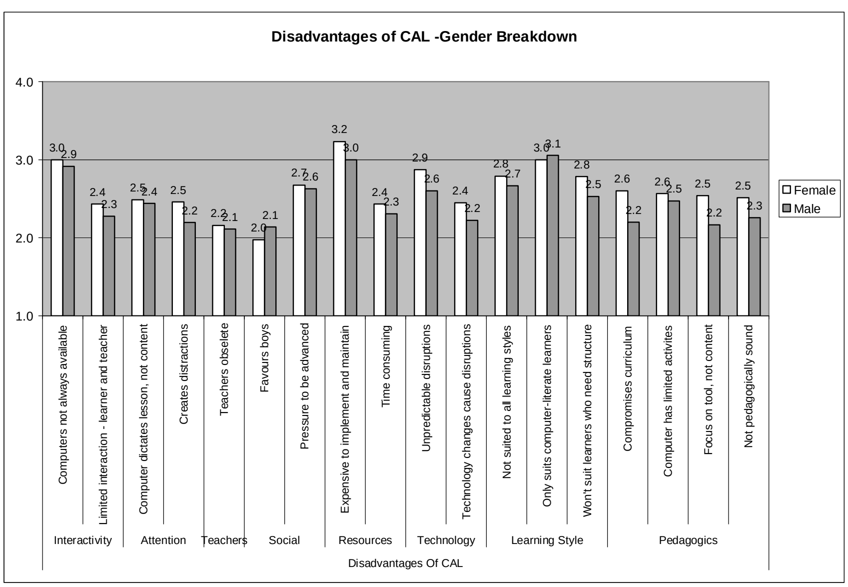


4.3.1.5.1.2 Gender Breakdown

Table 90: The Disadvantages of Computers in Education – Gender Breakdown

Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	Computers not always available	Female	15	69	15	0	85	15
		Male	6	83	9	3	89	11
	Limited interaction - learner and teacher	Female	5	41	46	8	46	54
		Male	3	25	69	3	28	72
Attention	Computer dictates lesson, not content	Female	0	49	51	0	49	51
		Male	0	50	44	6	50	50
	Creates distractions	Female	3	49	41	8	51	49
		Male	0	25	69	6	25	75
Teachers	Teachers obsolete	Female	3	16	76	5	18	82
		Male	0	28	56	17	28	72
Social	Favours boys	Female	3	13	63	21	16	84
		Male	6	14	69	11	19	81
	Pressure to be advanced	Female	8	54	35	3	62	38
		Male	9	54	29	9	63	37
Resources	Expensive to implement and maintain	Female	28	67	5	0	95	5
		Male	22	61	11	6	83	17
	Time consuming	Female	3	41	54	3	43	57
		Male	6	28	58	8	33	67
Technology	Unpredictable disruptions	Female	15	59	23	3	74	26
		Male	9	51	31	9	60	40
	Technology changes cause disruptions	Female	8	32	58	3	39	61
		Male	3	28	58	11	31	69
Learning Style	Not suited to all learning styles	Female	8	66	24	3	74	26
		Male	8	58	25	8	67	33
	Only suits computer-literate learners	Female	21	59	21	0	79	21
		Male	17	75	6	3	92	8
	Won't suit learners who need structure	Female	11	57	32	0	68	32
		Male	3	53	39	6	56	44
Pedagogics	Compromises curriculum	Female	9	43	49	0	**51**	49
		Male	0	29	63	9	**29**	71
	Computer has limited activities	Female	3	51	46	0	54	46
		Male	6	44	42	8	50	50
	Focus on tool, not content	Female	11	35	51	3	46	54
		Male	3	22	64	11	25	75
	Not pedagogically sound	Female	9	37	51	3	46	54
		Male	3	31	54	11	34	66

Figure 92



In general, the views of both female and male teacher groups appear similar. However, on average female teachers demonstrate levels of agreement that CAL systems would not suit learners who need structure, that CAL systems compromise the curriculum and that computers have limited activities, while male teachers indicate general disagreement.

4.3.1.5.1.3 Demographic Breakdown

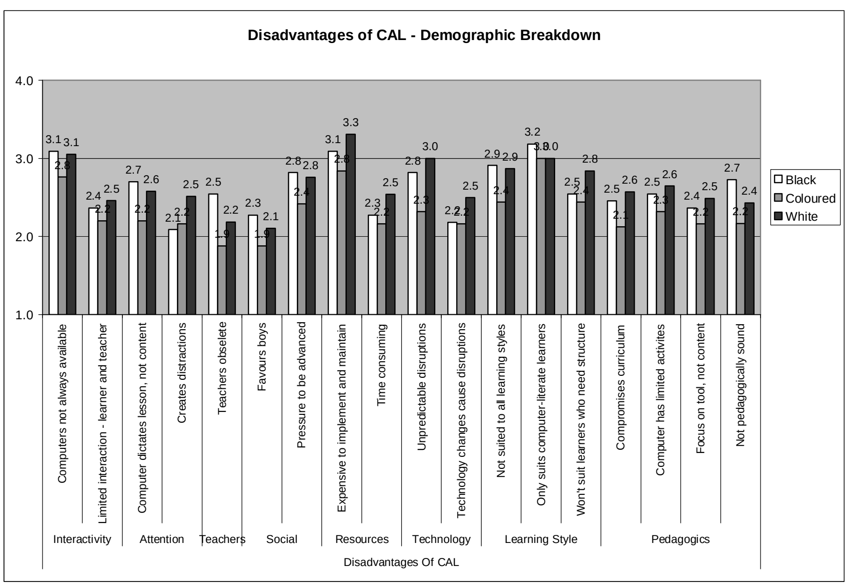
Table 91: The Disadvantages of Computers in Education – Demographic Breakdown

Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	Computers not always available	Black	9	91	0	0	100	0
		Coloured	4	72	20	4	76	24
		White	16	74	11	0	89	11
	Limited interaction - learner and teacher	Black	0	36	64	0	36	64
		Coloured	4	20	68	8	24	76
		White	5	41	49	5	46	54
Attention	Computer dictates lesson, not content	Black	0	70	30	0	**70**	30
		Coloured	0	28	64	8	**28**	72
		White	0	58	42	0	58	42
	Creates distractions	Black	0	18	73	9	18	82
		Coloured	0	28	60	12	28	72
		White	3	49	46	3	**51**	49
Teachers	Teachers obsolete	Black	0	55	45	0	**55**	45
		Coloured	0	12	64	24	12	88
		White	3	18	74	5	21	79
Social	Favours boys	Black	9	9	82	0	18	82
		Coloured	4	4	68	24	8	92
		White	3	21	61	16	24	76
	Pressure to be advanced	Black	0	82	18	0	**82**	18
		Coloured	8	38	42	13	46	54
		White	11	57	30	3	68	32
Resources	Expensive to implement and maintain	Black	18	73	9	0	91	9
		Coloured	16	60	16	8	76	24
		White	33	64	3	0	97	3
	Time consuming	Black	0	27	73	0	27	73
		Coloured	4	24	56	16	28	72
		White	5	43	51	0	49	51
Technology	Unpredictable disruptions	Black	9	64	27	0	73	27
		Coloured	4	36	48	12	**40**	60
		White	18	66	13	3	84	16
	Technology changes cause disruptions	Black	0	27	64	9	27	73
		Coloured	4	20	64	12	24	76
		White	8	37	53	3	45	55
Learning Style	Not suited to all learning styles	Black	0	91	9	0	91	9
		Coloured	8	40	40	12	**48**	52
		White	11	68	18	3	79	21
	Only suits computer-literate learners	Black	18	82	0	0	100	0
		Coloured	16	68	16	0	84	16
		White	21	62	15	3	82	18
	Won't suit learners who need structure	Black	0	55	45	0	55	45
		Coloured	4	44	44	8	**48**	52
		White	11	62	27	0	**73**	27
Pedagogics	Compromises curriculum	Black	0	45	55	0	45	55
		Coloured	0	25	63	13	25	75
		White	9	40	51	0	49	51
	Computer has limited activities	Black	0	55	45	0	55	45
		Coloured	8	28	52	12	**36**	64
		White	3	59	38	0	62	38
	Focus on tool, not content	Black	0	36	64	0	36	64
		Coloured	8	16	60	16	24	76
		White	8	35	54	3	43	57
	Not pedagogically sound	Black	0	73	27	0	**73**	27
		Coloured	8	17	58	17	**25**	75
		White	6	34	57	3	40	60

Teachers who belong to the Black demographic group demonstrate greater consensus than teachers from other demographic groups that: computers are not always available to use in schools; computers rather than lesson content dictate lessons; computers will make teachers obsolete; there is pressure to be technologically advanced; the use of computers are more suited to computer literate learners and that the use of computers in education is not pedagogically sound.

Teachers from the Coloured demographic group demonstrate lower levels of agreement across the board. Teachers from the White demographic group show greater consensus that: the use of CAL systems create distractions and cause disruptions in lesson time; the implementation and maintenance of CAL systems is too costly; the use of CAL is time consuming and focuses on the tool rather than the content; the use of CAL systems won't suit learners who need structure and that computers provide limited educational activities.

Figure 93



4.3.1.5.1.4 Age Groups

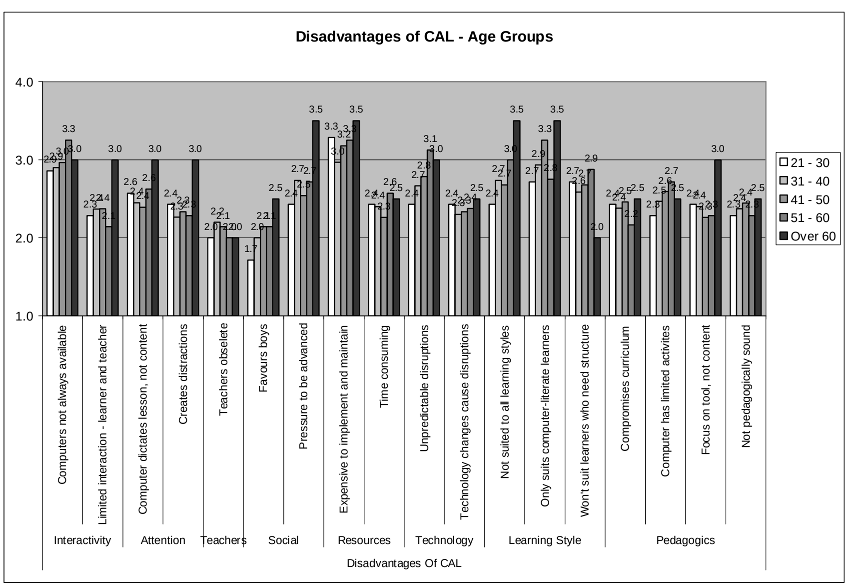
Table 92: The Disadvantages of Computers in Education – Age Group Breakdown (*Continued Overleaf)*

Groups	Items	Age groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	Computers not always available	21 - 30	0	86	14	0	86	14
		31 - 40	7	80	10	3	87	13
		41 - 50	14	68	18	0	82	18
		51 - 60	25	75	0	0	100	0
		Over 60	0	100	0	0	100	0
	Limited interaction - learner and teacher	21 - 30	0	43	43	14	43	57
		31 - 40	3	33	60	3	37	63
		41 - 50	7	30	56	7	37	63
		51 - 60	0	14	86	0	14	86
		Over 60	0	100	0	0	100	0
Attention	Computer dictates lesson, not content	21 - 30	0	57	43	0	57	43
		31 - 40	0	48	48	3	48	52
		41 - 50	0	43	54	4	43	57
		51 - 60	0	63	38	0	63	38
		Over 60	0	100	0	0	100	0
	Creates distractions	21 - 30	0	43	57	0	43	57
		31 - 40	0	37	53	10	37	63
		41 - 50	4	30	63	4	33	67
		51 - 60	0	43	43	14	43	57
		Over 60	0	100	0	0	100	0
Teachers	Teachers obsolete	21 - 30	0	14	71	14	14	86
		31 - 40	0	33	53	13	33	67
		41 - 50	4	18	68	11	21	79
		51 - 60	0	0	100	0	0	100
		Over 60	0	0	100	0	0	100
Social	Favours boys	21 - 30	0	14	43	43	14	86
		31 - 40	3	7	77	13	10	90
		41 - 50	7	14	64	14	21	79
		51 - 60	0	29	57	14	29	71
		Over 60	0	50	50	0	50	50
	Pressure to be advanced	21 - 30	14	29	43	14	43	57
		31 - 40	13	50	33	3	63	37
		41 - 50	0	62	31	8	62	38
		51 - 60	0	71	29	0	71	29
		Over 60	50	50	0	0	100	0
Resources	Expensive to implement and maintain	21 - 30	29	71	0	0	100	0
		31 - 40	17	67	13	3	83	17
		41 - 50	32	57	7	4	89	11
		51 - 60	25	75	0	0	100	0
		Over 60	50	50	0	0	100	0
	Time consuming	21 - 30	0	43	57	0	43	57
		31 - 40	3	37	57	3	40	60
		41 - 50	4	30	56	11	33	67
		51 - 60	14	29	57	0	43	57
		Over 60	0	50	50	0	50	50
Technology	Unpredictable disruptions	21 - 30	0	57	29	14	57	43
		31 - 40	10	50	37	3	60	40
		41 - 50	18	50	25	7	68	32
		51 - 60	13	88	0	0	100	0
		Over 60	0	100	0	0	100	0
	Technology changes cause disruptions	21 - 30	0	43	57	0	43	57
		31 - 40	10	17	67	7	27	73
		41 - 50	4	33	56	7	37	63
		51 - 60	0	50	38	13	50	50
		Over 60	0	50	50	0	50	50
Learning Style	Not suited to all learning styles	21 - 30	0	57	29	14	57	43
		31 - 40	10	60	23	7	70	30
		41 - 50	7	57	32	4	64	36
		51 - 60	0	100	0	0	100	0
		Over 60	50	50	0	0	100	0
	Only suits computer-literate learners	21 - 30	14	43	43	0	57	43
		31 - 40	10	73	17	0	83	17
		41 - 50	29	68	4	0	96	4
		51 - 60	13	63	13	13	75	25
		Over 60	50	50	0	0	100	0
	Won't suit learners who need structure	21 - 30	0	71	29	0	71	29

		31 - 40	7	48	41	3	55	45
		41 - 50	11	50	36	4	61	39
		51 - 60	0	88	13	0	88	13
		Over 60	0	0	100	0	0	100
Pedagogics	Compromises curriculum	21 - 30	0	43	57	0	43	57
		31 - 40	3	38	52	7	41	59
		41 - 50	8	35	54	4	42	58
		51 - 60	0	17	83	0	17	83
		Over 60	0	50	50	0	50	50
	Computer has limited activities	21 - 30	0	29	71	0	29	71
		31 - 40	7	40	47	7	47	53
		41 - 50	4	56	37	4	59	41
		51 - 60	0	71	29	0	71	29
		Over 60	0	50	50	0	50	50
	Focus on tool, not content	21 - 30	14	29	43	14	43	57
		31 - 40	10	30	50	10	40	60
		41 - 50	4	22	70	4	26	74
		51 - 60	0	29	71	0	29	71
		Over 60	0	100	0	0	100	0
	Not pedagogically sound	21 - 30	0	29	71	0	29	71
		31 - 40	4	37	52	7	41	59
		41 - 50	11	30	52	7	41	59
		51 - 60	0	43	43	14	43	57
		Over 60	0	50	50	0	50	50

On average, the levels of agreement between teachers from different age groups tend to be homogenous with slight variations, though teachers from the over 60 age group tend to demonstrate higher levels of agreement. Teachers in the over 60 age group demonstrate strong agreement that CAL systems are costly, that social pressure to be technologically advanced would increase with CAL systems, CAL systems do not suit all learners' learning styles and that that CAL systems would favour computer literate learners.

Figure 94



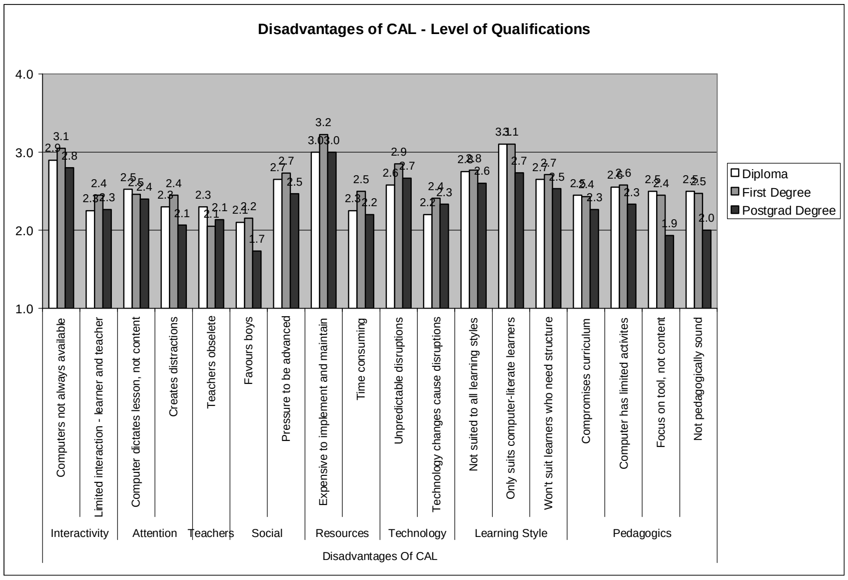
4.3.1.5.1.5 Level of Qualifications

Table 93: The Disadvantages of Computers in Education – Level of Qualification Breakdown

Groups	Items	Level of Qualifications	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Interactivity	Computers not always available	Diploma	5	79	16	0	84	16
		First Degree	15	78	5	3	93	8
		Postgrad Degree	7	67	27	0	73	27
	Limited interaction - learner and teacher	Diploma	0	30	65	5	30	70
		First Degree	8	34	53	5	42	58
		Postgrad Degree	0	33	60	7	33	67
Attention	Computer dictates lesson, not content	Diploma	0	53	47	0	53	47
		First Degree	0	51	44	5	51	49
		Postgrad Degree	0	40	60	0	40	60
	Creates distractions	Diploma	0	40	50	10	40	60
		First Degree	3	42	53	3	45	55
		Postgrad Degree	0	20	67	13	20	80
Teachers	Teachers obsolete	Diploma	0	35	60	5	35	65
		First Degree	3	13	72	13	15	85
		Postgrad Degree	0	27	60	13	27	73
Social	Favours boys	Diploma	0	20	70	10	20	80
		First Degree	8	15	62	15	23	77
		Postgrad Degree	0	0	73	27	0	100
	Pressure to be advanced	Diploma	5	60	30	5	65	35
		First Degree	11	57	27	5	68	32
		Postgrad Degree	7	40	47	7	47	53
Resources	Expensive to implement and maintain	Diploma	15	75	5	5	90	10
		First Degree	35	55	8	3	90	10
		Postgrad Degree	13	73	13	0	87	13
	Time consuming	Diploma	0	35	55	10	35	65
		First Degree	8	39	47	5	47	53
		Postgrad Degree	0	20	80	0	20	80
Technology	Unpredictable disruptions	Diploma	5	53	37	5	58	42
		First Degree	15	60	20	5	75	25
		Postgrad Degree	13	47	33	7	60	40
	Technology changes cause disruptions	Diploma	0	25	70	5	25	75
		First Degree	8	33	51	8	41	59
		Postgrad Degree	7	27	60	7	33	67
Learning Style	Not suited to all learning styles	Diploma	5	70	20	5	75	25
		First Degree	13	56	26	5	69	31
		Postgrad Degree	0	67	27	7	67	33
	Only suits computer-literate learners	Diploma	15	80	5	0	95	5
		First Degree	25	60	15	0	85	15
		Postgrad Degree	7	67	20	7	73	27
	Won't suit learners who need structure	Diploma	0	65	35	0	65	35
		First Degree	13	50	32	5	63	37
		Postgrad Degree	0	53	47	0	53	47
Pedagogics	Compromises curriculum	Diploma	0	50	45	5	50	50
		First Degree	9	31	54	6	40	60
		Postgrad Degree	0	27	73	0	27	73
	Computer has limited activities	Diploma	0	60	35	5	60	40
		First Degree	8	47	39	5	55	45
		Postgrad Degree	0	33	67	0	33	67
	Focus on tool, not content	Diploma	10	35	50	5	45	55
		First Degree	8	34	53	5	42	58
		Postgrad Degree	0	7	80	13	7	93
	Not pedagogically sound	Diploma	10	40	40	10	50	50
		First Degree	6	42	47	6	47	53
		Postgrad Degree	0	7	86	7	7	93

Though on average teachers from all qualification groups generally show similar levels of agreement, teachers with postgraduate qualifications tend to show lower levels of agreement.

Figure 95



4.3.1.5.1.6 Level of Computer Use

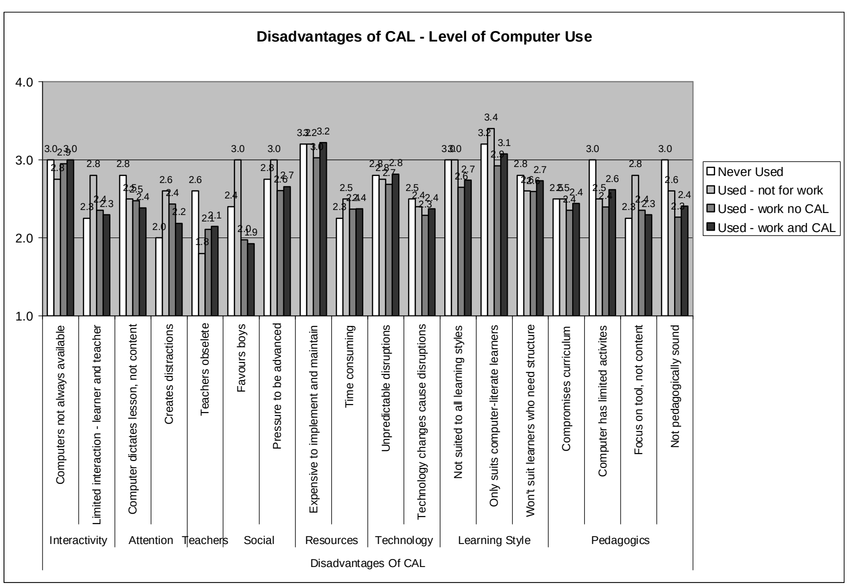
Table 94: The Disadvantages of Computers in Education – Level of Computer Use Breakdown (*Continued Overleaf*)

Groups	Items	Level of Computer Use	Levels of Agreement				Totals	
			Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Interactivity	Computers not always available	Never Used	0	100	0	0	100	0
		Used - not for work	25	25	50	0	50	50
		Used - work no CAL	5	87	5	3	92	8
		Used - work and CAL	19	63	19	0	81	19
	Limited interaction - learner and teacher	Never Used	0	25	75	0	25	75
		Used - not for work	20	40	40	0	60	40
		Used - work no CAL	3	35	57	5	38	62
		Used - work and CAL	4	30	59	7	33	67
Attention	Computer dictates lesson, not content	Never Used	0	80	20	0	80	20
		Used - not for work	0	50	50	0	50	50
		Used - work no CAL	0	53	42	5	53	47
		Used - work and CAL	0	38	62	0	38	62
	Creates distractions	Never Used	0	0	100	0	0	100
		Used - not for work	0	60	40	0	60	40
		Used - work no CAL	3	43	49	5	46	54
		Used - work and CAL	0	30	59	11	30	70
Teachers	Teachers obsolete	Never Used	0	60	40	0	60	40
		Used - not for work	0	0	80	20	0	100
		Used - work no CAL	0	22	68	11	22	78
		Used - work and CAL	4	19	67	11	22	78
Social	Favours boys	Never Used	20	0	80	0	20	80
		Used - not for work	20	60	20	0	80	20
		Used - work no CAL	0	11	76	14	11	89
		Used - work and CAL	4	11	59	26	15	85
	Pressure to be advanced	Never Used	0	75	25	0	75	25
		Used - not for work	50	0	50	0	50	50
		Used - work no CAL	5	55	34	5	61	39
		Used - work and CAL	8	58	27	8	65	35
Resources	Expensive to implement and maintain	Never Used	20	80	0	0	100	0
		Used - not for work	40	40	20	0	80	20
		Used - work no CAL	18	68	11	3	87	13
		Used - work and CAL	33	59	4	4	93	7
	Time consuming	Never Used	0	25	75	0	25	75
		Used - not for work	25	0	75	0	25	75
		Used - work no CAL	5	32	58	5	37	63
		Used - work and CAL	0	44	48	7	44	56
Technology	Unpredictable disruptions	Never Used	20	40	40	0	60	40

		Used - not for work	25	25	50	0	50	50
		Used - work no CAL	8	58	29	5	66	34
		Used - work and CAL	15	59	19	7	74	26
	Technology changes cause disruptions	Never Used	0	50	50	0	50	50
		Used - not for work	20	0	80	0	20	80
		Used - work no CAL	3	32	58	8	34	66
		Used - work and CAL	7	30	56	7	37	63
Learning Style	Not suited to all learning styles	Never Used	0	100	0	0	100	0
		Used - not for work	40	20	40	0	60	40
		Used - work no CAL	5	59	30	5	65	35
		Used - work and CAL	7	67	19	7	74	26
	Only suits computer-literate learners	Never Used	20	80	0	0	100	0
		Used - not for work	60	20	20	0	80	20
		Used - work no CAL	11	74	13	3	84	16
		Used - work and CAL	22	63	15	0	85	15
	Won't suit learners who need structure	Never Used	20	40	40	0	60	40
		Used - not for work	20	20	60	0	40	60
		Used - work no CAL	5	54	35	5	59	41
		Used - work and CAL	4	65	31	0	69	31
Pedagogics	Compromises curriculum	Never Used	0	50	50	0	50	50
		Used - not for work	0	50	50	0	50	50
		Used - work no CAL	3	35	57	5	38	62
		Used - work and CAL	8	32	56	4	40	60
	Computer has limited activities	Never Used	20	60	20	0	80	20
		Used - not for work	25	0	75	0	25	75
		Used - work no CAL	0	45	50	5	45	55
		Used - work and CAL	4	58	35	4	62	38
	Focus on tool, not content	Never Used	0	25	75	0	25	75
		Used - not for work	20	40	40	0	60	40
		Used - work no CAL	5	32	54	8	38	62
		Used - work and CAL	7	22	63	7	30	70
	Not pedagogically sound	Never Used	0	100	0	0	100	0
		Used - not for work	20	20	60	0	40	60
		Used - work no CAL	3	29	59	9	32	68
		Used - work and CAL	7	33	52	7	41	59

In general, teachers who have never used computers before, or have used computers but not for work purposes tend to have higher levels of agreement and consensus regarding the disadvantages of CAL.

Figure 96

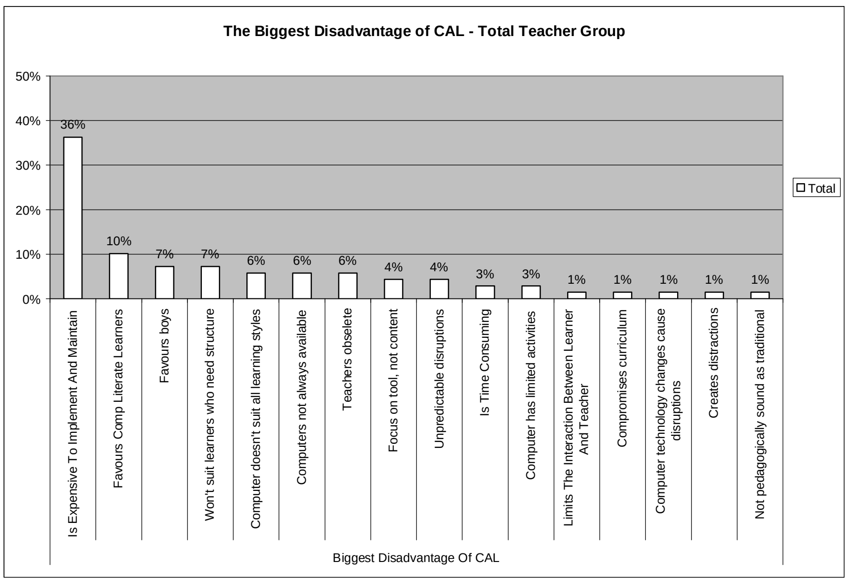


4.3.1.5.2 The Biggest Disadvantage of Computers in Education

This item explores which single benefit statement teacher agrees with most. The results are indicated in a proportional percentage breakdown of the total answers provided are presented in a graph format.

4.3.1.5.2.1 Total Teacher Group

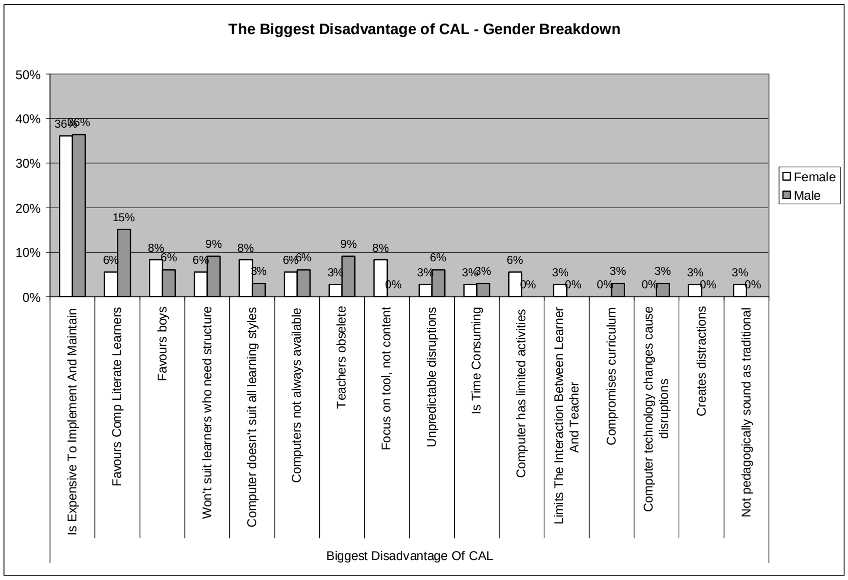
Figure 97



Across the entire teacher group a greater level of consensus is demonstrated at 36% that the costly nature to implement and maintain CAL systems is the biggest disadvantage of CAL implementation. The literature indicates that a consequence of CAL implementation is a rise in intuition fees, faulty or outdated equipment and insufficient technical support (Baillie *et al.*, 2000; Brabazon, 2000; Heide *et al.*, 2001; Richard, 2003) that creates concern whether the level of investment required is legitimate (Draper *et al.*, 2002; Mayer, 2000). To a lesser degree at 10% agreement, teachers feel that the level of learner computer literacy would affect the success of CAL implementation and use, as supported in the literature (Desai, 2000).

4.3.1.5.2.2 Gender Breakdown

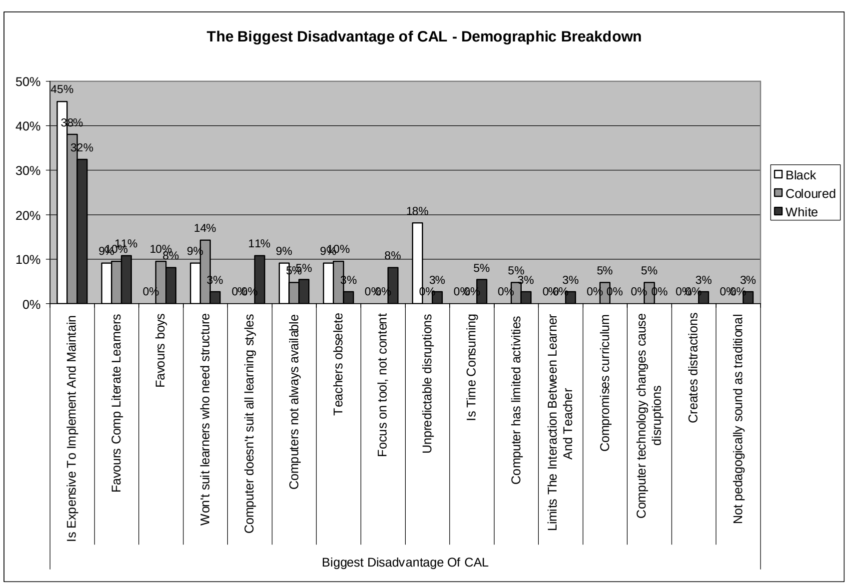
Figure 98



Teachers from both gender groups show high levels of agreement that the costly nature to implement and maintain CAL systems is the biggest disadvantage of CAL implementation. Male teachers, however, demonstrate concern at 15% that CAL systems would only favour computer literate learners.

4.3.1.5.2.3 Demographic Breakdown

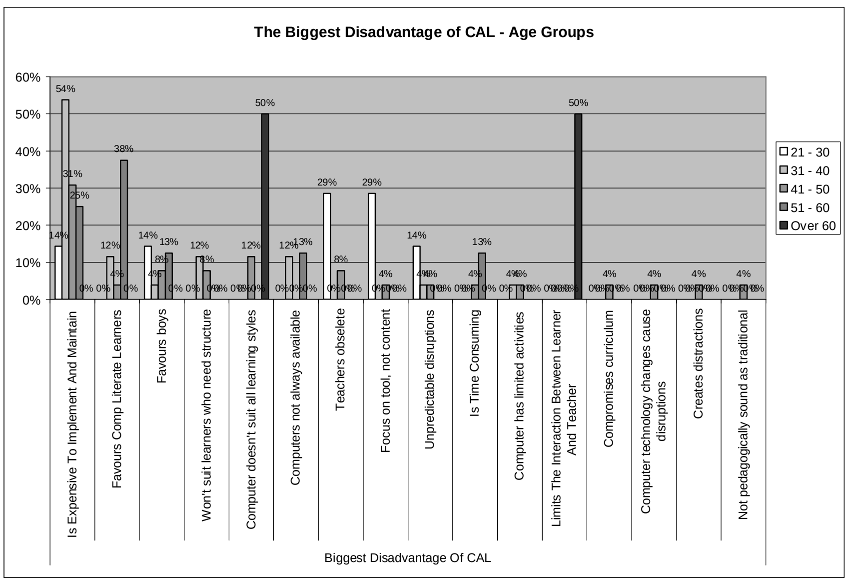
Figure 99



Though teachers from all demographic groups agree the most that CAL systems are expensive to implement and maintain, teachers from the Black demographic group show greater consensus at 45%. Teachers from the Black demographic group also agree at higher levels at 18% that CAL systems create unpredictable disruptions, while 14% of Coloured teachers feel that CAL systems would not suit learners who need structure.

4.3.1.5.2.4 Age Groups

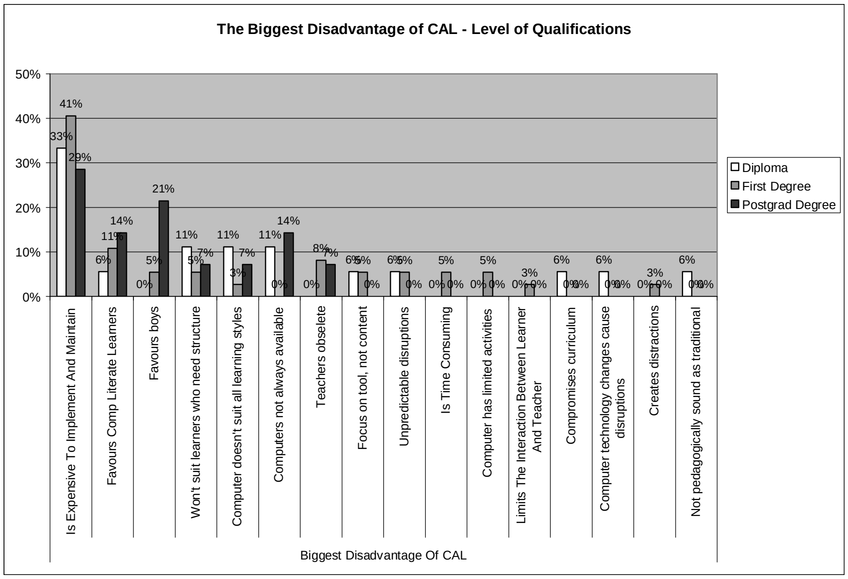
Figure 100



Teachers in the 21 to 30 age group feel that the biggest disadvantages to CAL implementation are that computers will make teachers obsolete and that CAL systems tend to focus on the tool rather than content. Teachers in the 31 to 40 and 41 to 50 age groups agree at 54% and 31% respectively that the cost implications is the biggest disadvantage to CAL implementation. Teachers in the 51 to 60 age group feel more strongly that CAL systems would only favour computer literate learners, while teachers in the over 60 age group show greater concern for the limited interaction between teacher and learners and the unsuitability of CAL systems to all learning styles.

4.3.1.5.2.5 Level of Qualifications

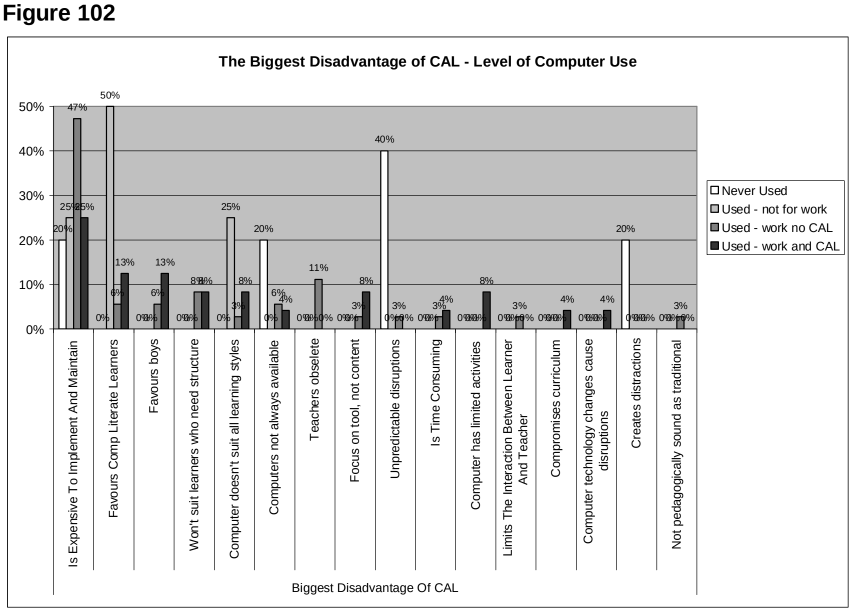
Figure 101



Though teachers from all demographic groups agree the most that CAL systems are expensive to implement and maintain, teachers with first degrees show the most consensus at 41%. Teachers who have postgraduate qualifications also show concern that CAL systems tend to favour boys, that CAL systems tend to suit computer literate learners and that the general availability of computers are low in schools.

4.3.1.5.2.6 Level of Computer Use

Figure 102



Teachers who have never used computers feel that the unpredictable disruptions that CAL systems create is the biggest disadvantage of CAL implementation, while teachers who have used computers but not for work purposes show greater concern that CAL systems would only suit computer literate learners. Teachers who have used computers for work and also those who have used computers for both work and CAL feel that a cost implication is the biggest disadvantage of CAL implementation.

4.3.2 **THE IMPLEMENTATION OF CAL**

4.3.2.1 Perceived Factors Preventing the Implementation of CAL in South African Schools

This section reports on the factors that teachers perceive to be barriers to CAL implementation in South African schools. Items are sorted into categories and their relevant items, set out as follows:

- *The need for computers*, including no need for computers, and less priority for computers
- *Staffing*, including not enough staff and no trained computer staff
- *Resources*, including no funds, no electricity and no telephone lines
- *Limitations*, including inadequate classrooms, no space for computers, and theft and security.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly disagree, disagree, agree and strongly agree. A totals column has been added to provide a summary of overall agreement and disagreement.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly disagree to 4 for strongly agree. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates strong disagreement
- 1.76 to 2.5 indicates general disagreement
- 2.51 to 3.25 indicates general agreement
- 3.26 to 4 indicates strong agreement.

4.3.2.1.1 Total Teacher Group

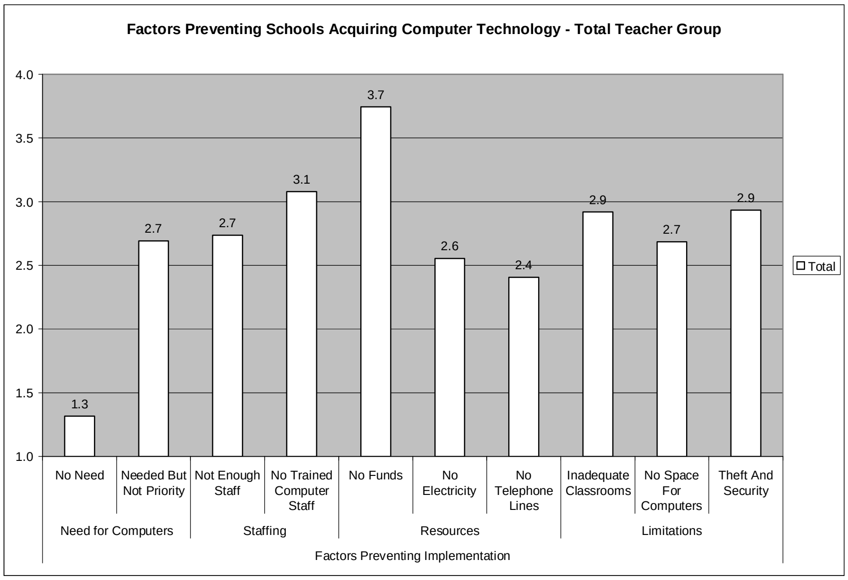
Table 95: The Factors Preventing the Implementation of CAL in South African Schools – Total Teacher Group

Categories	Items	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Need for Computers	No Need	0	1	29	70	1	99
	Needed But Not Priority	16	49	23	12	65	35
Staffing	Not Enough Staff	21	39	32	8	61	39
	No Trained Computer Staff	36	38	23	3	74	26
Resources	No Funds	77	21	3	0	97	3
	No Electricity	15	38	35	12	53	47
	No Telephone Lines	8	36	43	12	45	55
Limitations	Inadequate Classrooms	31	41	18	11	72	28
	No Space For Computers	29	21	41	10	49	51
	Theft And Security	24	47	28	1	71	29

As a whole, teachers agree most strongly that a lack of funds is a barrier to CAL implementation in South African schools. The literature indicates that schools are often under-funded for sufficient technology implementation in schools (Schofield, 1995). Also, CAL implementation often results in a rise in tuition fees, faulty or outdated equipment and insufficient technical support (Baillie *et al.*, 2000; Brabazon, 2000; Heide *et al.*, 2001; Richard, 2003) that often prevents the initial investment being made (Draper *et al.*, 2002; Mayer, 2000).

At lower levels of agreement, teachers also indicate that the implementation of CAL systems in South African schools is a lower priority function with regard to schools needs and resources. The findings also indicate that having too few staff and trained computer staff, inadequate classrooms, space limitations, and theft and security issues also remain challenges to CAL implementation. These findings support previous research studies performed in South African schools (NCETDE, 1998).

Figure 103



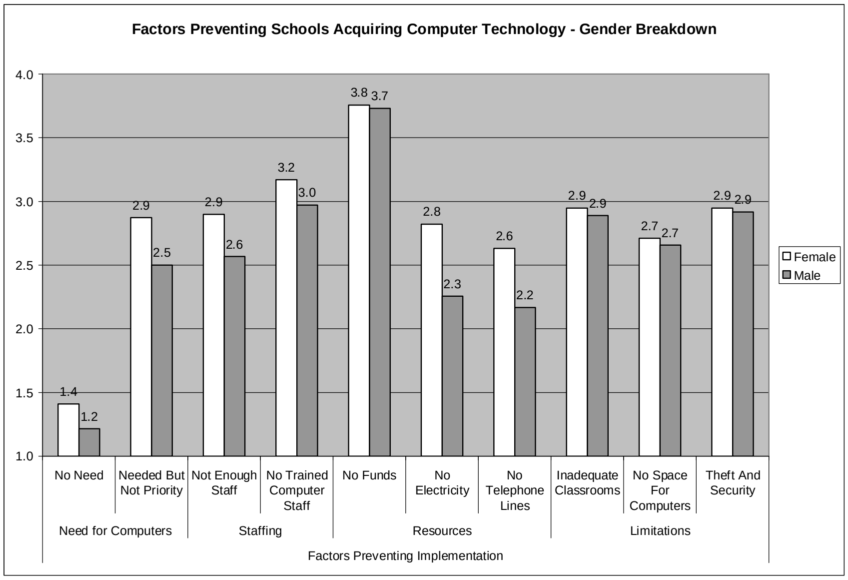
4.3.2.1.2 Gender Breakdown

Table 96: The Factors Preventing the Implementation of CAL in South African Schools – Gender Breakdown

Categories	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Need for Computers	No Need	Female	0	0	41	59	0	100
		Male	0	3	16	81	3	97
	Needed But Not Priority	Female	23	49	21	8	72	28
		Male	8	50	25	17	58	42
Staffing	Not Enough Staff	Female	23	46	28	3	69	31
		Male	19	32	35	14	51	49
	No Trained Computer Staff	Female	41	39	15	5	80	20
		Male	31	36	33	0	67	33
Resources	No Funds	Female	76	24	0	0	100	0
		Male	78	16	5	0	95	5
	No Electricity	Female	15	59	18	8	74	26
		Male	14	14	54	17	29	71
	No Telephone Lines	Female	8	58	24	11	66	34
		Male	8	14	64	14	22	78
Limitations	Inadequate Classrooms	Female	32	45	11	13	76	24
		Male	31	36	25	8	67	33
	No Space For Computers	Female	29	24	37	11	53	47
		Male	29	17	46	9	46	54
	Theft And Security	Female	26	46	26	3	72	28
		Male	22	47	31	0	69	31

Though teachers from both gender groups show similar high levels of agreement regarding the lack of funds to implement CAL systems, the female teacher group in general demonstrates higher levels of agreement than male teachers across the board. On average female teachers tend to show levels of agreement for the lower priority for CAL implementation, lack of electricity and lack of telephone lines as barriers to CAL implementation, while male teachers show general disagreement.

Figure 104



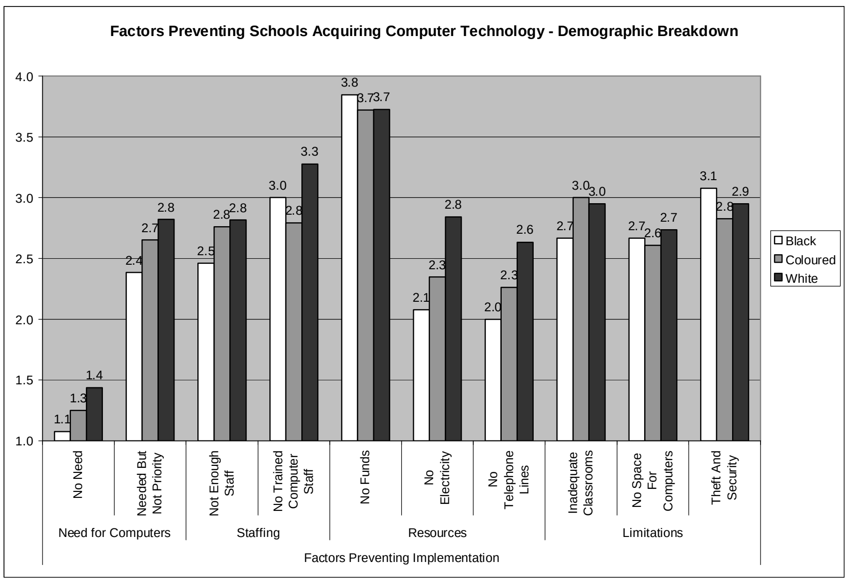
4.3.2.1.3 Demographic Breakdown

Table 97: The Factors Preventing the Implementation of CAL in South African Schools – Demographic Breakdown

Categories	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Need for Computers	No Need	Black	0	0	8	92	0	100
		Coloured	0	0	25	75	0	100
		White	0	3	38	59	3	97
	Needed But Not Priority	Black	8	46	23	23	54	46
		Coloured	22	39	22	17	61	39
		White	15	56	23	5	72	28
Staffing	Not Enough Staff	Black	15	31	38	15	46	54
		Coloured	36	16	36	12	52	48
		White	13	58	26	3	71	29
	No Trained Computer Staff	Black	31	38	31	0	69	31
		Coloured	25	33	38	4	58	42
		White	45	40	13	3	85	15
Resources	No Funds	Black	92	0	8	0	92	8
		Coloured	76	20	4	0	96	4
		White	73	28	0	0	100	0
	No Electricity	Black	8	15	54	23	23	77
		Coloured	22	9	52	17	30	70
		White	13	63	18	5	76	24
	No Telephone Lines	Black	0	15	69	15	15	85
		Coloured	13	17	52	17	30	70
		White	8	55	29	8	63	37
Limitations	Inadequate Classrooms	Black	33	25	17	25	58	42
		Coloured	32	41	23	5	73	27
		White	30	45	15	10	75	25
	No Space For Computers	Black	33	17	33	17	50	50
		Coloured	26	22	39	13	48	52
		White	29	21	45	5	50	50
	Theft And Security	Black	31	46	23	0	77	23
		Coloured	17	48	35	0	65	35
		White	26	46	26	3	72	28

Though teachers from all demographic groups agree very strongly that a lack of funds prevents CAL implementation in South African schools, teachers in the Black demographic group on average agree at higher levels. Teachers who belong to the White demographic group also agree very strongly that the lack of trained computer staff is a barrier to CAL implementation, while indicating general concern for the lack of electricity and telephone lines as inhibiting CAL implementation.

Figure 105



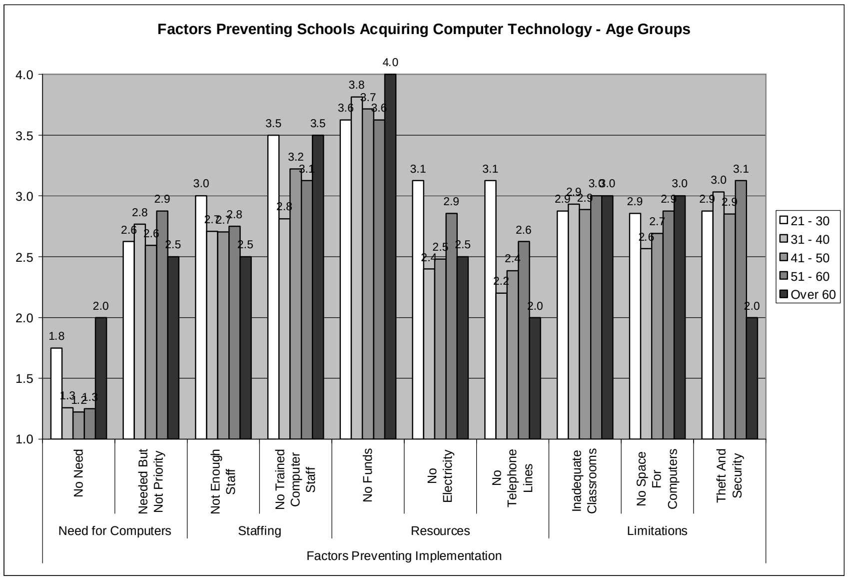
4.3.2.1.4 Age Groups

Teachers from all age groups agree very strongly on average that a lack of funds is a barrier to CAL implementation; while teachers in the 21 to 30 and over 60 age groups show strong concern that having no trained computer staff in schools provides a challenge to the implementation of CAL in South African schools.

Table 98: The Factors Preventing the Implementation of CAL in South African Schools – Age Group Breakdown

Categories	Items	Age Groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Need for Computers	No Need	21 - 30	0	0	75	25	0	100
		31 - 40	0	0	26	74	0	100
		41 - 50	0	0	22	78	0	100
		51 - 60	0	0	25	75	0	100
		Over 60	0	50	0	50	50	50
	Needed But Not Priority	21 - 30	13	50	25	13	63	38
		31 - 40	17	57	13	13	73	27
		41 - 50	19	37	30	15	56	44
		51 - 60	13	63	25	0	75	25
		Over 60	0	50	50	0	50	50
Staffing	Not Enough Staff	21 - 30	38	25	38	0	63	38
		31 - 40	26	32	29	13	58	42
		41 - 50	15	48	30	7	63	37
		51 - 60	13	50	38	0	63	38
		Over 60	0	50	50	0	50	50
	No Trained Computer Staff	21 - 30	50	50	0	0	100	0
		31 - 40	31	25	38	6	56	44
		41 - 50	37	48	15	0	85	15
		51 - 60	38	38	25	0	75	25
		Over 60	50	50	0	0	100	0
Resources	No Funds	21 - 30	75	13	13	0	88	13
		31 - 40	81	19	0	0	100	0
		41 - 50	75	21	4	0	96	4
		51 - 60	63	38	0	0	100	0
		Over 60	100	0	0	0	100	0
	No Electricity	21 - 30	50	25	13	13	75	25
		31 - 40	17	27	37	20	43	57
		41 - 50	7	41	44	7	48	52
		51 - 60	0	86	14	0	86	14
		Over 60	0	50	50	0	50	50
	No Telephone Lines	21 - 30	50	25	13	13	75	25
		31 - 40	3	33	43	20	37	63
		41 - 50	4	38	50	8	42	58
		51 - 60	0	63	38	0	63	38
		Over 60	0	0	100	0	0	100
Limitations	Inadequate Classrooms	21 - 30	25	50	13	13	75	25
		31 - 40	31	41	17	10	72	28
		41 - 50	30	41	19	11	70	30
		51 - 60	38	38	13	13	75	25
		Over 60	50	0	50	0	50	50
	No Space For Computers	21 - 30	43	0	57	0	43	57
		31 - 40	30	17	33	20	47	53
		41 - 50	19	35	42	4	54	46
		51 - 60	38	13	50	0	50	50
		Over 60	50	0	50	0	50	50
	Theft And Security	21 - 30	38	13	50	0	50	50
		31 - 40	23	57	20	0	80	20
		41 - 50	22	44	30	4	67	33
		51 - 60	25	63	13	0	88	13
		Over 60	0	0	100	0	0	100

Figure 106



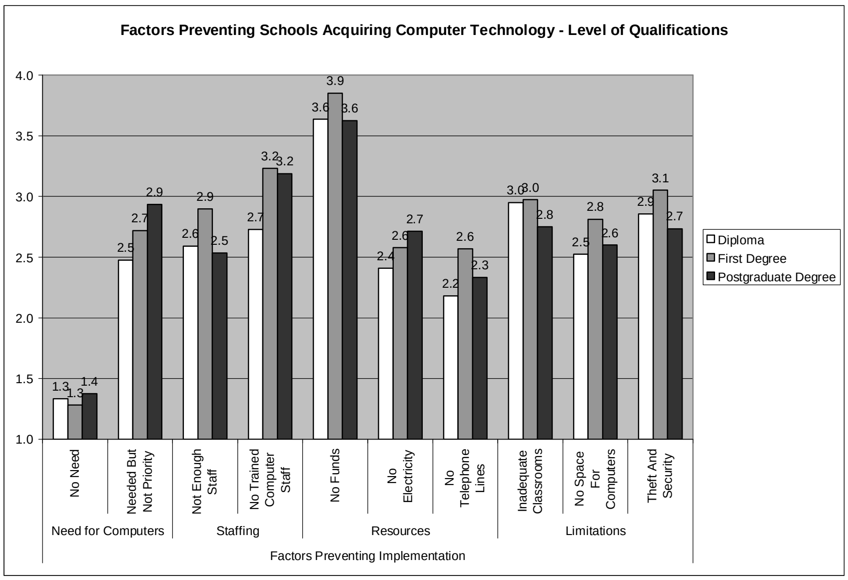
4.3.2.1.5 Level of Qualifications

Table 99: The Factors Preventing the Implementation of CAL in South African Schools – Level of Qualification Breakdown

Categories	Items	Level of Qualifications	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Need for Computers	No Need	Diploma	0	5	24	71	5	95
		First Degree	0	0	28	72	0	100
		Postgraduate Degree	0	0	38	63	0	100
	Needed But Not Priority	Diploma	14	43	19	24	57	43
		First Degree	15	51	23	10	67	33
		Postgraduate Degree	20	53	27	0	73	27
Staffing	Not Enough Staff	Diploma	18	32	41	9	50	50
		First Degree	26	46	21	8	72	28
		Postgraduate Degree	13	33	47	7	47	53
	No Trained Computer Staff	Diploma	18	41	36	5	59	41
		First Degree	44	38	15	3	82	18
		Postgraduate Degree	44	31	25	0	75	25
Resources	No Funds	Diploma	68	27	5	0	95	5
		First Degree	85	15	0	0	100	0
		Postgraduate Degree	69	25	6	0	94	6
	No Electricity	Diploma	9	36	41	14	45	55
		First Degree	18	34	34	13	53	47
		Postgraduate Degree	14	50	29	7	64	36
	No Telephone Lines	Diploma	0	32	55	14	32	68
		First Degree	14	41	35	11	54	46
		Postgraduate Degree	7	33	47	13	40	60
Limitations	Inadequate Classrooms	Diploma	35	35	20	10	70	30
		First Degree	32	45	13	11	76	24
		Postgraduate Degree	25	38	25	13	63	38
	No Space For Computers	Diploma	24	19	43	14	43	57
		First Degree	35	19	38	8	54	46
		Postgraduate Degree	20	27	47	7	47	53
	Theft And Security	Diploma	19	48	33	0	67	33
		First Degree	23	59	18	0	82	18
		Postgraduate Degree	33	13	47	7	47	53

On average, agreements are at similar levels across all qualification groups. Teachers in all age groups show strong agreement that a lack of funds prevents CAL implementation in South African schools. Teachers with degrees, however, show greater concern for the lack of trained computer staff and its implications for CAL implementation.

Figure 107



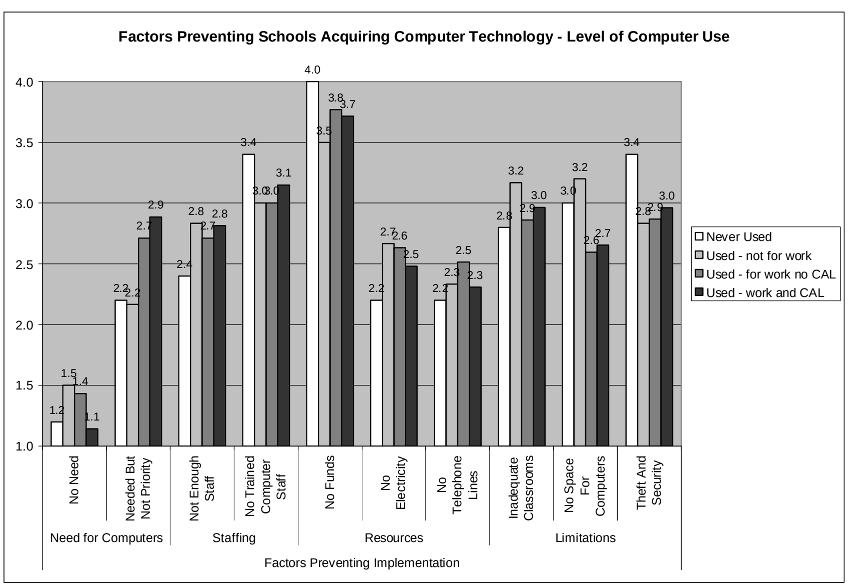
4.3.2.1.6 Level of Computer Use

On average, teachers from all computer use groups show strong agreement that a lack of funds prevents CAL implementation in South African schools. Teachers who have never used computers also show strong concern that a lack of trained computer staff and theft and security issues prevent the implementation of CAL systems into schools.

Table 100: The Factors Preventing the Implementation of CAL in South African Schools – Level of Computer Use Breakdown

Categories	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Need for Computers	No Need	Never Used	0	0	20	80	0	100
		Used - not for work	0	17	17	67	17	83
		Used - for work no CAL	0	0	43	57	0	100
		Used - work and CAL	0	0	14	86	0	100
	Needed But Not Priority	Never Used	20	20	20	40	40	60
		Used - not for work	0	50	17	33	50	50
		Used - for work no CAL	11	58	24	8	68	32
		Used - work and CAL	27	42	23	8	69	31
Staffing	Not Enough Staff	Never Used	20	40	0	40	60	40
		Used - not for work	33	33	17	17	67	33
		Used - for work no CAL	18	39	37	5	58	42
		Used - work and CAL	22	41	33	4	63	37
	No Trained Computer Staff	Never Used	60	20	20	0	80	20
		Used - not for work	33	50	0	17	83	17
		Used - for work no CAL	31	38	31	0	69	31
		Used - work and CAL	41	37	19	4	78	22
Resources	No Funds	Never Used	100	0	0	0	100	0
		Used - not for work	67	17	17	0	83	17
		Used - for work no CAL	79	18	3	0	97	3
		Used - work and CAL	71	29	0	0	100	0
	No Electricity	Never Used	0	40	40	20	40	60
		Used - not for work	33	17	33	17	50	50
		Used - for work no CAL	18	39	29	13	58	42
		Used - work and CAL	8	40	44	8	48	52
	No Telephone Lines	Never Used	0	40	40	20	40	60
		Used - not for work	17	17	50	17	33	67
		Used - for work no CAL	14	35	41	11	49	51
		Used - work and CAL	0	42	46	12	42	58
Limitations	Inadequate Classrooms	Never Used	40	20	20	20	60	40
		Used - not for work	67	0	17	17	67	33
		Used - for work no CAL	17	56	25	3	72	28
		Used - work and CAL	41	33	7	19	74	26
	No Space For Computers	Never Used	60	0	20	20	60	40
		Used - not for work	40	40	20	0	80	20
		Used - for work no CAL	24	16	54	5	41	59
		Used - work and CAL	27	27	31	15	54	46
	Theft And Security	Never Used	40	60	0	0	100	0
		Used - not for work	33	17	50	0	50	50
		Used - for work no CAL	18	50	32	0	68	32
		Used - work and CAL	27	46	23	4	73	27

Figure 108



4.3.2.2 School Priority Needs for the Implementation of CAL

4.3.2.2.1 Priorities for Teachers

4.3.2.2.1.1 Priority Focuses for the Implementation of CAL

This section reports on the factors that teachers believe to be the priorities for CAL implementation. Items are sorted into categories and their relevant items, set out as follows:

- *Administration*, including better assignment management, better record keeping and more accurate marking and assessment
- *Communication*, including better communication between teachers and learners and between staff
- *Interaction*, including access to information and resources and interacting and sharing with other schools
- *Time*, including less time marking and doing administration and less time preparing tests
- *Learners*, including providing learners with more individual attention
- *Training*, including the need for ongoing training.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly disagree, disagree, agree and strongly agree. A totals column has been added to provide a summary of overall agreement and disagreement.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly disagree to 4 for strongly agree. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates strong disagreement

- 1.76 to 2.5 indicates general disagreement
- 2.51 to 3.25 indicates general agreement
- 3.26 to 4 indicates strong agreement.

4.3.2.2.1.1.1 Total Teacher Group

Table 101: Teachers' Priority Focuses for the Implementation of CAL in Schools – Total Teacher Group

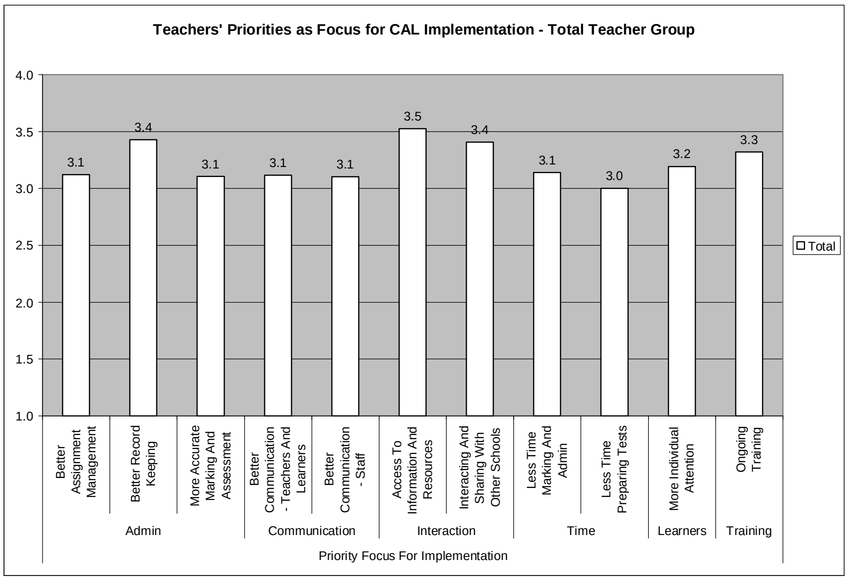
Groups	Items	Levels of Agreement				Totals	
		Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Admin	Better Assignment Management	27	58	15	0	85	15
	Better Record Keeping	49	44	6	0	94	6
	More Accurate Marking And Assessment	28	55	17	0	83	17
Communication	Better Communication - Teachers And Learners	30	52	18	0	82	18
	Better Communication - Staff	29	53	18	0	82	18
Interaction	Access To Information And Resources	59	35	6	0	94	6
	Interacting And Sharing With Other Schools	49	43	8	0	92	8
Time	Less Time Marking And Admin	33	47	19	0	81	19
	Less Time Preparing Tests	27	47	24	1	74	26
Learners	More Individual Attention	38	42	19	0	81	19
Training	Ongoing Training	40	53	8	0	92	8

In general, the teacher group as a whole show higher levels of agreement of above 70% across all priority items. On average however, teachers show strong agreement for the priority needs of:

- better record keeping process, a function of administrative and management software that allows teachers to create administrative worksheets, class documents and study guides for class use while keeping an organized storage format of relevant documents (Johnson, 2003; Pieters, 2001)
- greater access to information and resources, that, as indicated in the literature, allows for quicker synthesis and analysis of relevant information (Baillie *et al.*, 2000; Valdez *et al.,* 2004)
- interacting and sharing resources with other schools, a function of a collaborative peer supported learning community (Lai, 1996; Owen *et al.*, 1998; Schrum *et al.*, 1997; Valdez *et al.,* 2004)

- the need for ongoing training for CAL implementation, as supported in the literature that indicates that most teachers were trained before computers were an integral part of work activities and therefore require intensive training, while those that have received training often report that the training is inadequate and irrelevant (Schofield, 1995).

Figure 109



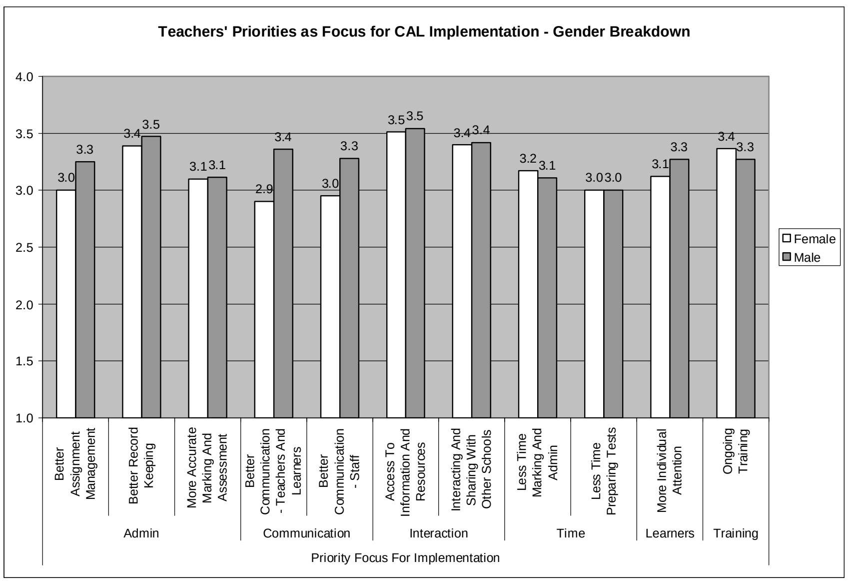
4.3.2.2.1.1.2 Gender Breakdown

Table 102: Teachers' Priority Focuses for the Implementation of CAL in Schools – Gender Breakdown

Groups	Items	Gender Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Admin	Better Assignment Management	Female	21	58	21	0	79	21
		Male	33	58	8	0	92	8
	Better Record Keeping	Female	46	46	7	0	93	7
		Male	53	42	6	0	94	6
	More Accurate Marking And Assessment	Female	32	46	22	0	78	22
		Male	23	66	11	0	89	11
Communication	Better Communication - Teachers And Learners	Female	17	56	27	0	73	27
		Male	44	47	8	0	92	8
	Better Communication - Staff	Female	17	61	22	0	78	22
		Male	42	44	14	0	86	14
Interaction	Access To Information And Resources	Female	59	34	7	0	93	7
		Male	59	35	5	0	95	5
	Interacting And Sharing With Other Schools	Female	50	40	10	0	90	10
		Male	47	47	6	0	94	6
Time	Less Time Marking And Admin	Female	39	39	22	0	78	22
		Male	27	57	16	0	84	16
	Less Time Preparing Tests	Female	29	44	24	2	73	27
		Male	24	51	24	0	76	24
Learners	More Individual Attention	Female	37	39	24	0	76	24
		Male	41	46	14	0	86	14
Training	Ongoing Training	Female	46	44	10	0	90	10
		Male	32	62	5	0	95	5

In general, male and female teachers both show strong levels of agreement that better record keeping, access to information and resources, interacting and sharing with other schools and ongoing training are priorities for CAL implementation in South African schools. On average however, the male teaching group shows stronger levels of agreement than the female teaching group that the priorities for CAL also include the need for better assignment management, better communication between teachers, learners and staff and more individual attention for learners.

Figure 110



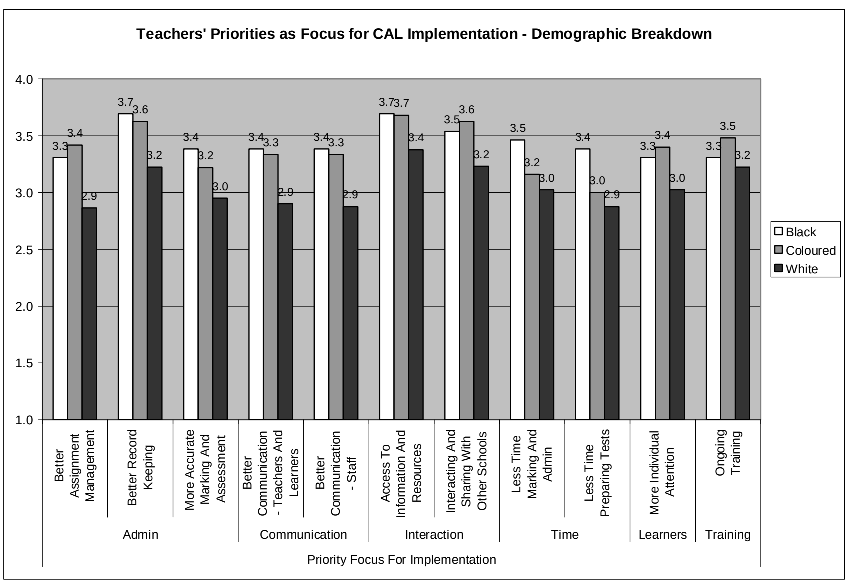
4.3.2.2.1.1.3 Demographic Breakdown

In general, teachers from the Black and Coloured demographic groups show stronger levels of agreement across the board than teachers from the White demographic group. However, teachers from all demographic groups agree strongly that the need for better access to information and resources is a priority for CAL implementation.

Table 103: Teachers' Priority Focuses for the Implementation of CAL in Schools – Demographic Breakdown

Groups	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Admin	Better Assignment Management	Black	31	69	0	0	100	0
		Coloured	42	58	0	0	100	0
		White	16	54	30	0	70	30
	Better Record Keeping	Black	69	31	0	0	100	0
		Coloured	67	29	4	0	96	4
		White	33	58	10	0	90	10
	More Accurate Marking And Assessment	Black	38	62	0	0	100	0
		Coloured	39	43	17	0	83	17
		White	18	60	23	0	78	23
Communication	Better Communication - Teachers And Learners	Black	46	46	8	0	92	8
		Coloured	46	42	13	0	88	13
		White	15	60	25	0	75	25
	Better Communication - Staff	Black	46	46	8	0	92	8
		Coloured	46	42	13	0	88	13
		White	13	63	25	0	75	25
Interaction	Access To Information And Resources	Black	69	31	0	0	100	0
		Coloured	72	24	4	0	96	4
		White	48	43	10	0	90	10
	Interacting And Sharing With Other Schools	Black	54	46	0	0	100	0
		Coloured	67	29	4	0	96	4
		White	36	51	13	0	87	13
Time	Less Time Marking And Admin	Black	54	38	8	0	92	8
		Coloured	28	60	12	0	88	12
		White	30	43	28	0	73	28
	Less Time Preparing Tests	Black	46	46	8	0	92	8
		Coloured	28	48	20	4	76	24
		White	20	48	33	0	68	33
Learners	More Individual Attention	Black	38	54	8	0	92	8
		Coloured	56	28	16	0	84	16
		White	28	48	25	0	75	25
Training	Ongoing Training	Black	31	69	0	0	100	0
		Coloured	56	36	8	0	92	8
		White	33	58	10	0	90	10

Figure 111



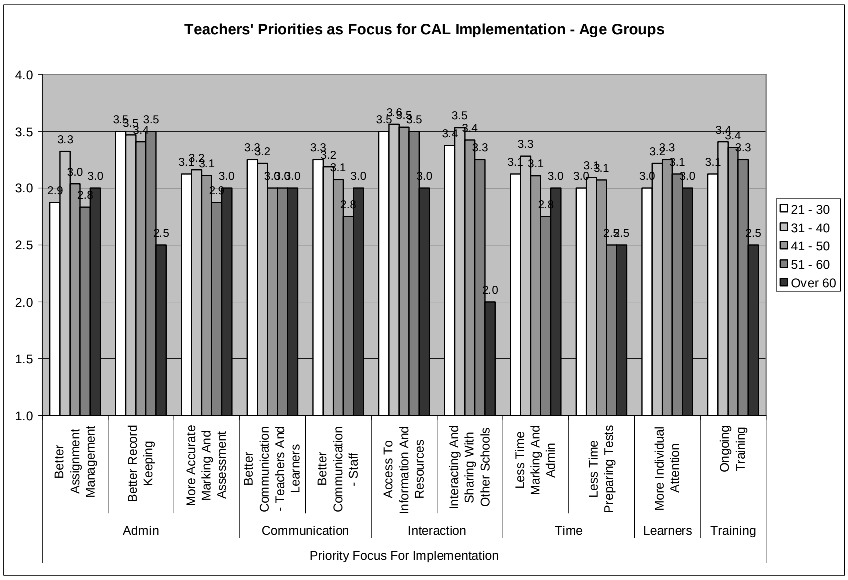
4.3.2.2.1.1.4 Age Groups

Table 104: Teachers' Priority Focuses for the Implementation of CAL in Schools – Age Group Breakdown

Groups	Items	Age Groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Admin	Better Assignment Management	21 - 30	25	38	38	0	63	38
		31 - 40	35	61	3	0	97	3
		41 - 50	22	59	19	0	81	19
		51 - 60	17	50	33	0	67	33
		Over 60	0	100	0	0	100	0
	Better Record Keeping	21 - 30	50	50	0	0	100	0
		31 - 40	53	41	6	0	94	6
		41 - 50	44	52	4	0	96	4
		51 - 60	63	25	13	0	88	13
		Over 60	0	50	50	0	50	50
	More Accurate Marking And Assessment	21 - 30	25	63	13	0	88	13
		31 - 40	39	39	23	0	77	23
		41 - 50	22	67	11	0	89	11
		51 - 60	13	63	25	0	75	25
		Over 60	0	100	0	0	100	0
Communication	Better Communication - Teachers And Learners	21 - 30	38	50	13	0	88	13
		31 - 40	38	47	16	0	84	16
		41 - 50	19	63	19	0	81	19
		51 - 60	25	50	25	0	75	25
		Over 60	50	0	50	0	50	50
	Better Communication - Staff	21 - 30	38	50	13	0	88	13
		31 - 40	38	44	19	0	81	19
		41 - 50	22	63	15	0	85	15
		51 - 60	13	50	38	0	63	38
		Over 60	0	100	0	0	100	0
Interaction	Access To Information And Resources	21 - 30	50	50	0	0	100	0
		31 - 40	63	31	6	0	94	6
		41 - 50	57	39	4	0	96	4
		51 - 60	63	25	13	0	88	13
		Over 60	50	0	50	0	50	50
	Interacting And Sharing With Other Schools	21 - 30	38	63	0	0	100	0
		31 - 40	59	34	6	0	94	6
		41 - 50	46	50	4	0	96	4
		51 - 60	38	50	13	0	88	13
		Over 60	0	0	100	0	0	100
Time	Less Time Marking And Admin	21 - 30	38	38	25	0	75	25
		31 - 40	41	47	13	0	88	13
		41 - 50	29	54	18	0	82	18
		51 - 60	25	25	50	0	50	50
		Over 60	0	100	0	0	100	0
	Less Time Preparing Tests	21 - 30	25	50	25	0	75	25
		31 - 40	34	44	19	3	78	22
		41 - 50	29	50	21	0	79	21
		51 - 60	0	50	50	0	50	50
		Over 60	0	50	50	0	50	50
Learners	More Individual Attention	21 - 30	38	25	38	0	63	38
		31 - 40	47	28	25	0	75	25
		41 - 50	36	54	11	0	89	11
		51 - 60	25	63	13	0	88	13
		Over 60	0	100	0	0	100	0
Training	Ongoing Training	21 - 30	25	63	13	0	88	13
		31 - 40	50	41	9	0	91	9
		41 - 50	39	57	4	0	96	4
		51 - 60	25	75	0	0	100	0
		Over 60	0	50	50	0	50	50

In general, the over 60 age group shows lower degrees of consensus in priority items across the board. Other age groups, however, show strong agreement for the need of better record keeping systems, having access to information and resources, and interacting and sharing resources with other schools as priorities for CAL implementation.

Figure 112



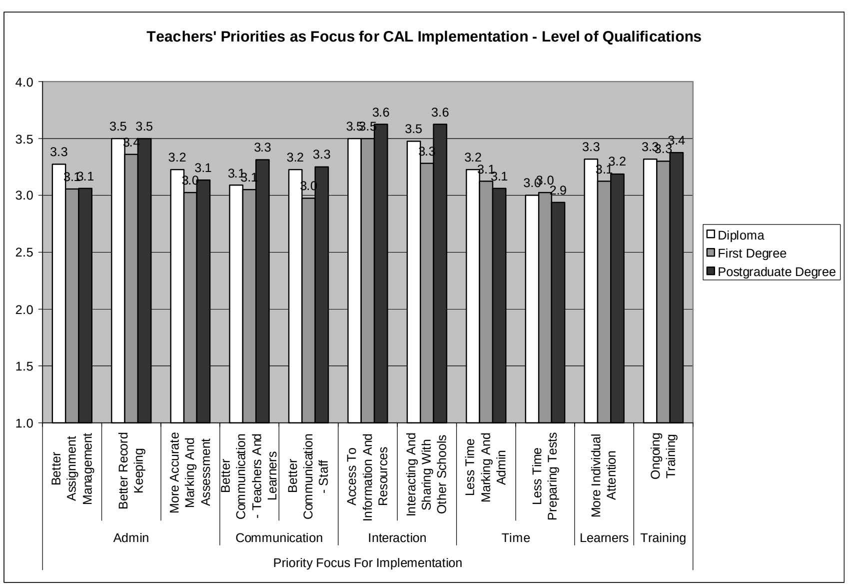
4.3.2.2.1.1.5 Level of Qualifications

Agreement generally is at similar levels for teachers from all qualification groups. Strong agreement across all groups is indicated for the need for better record keeping systems, access to information and resources, interacting and sharing with other schools and the need for ongoing training as priorities for CAL implementation in schools in South Africa.

Table 105: Teachers' Priority Focuses for the Implementation of CAL in Schools – Level of Qualification Breakdown

Groups	Items	Level of Qualifications	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Admin	Better Assignment Management	Diploma	32	64	5	0	95	5
		First Degree	22	61	17	0	83	17
		Postgraduate Degree	31	44	25	0	75	25
	Better Record Keeping	Diploma	55	41	5	0	95	5
		First Degree	44	49	8	0	92	8
		Postgraduate Degree	56	38	6	0	94	6
	More Accurate Marking And Assessment	Diploma	41	41	18	0	82	18
		First Degree	21	62	18	0	82	18
		Postgraduate Degree	27	60	13	0	87	13
Communication	Better Communication - Teachers And Learners	Diploma	36	36	27	0	73	27
		First Degree	23	59	18	0	82	18
		Postgraduate Degree	38	56	6	0	94	6
	Better Communication - Staff	Diploma	36	50	14	0	86	14
		First Degree	21	56	23	0	77	23
		Postgraduate Degree	38	50	13	0	88	13
Interaction	Access To Information And Resources	Diploma	55	41	5	0	95	5
		First Degree	58	35	8	0	93	8
		Postgraduate Degree	69	25	6	0	94	6
	Interacting And Sharing With Other Schools	Diploma	57	33	10	0	90	10
		First Degree	38	51	10	0	90	10
		Postgraduate Degree	63	38	0	0	100	0
Time	Less Time Marking And Admin	Diploma	41	41	18	0	82	18
		First Degree	30	53	18	0	83	18
		Postgraduate Degree	31	44	25	0	75	25
	Less Time Preparing Tests	Diploma	32	41	23	5	73	27
		First Degree	25	53	23	0	78	23
		Postgraduate Degree	25	44	31	0	69	31
Learners	More Individual Attention	Diploma	50	32	18	0	82	18
		First Degree	33	48	20	0	80	20
		Postgraduate Degree	38	44	19	0	81	19
Training	Ongoing Training	Diploma	41	50	9	0	91	9
		First Degree	40	50	10	0	90	10
		Postgraduate Degree	38	63	0	0	100	0

Figure 113



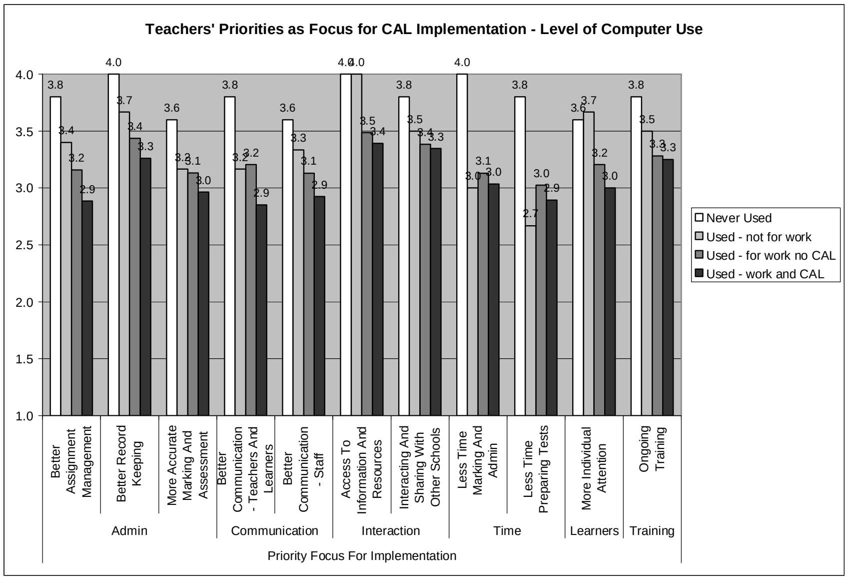
4.3.2.2.1.1.6 Level of Computer Use

Table 106: Teachers' Priority Focuses for the Implementation of CAL in Schools – Level of Computer Use Breakdown

Groups	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Admin	Better Assignment Management	Never Used	80	20	0	0	100	0
		Used - not for work	40	60	0	0	100	0
		Used - for work no CAL	26	63	11	0	89	11
		Used - work and CAL	15	58	27	0	73	27
	Better Record Keeping	Never Used	100	0	0	0	100	0
		Used - not for work	67	33	0	0	100	0
		Used - for work no CAL	46	51	3	0	97	3
		Used - work and CAL	41	44	15	0	85	15
	More Accurate Marking And Assessment	Never Used	60	40	0	0	100	0
		Used - not for work	33	50	17	0	83	17
		Used - for work no CAL	26	61	13	0	87	13
		Used - work and CAL	22	52	26	0	74	26
Communication	Better Communication - Teachers And Learners	Never Used	80	20	0	0	100	0
		Used - not for work	33	50	17	0	83	17
		Used - for work no CAL	33	54	13	0	87	13
		Used - work and CAL	15	56	30	0	70	30
	Better Communication - Staff	Never Used	80	0	20	0	80	20
		Used - not for work	33	67	0	0	100	0
		Used - for work no CAL	28	56	15	0	85	15
		Used - work and CAL	19	56	26	0	74	26
Interaction	Access To Information And Resources	Never Used	100	0	0	0	100	0
		Used - not for work	100	0	0	0	100	0
		Used - for work no CAL	51	46	3	0	97	3
		Used - work and CAL	54	32	14	0	86	14
	Interacting And Sharing With Other Schools	Never Used	80	20	0	0	100	0
		Used - not for work	67	17	17	0	83	17
		Used - for work no CAL	44	51	5	0	95	5
		Used - work and CAL	46	42	12	0	88	12
Time	Less Time Marking And Admin	Never Used	100	0	0	0	100	0
		Used - not for work	33	33	33	0	67	33
		Used - for work no CAL	31	51	18	0	82	18
		Used - work and CAL	25	54	21	0	79	21
	Less Time Preparing Tests	Never Used	80	20	0	0	100	0
		Used - not for work	17	50	17	17	67	33
		Used - for work no CAL	26	51	23	0	77	23
		Used - work and CAL	21	46	32	0	68	32
Learners	More Individual Attention	Never Used	60	40	0	0	100	0
		Used - not for work	67	33	0	0	100	0
		Used - for work no CAL	36	49	15	0	85	15
		Used - work and CAL	32	36	32	0	68	32
Training	Ongoing Training	Never Used	80	20	0	0	100	0
		Used - not for work	50	50	0	0	100	0
		Used - for work no CAL	36	56	8	0	92	8
		Used - work and CAL	36	54	11	0	89	11

The data demonstrates that teachers who have never used computers before show strong levels of agreement across the board of priority items, while at the other end teachers who have used computers for work and for CAL indicate lower levels of agreement across the board. However, teachers in all computers use groups show strong agreement for the need of better record keeping systems, having access to information and resources, interacting and sharing resources with other schools and the need for ongoing training as priorities for CAL implementation.

Figure 114



4.3.2.2.1.2 The Biggest Priority for CAL Implementation

This section reports on the factors that teachers believe to be the biggest priorities for CAL implementation. Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: First Priority, Second Priority and Third Priority. In addition, a weighted average has been calculated by assigning weighted values to the ratings, with higher weightings allocated to first priority responses and lower weightings to the third priority responses, producing a Weighted Average Priority view.

4.3.2.2.1.2.1 Total Teacher Group

Table 107: Teachers' Biggest Priorities for the Implementation of CAL in Schools – Total Teacher Group

	Levels of Priority			
Items	**First Priority**	**Second Priority**	**Third Priority**	**Weighted Average Priority**
Access to information and resources	19	26	18	21
Better Assignment Management	1	5	3	3
Better Communication - Teachers And Learners	12	1	12	9
Better Communication - Teachers And Teachers	1	3	1	2
Better Record Keeping	10	9	11	10
Interacting And Sharing Resources With Other Schools	5	13	11	9
Less Time Marking And Administrating	8	7	9	8
Less Time Preparing Tests	3	4	3	3
More Accurate Marking	3	5	4	4
More Individual Attention To Learners	29	17	14	22
Ongoing Training At Time That Suits Teacher	9	9	15	10

On average, the teaching group as a whole indicates that providing more individual attention to learners and receiving greater access to information and resources are the biggest priorities for CAL implementation. The literature indicates that the CAL platforms allow learners greater opportunity to spend more independent time performing various educational activities that also allow teachers more time to provide learners with face to face interaction (Alessi *et al.*, 2001; Hitchcock, 2000). The use of CAL systems also allow rapid, easy and increased levels of access to a wide variety of information sources that can be stored locally on computers and adjusted to suit particular educational needs (Baillie *et al.*, 2000; Lelouche, 1998; Wiley, 2001).

4.3.2.2.1.2.2 Gender Breakdown

Table 108: Teachers' Biggest Priorities for the Implementation of CAL in Schools – Gender Breakdown

Gender Breakdown	Items	Levels of Priority			Weighted Average Priority
		First Priority	Second Priority	Third Priority	
Female	Access to information and resources	22	22	20	22
	Better Assignment Management	2	2	5	3
	Better Communication - Teachers And Learners	7	0	5	5
	Better Communication - Teachers And Teachers	0	0	3	1
	Better Record Keeping	10	10	8	9
	Interacting And Sharing Resources With Other Schools	5	12	10	8
	Less Time Marking And Administrating	7	7	13	8
	Less Time Preparing Tests	5	5	5	5
	More Accurate Marking	5	5	5	5
	More Individual Attention To Learners	27	22	18	24
	Ongoing Training At Time That Suits Teacher	10	15	10	11
Male	Access to information and resources	17	31	15	21
	Better Assignment Management	0	9	0	3
	Better Communication - Teachers And Learners	17	3	21	13
	Better Communication - Teachers And Teachers	3	6	0	3
	Better Record Keeping	11	9	15	11
	Interacting And Sharing Resources With Other Schools	6	14	12	9
	Less Time Marking And Administrating	8	6	6	7
	Less Time Preparing Tests	0	3	0	1
	More Accurate Marking	0	6	3	2
	More Individual Attention To Learners	31	11	9	20
	Ongoing Training At Time That Suits Teacher	8	3	21	9

Both male and female teaching groups indicate that providing individual attention to learners and having greater access to information and resources are the biggest priorities for CAL implementation in South African schools.

4.3.2.2.1.2.3 Demographic Breakdown

Table 109: Teachers' Biggest Priorities for the Implementation of CAL in Schools – Demographic Breakdown

Demographic Breakdown	Items	Levels of Priority			Weighted Average Priority
		First Priority	Second Priority	Third Priority	
Black	Access to information and resources	23	33	8	23
	Better Assignment Management	0	8	0	3
	Better Communication - Teachers And Learners	23	8	17	17
	Better Communication - Teachers And Teachers	0	8	0	3
	Better Record Keeping	15	0	17	11
	Interacting And Sharing Resources With Other Schools	8	17	8	11
	Less Time Marking And Administrating	8	8	8	8
	Less Time Preparing Tests	0	8	0	3
	More Accurate Marking	0	0	8	2
	More Individual Attention To Learners	15	0	17	11
	Ongoing Training At Time That Suits Teacher	8	8	17	10
Coloured	Access to information and resources	12	40	13	21
	Better Assignment Management	4	8	8	6
	Better Communication - Teachers And Learners	4	0	25	7
	Better Communication - Teachers And Teachers	4	4	0	3
	Better Record Keeping	12	8	13	11
	Interacting And Sharing Resources With Other Schools	4	12	13	8
	Less Time Marking And Administrating	4	4	4	4
	Less Time Preparing Tests	0	8	0	2
	More Accurate Marking	0	0	0	0
	More Individual Attention To Learners	36	4	8	21
	Ongoing Training At Time That Suits Teacher	20	12	17	17
White	Access to information and resources	23	15	24	21
	Better Assignment Management	0	3	0	1
	Better Communication - Teachers And Learners	13	0	3	7
	Better Communication - Teachers And Teachers	0	0	3	1
	Better Record Keeping	8	13	8	9
	Interacting And Sharing Resources With Other Schools	5	13	11	9
	Less Time Marking And Administrating	10	8	13	10
	Less Time Preparing Tests	5	0	5	4
	More Accurate Marking	5	10	5	7
	More Individual Attention To Learners	28	31	16	26
	Ongoing Training At Time That Suits Teacher	3	8	13	6

Teachers from all demographic groups demonstrate that receiving greater access to information and resources are of the biggest priorities for CAL implementation in South African schools, while teachers from the Coloured and White demographic groups indicate that providing individual attention to learners is also of high priority. Teachers from the Black demographic group also indicate that having better communication between teachers and learners is of importance, while teachers from the Coloured demographic group indicate that receiving training at a time that suits teachers is of high priority.

4.3.2.2.1.2.4 Age Groups

Table 110: Teachers' Biggest Priorities for the Implementation of CAL in Schools – Age Group Breakdown

Age Groups	Items	Levels of Priority			Weighted Average Priority
		First Priority	Second Priority	Third Priority	
21 - 30	Access to information and resources	0	29	43	17
	Better Assignment Management	0	0	0	0
	Better Communication - Teachers And Learners	38	0	0	19
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	25	43	0	25
	Interacting And Sharing Resources With Other Schools	13	0	29	12
	Less Time Marking And Administrating	0	0	0	0
	Less Time Preparing Tests	0	14	0	4
	More Accurate Marking	13	0	14	9
	More Individual Attention To Learners	13	14	14	13
	Ongoing Training At Time That Suits Teacher	0	0	0	0
31 - 40	Access to information and resources	25	28	16	24
	Better Assignment Management	3	6	6	5
	Better Communication - Teachers And Learners	6	3	16	7
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	6	3	10	6
	Interacting And Sharing Resources With Other Schools	3	22	6	9
	Less Time Marking And Administrating	3	9	10	6
	Less Time Preparing Tests	3	0	0	2
	More Accurate Marking	3	0	3	2
	More Individual Attention To Learners	31	13	16	23
	Ongoing Training At Time That Suits Teacher	16	16	16	16
41 - 50	Access to information and resources	11	26	12	16
	Better Assignment Management	0	7	0	2
	Better Communication - Teachers And Learners	11	0	15	9
	Better Communication - Teachers And Teachers	4	7	4	5
	Better Record Keeping	15	4	15	12
	Interacting And Sharing Resources With Other Schools	4	7	12	6
	Less Time Marking And Administrating	11	7	12	10
	Less Time Preparing Tests	4	7	4	5
	More Accurate Marking	0	11	0	3
	More Individual Attention To Learners	33	15	12	23
	Ongoing Training At Time That Suits Teacher	7	7	15	9
51 - 60	Access to information and resources	50	25	13	35
	Better Assignment Management	0	0	0	0
	Better Communication - Teachers And Learners	13	0	0	6
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	0	13	13	6
	Interacting And Sharing Resources With Other Schools	13	13	13	13
	Less Time Marking And Administrating	13	0	13	9
	Less Time Preparing Tests	0	0	13	3
	More Accurate Marking	0	13	0	4
	More Individual Attention To Learners	13	38	13	20
	Ongoing Training At Time That Suits Teacher	0	0	25	5
Over 60	Access to information and resources	0	0	50	10
	Better Assignment Management	0	0	0	0
	Better Communication - Teachers And Learners	0	0	0	0
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	0	50	0	15
	Interacting And Sharing Resources With Other Schools	0	0	0	0
	Less Time Marking And Administrating	50	0	0	25
	Less Time Preparing Tests	0	0	0	0
	More Accurate Marking	0	0	50	10
	More Individual Attention To Learners	50	50	0	40
	Ongoing Training At Time That Suits Teacher	0	0	0	0

Teachers from the 21 to 30 age group indicate that having better record keeping systems is of the highest priority for CAL implementation, while teachers in the age groups from ages 31 to 60 indicate that receiving greater access to information and resources and providing individual attention to learners are of most significance for CAL implementation. Teachers in the over 60 age group also indicate that providing greater individual attention to learners and spending less time on marking and administration activities are of high priority.

4.3.2.2.1.2.5 Level of Qualifications

Table 111: Teachers' Biggest Priorities for the Implementation of CAL in Schools – Level of Qualification Breakdown

Level of Qualifications	Items	Levels of Priority: First Priority	Second Priority	Third Priority	Weighted Average Priority
Diploma	Access to information and resources	14	29	29	21
	Better Assignment Management	0	5	5	2
	Better Communication - Teachers And Learners	14	5	14	11
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	5	5	14	7
	Interacting And Sharing Resources With Other Schools	9	10	10	9
	Less Time Marking And Administrating	5	5	0	4
	Less Time Preparing Tests	5	5	0	4
	More Accurate Marking	0	5	0	1
	More Individual Attention To Learners	32	14	10	22
	Ongoing Training At Time That Suits Teacher	18	19	19	19
First Degree	Access to information and resources	18	33	16	22
	Better Assignment Management	3	5	3	3
	Better Communication - Teachers And Learners	15	0	14	10
	Better Communication - Teachers And Teachers	0	3	3	1
	Better Record Keeping	10	8	11	10
	Interacting And Sharing Resources With Other Schools	3	15	8	8
	Less Time Marking And Administrating	10	8	14	10
	Less Time Preparing Tests	3	5	3	3
	More Accurate Marking	0	3	5	2
	More Individual Attention To Learners	31	15	16	23
	Ongoing Training At Time That Suits Teacher	8	5	8	7
Postgraduate Degree	Access to information and resources	31	6	6	19
	Better Assignment Management	0	6	0	2
	Better Communication - Teachers And Learners	0	0	6	1
	Better Communication - Teachers And Teachers	6	6	0	5
	Better Record Keeping	19	19	6	16
	Interacting And Sharing Resources With Other Schools	6	13	19	11
	Less Time Marking And Administrating	6	6	13	8
	Less Time Preparing Tests	0	0	6	1
	More Accurate Marking	13	13	6	11
	More Individual Attention To Learners	19	25	13	19
	Ongoing Training At Time That Suits Teacher	0	6	25	7

Teachers from all qualifications groups agree that receiving greater access to information resources and providing individual attention to learners are of high priority for the implementation of CAL systems in schools in South Africa. Teachers with diplomas also indicate that having ongoing training at times that suit teachers is of significance, while teachers in the postgraduate degree qualification group also suggest that having better record keeping systems is of high priority.

4.3.2.2.1.2.6 Level of Computer Use

Table 112: Teachers' Biggest Priorities for the Implementation of CAL in Schools – Level of Computer Use Breakdown

Level of Computer Use	Items	Levels of Priority First Priority	Second Priority	Third Priority	Weighted Average Priority
Never Used	Access to information and resources	20	20	0	16
	Better Assignment Management	0	20	0	6
	Better Communication - Teachers And Learners	20	0	40	18
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	0	0	0	0
	Interacting And Sharing Resources With Other Schools	0	20	20	10
	Less Time Marking And Administrating	20	40	0	22
	Less Time Preparing Tests	20	0	0	10
	More Accurate Marking	0	0	0	0
	More Individual Attention To Learners	0	0	40	8
	Ongoing Training At Time That Suits Teacher	20	0	0	10
Used - not for work	Access to information and resources	33	0	20	21
	Better Assignment Management	0	0	0	0
	Better Communication - Teachers And Learners	0	0	20	4
	Better Communication - Teachers And Teachers	0	0	0	0
	Better Record Keeping	0	20	20	10
	Interacting And Sharing Resources With Other Schools	17	40	0	20
	Less Time Marking And Administrating	17	0	20	12
	Less Time Preparing Tests	0	0	20	4
	More Accurate Marking	0	0	0	0
	More Individual Attention To Learners	33	20	0	23
	Ongoing Training At Time That Suits Teacher	0	20	0	6
Used - for work no CAL	Access to information and resources	21	32	21	24
	Better Assignment Management	3	5	3	3
	Better Communication - Teachers And Learners	13	0	8	8
	Better Communication - Teachers And Teachers	3	5	0	3
	Better Record Keeping	13	8	13	12
	Interacting And Sharing Resources With Other Schools	0	11	11	5
	Less Time Marking And Administrating	5	3	13	6
	Less Time Preparing Tests	3	5	0	3
	More Accurate Marking	3	3	8	4
	More Individual Attention To Learners	32	16	13	23
	Ongoing Training At Time That Suits Teacher	5	13	11	9
Used - work and CAL	Access to information and resources	14	25	15	18
	Better Assignment Management	0	4	4	2
	Better Communication - Teachers And Learners	11	4	12	9
	Better Communication - Teachers And Teachers	0	0	4	1
	Better Record Keeping	11	11	8	10
	Interacting And Sharing Resources With Other Schools	11	11	12	11
	Less Time Marking And Administrating	7	7	4	6
	Less Time Preparing Tests	0	4	4	2
	More Accurate Marking	4	11	0	5
	More Individual Attention To Learners	29	21	12	23
	Ongoing Training At Time That Suits Teacher	14	4	27	14

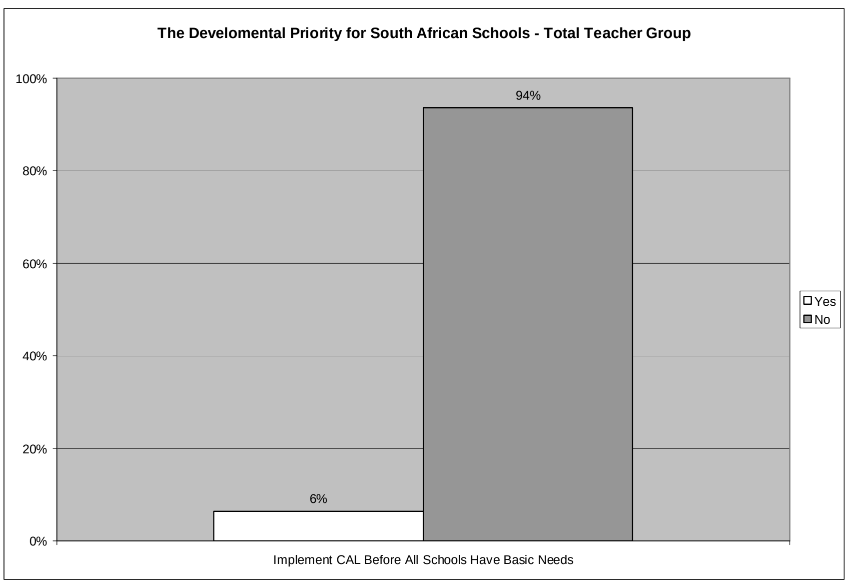
Teachers from all computer use groups agree that having greater access to information and resources is of priority for CAL implementation, while all teachers that have used computers feel that providing individual attention to learners if of high importance. Teachers who have never used computers feel that having less time marking and having better communication between teachers and learners are of significance, while teachers who have used computers but not for work feel that sharing resources and networking with other schools is vital.

4.3.2.2.2 The Developmental Priority for South African Schools

This section provides insight into whether teachers feel that the widespread implementation of CAL systems should occur before all schools in the country have received basic needs such as sufficient staffing, water, sanitation and electrical facilities. Results are presented in graphs as a percentage breakdown of agreement versus disagreement.

4.3.2.2.2.1 Total Teacher Group

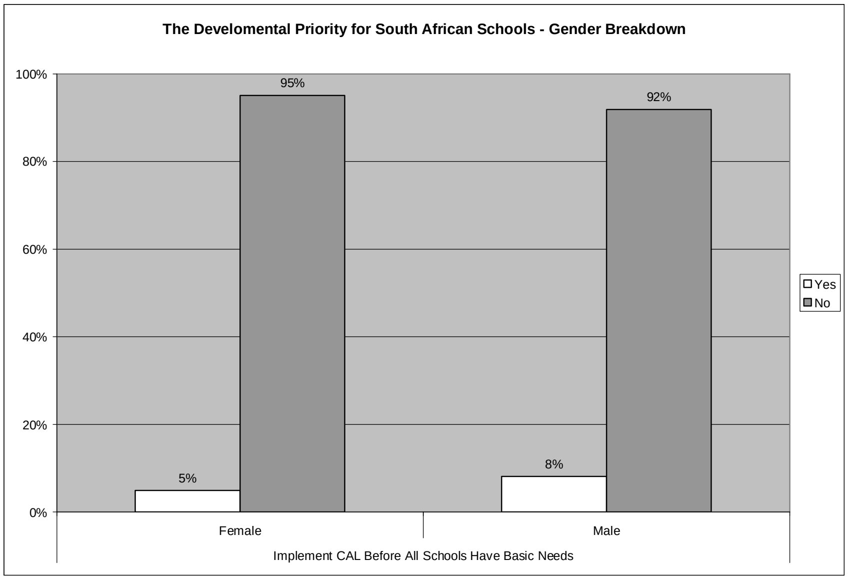
Figure 115



Teachers as a group overwhelmingly indicate that the widespread implementation of CAL systems should not occur before all schools have their basic needs fulfilled. The literature indicates that a discrepancy exists between the aspiration for technology in schools and the vision that all schools have the fulfilment of basic infrastructural needs (Johnson, 2003; Richard, 2003). Also, Maslow's hierarchy of needs in the educational and technological framework requires that all adequate infrastructural needs are met in schools before technology related learning systems are implemented, as technology may not succeed or be relevant in learning environments that are under resourced (Johnson, 2003) – a view that the findings support.

4.3.2.2.2.2 Gender Breakdown

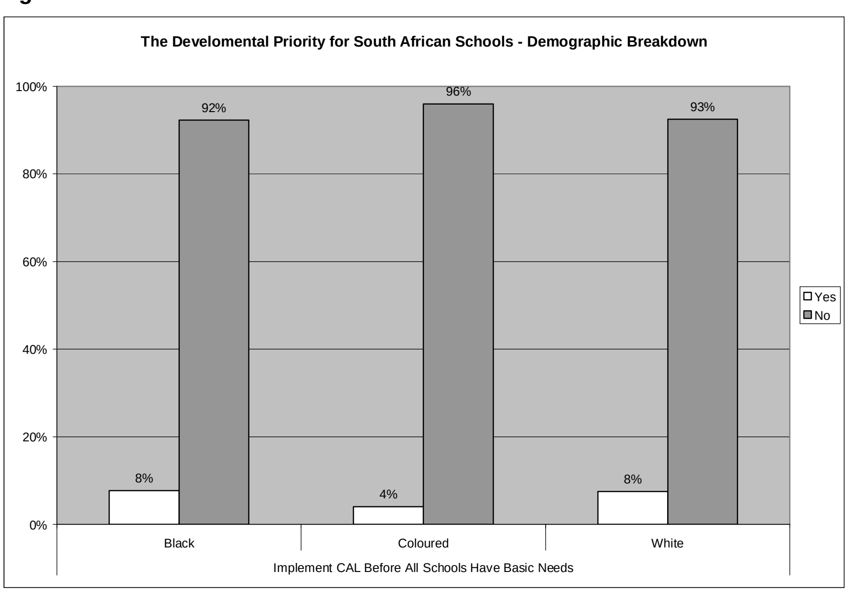
Figure 116



Both female and male groups of teachers agree strongly that the widespread implementation of CAL systems should not occur before all schools have their basic needs provided.

4.3.2.2.2.3 Demographic Breakdown

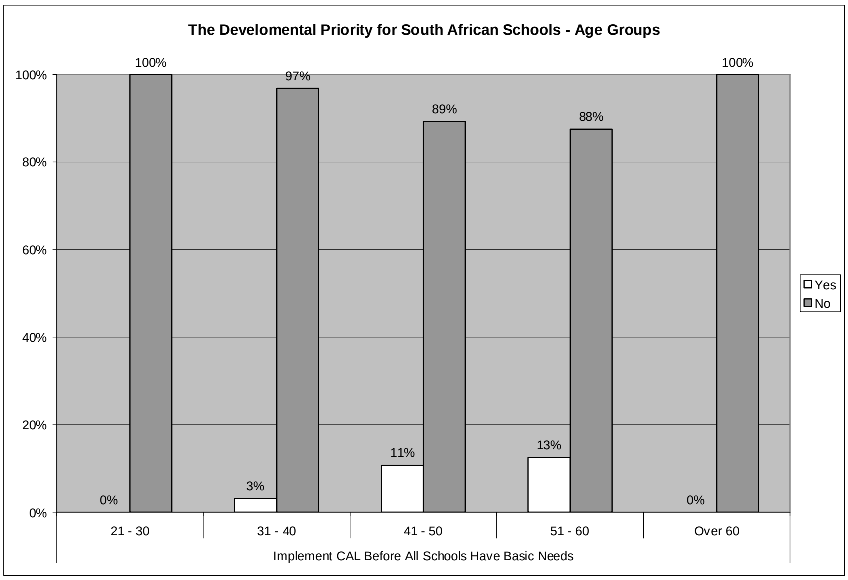
Figure 117



All the demographic groups agree strongly that the widespread implementation of CAL systems should not occur before all schools have their basic needs fulfilled.

4.3.2.2.2.4 Age Groups

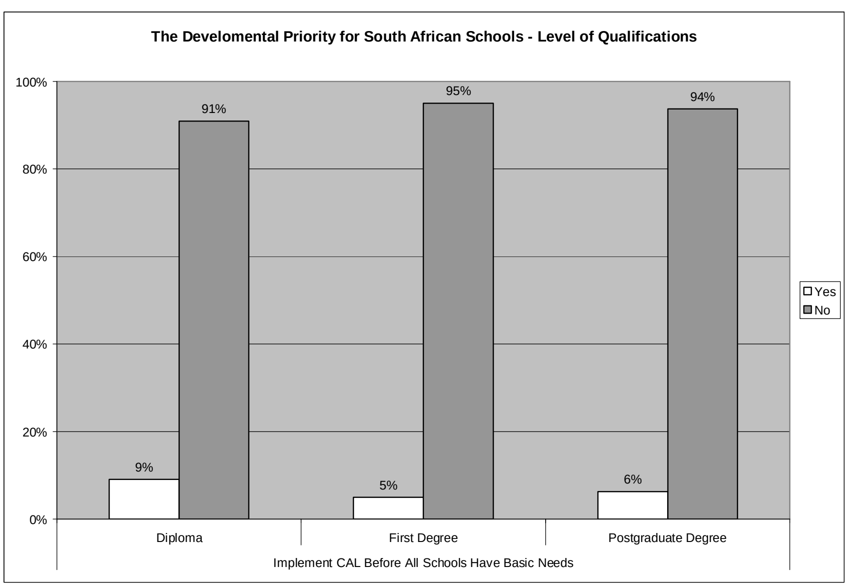
Figure 118



All age groups agree significantly that the widespread implementation of CAL systems should not occur before all schools have their basic needs provided.

4.3.2.2.2.5 Level of Qualifications

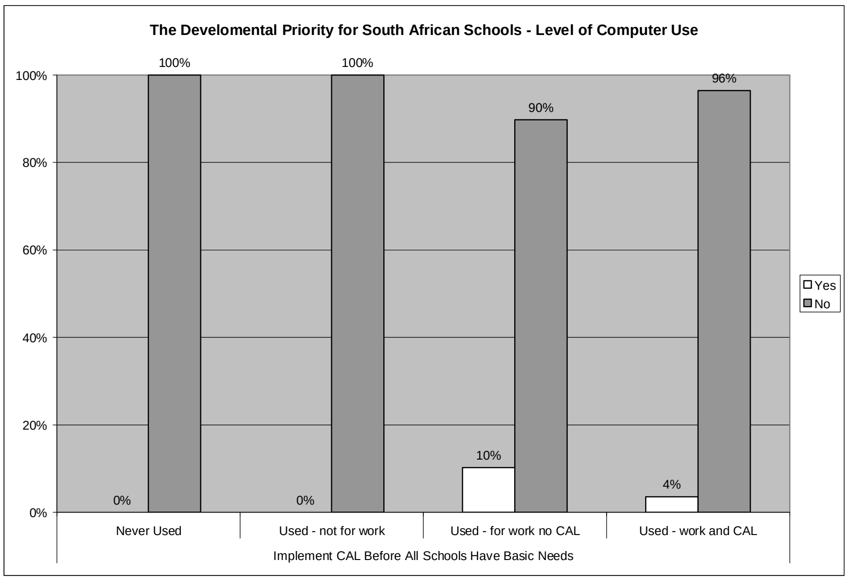
Figure 119



Teachers with all levels of qualifications also agree overwhelmingly that the widespread implementation of CAL systems should not occur before all schools have their basic needs fulfilled.

4.3.2.2.2.6 Level of Computer Use

Figure 120



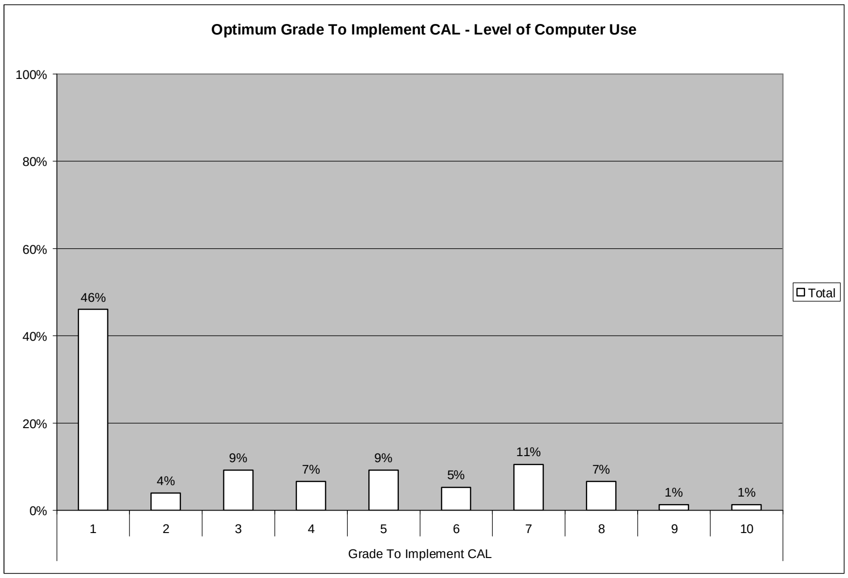
Teachers who have all levels of experience in computer use agree strongly that the widespread implementation of CAL systems should not occur before all schools have their basic needs provided.

4.3.3 The Optimum Grade for CAL Implementation

This section demonstrates which grades teachers believe to be the most effective and relevant to begin the process of CAL implementation. Results are demonstrated in graph format, indicating the percentage distribution for grades as indicated in teacher responses. Also, an average across all the grade responses has been calculated and also presented in graph format.

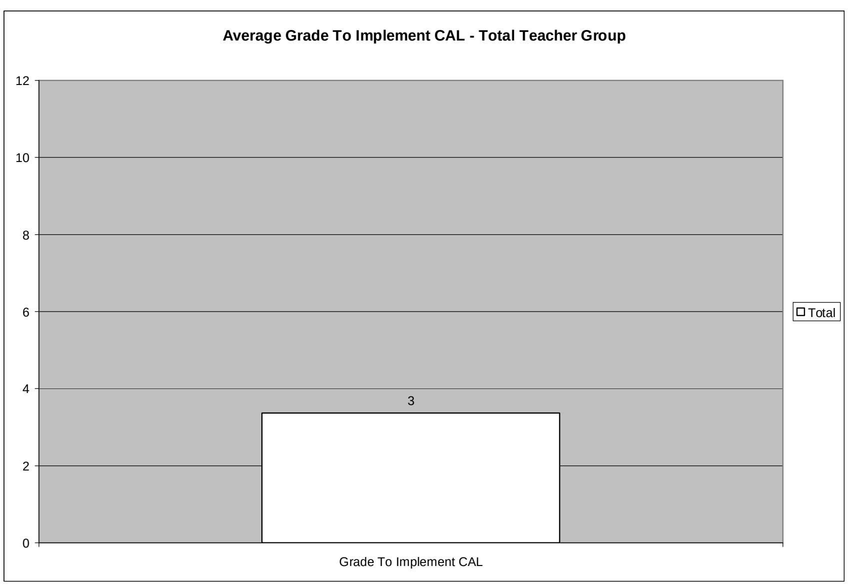
4.3.3.1 Total Teacher Group

Figure 121



The teaching group as a whole shows greater consensus at 46% that Grade One the optimum grade for CAL implementation at schools.

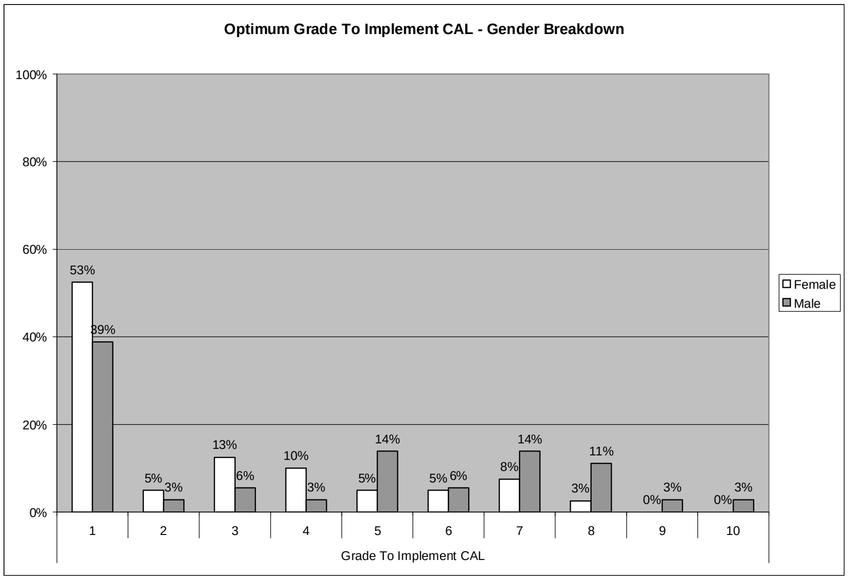
Figure 122



On average however, the optimal grade for CAL implementation in schools is Grade Three.

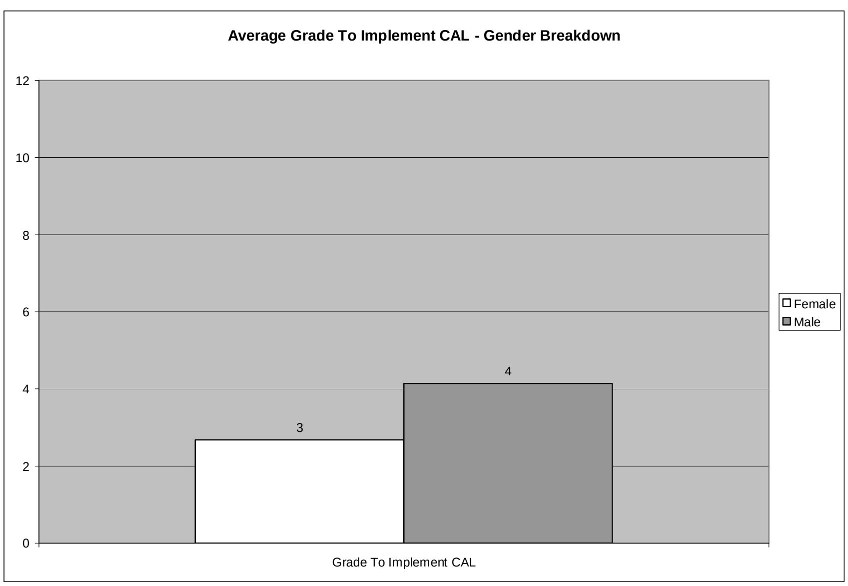
4.3.3.2 Gender Breakdown

Figure 123



Both female and male teaching groups show greater agreement, at 53% and 39% respectively, that the optimum grade for CAL implementation at schools is Grade One. However, male teachers also indicate that Grades Five to Eight are favourable for CAL implementation, as 45% of the responses are spread across these Grades in the findings.

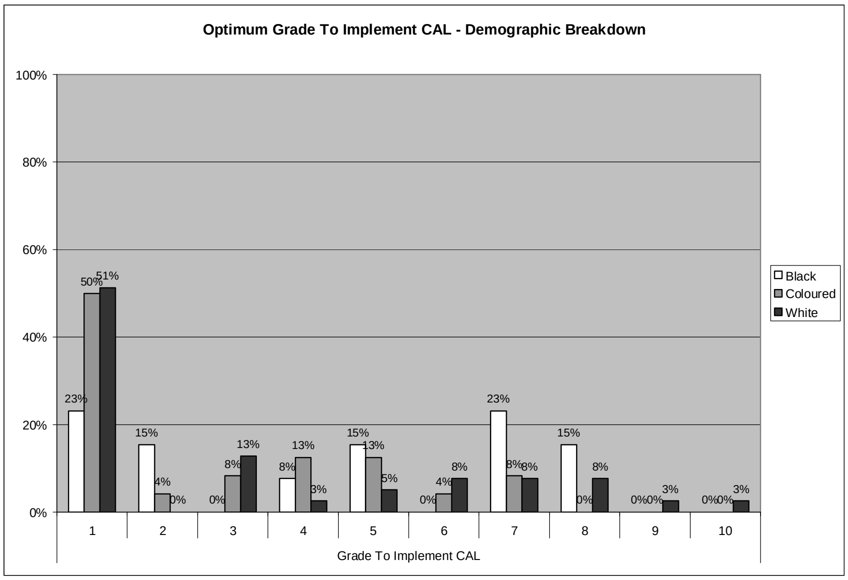
Figure 124



The female teaching group on average indicates that the optimal grade for CAL implementation in schools is Grade Three, while the male teaching group indicates Grade Four.

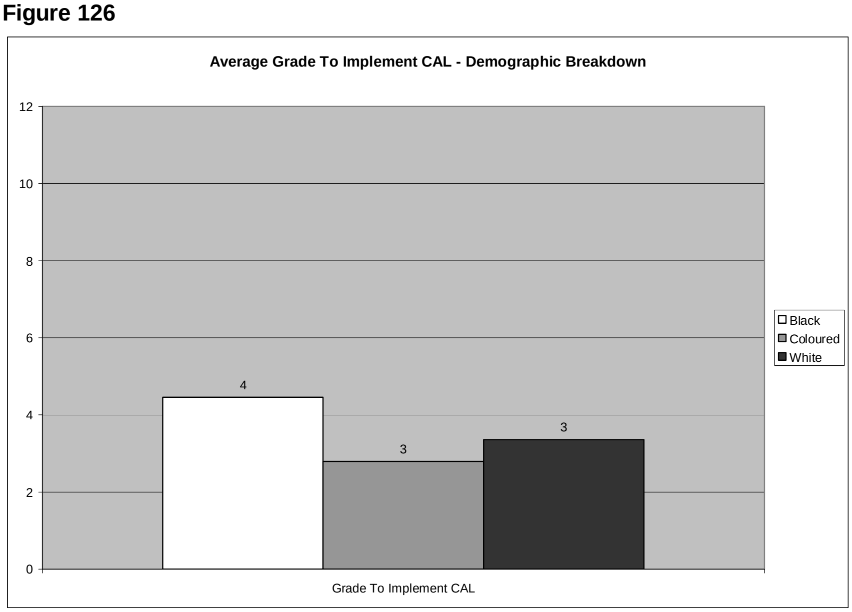
4.3.3.3 Demographic Breakdown

Figure 125



The Coloured and White demographic groups suggest that the optimum grade for CAL implementation at schools is Grade One, while teachers who belong to the Black demographic group are undecided, indicating both Grades One and Seven as favourable at 23% agreement.

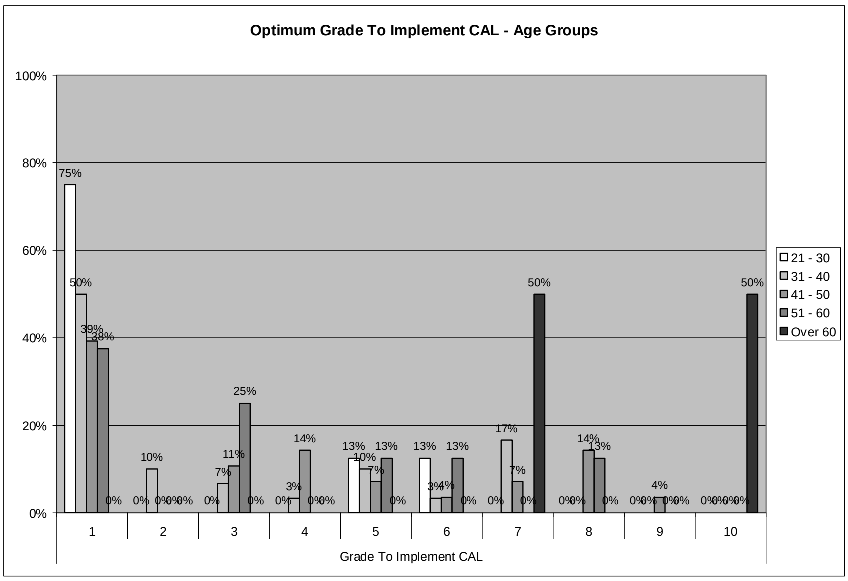
Figure 126



Teachers from both Coloured and White demographic groups on average believe that Grade Three is the optimal grade for CAL implementation, while teachers who belong to the Black demographic group on average feel that Grade Four is the optimal grade.

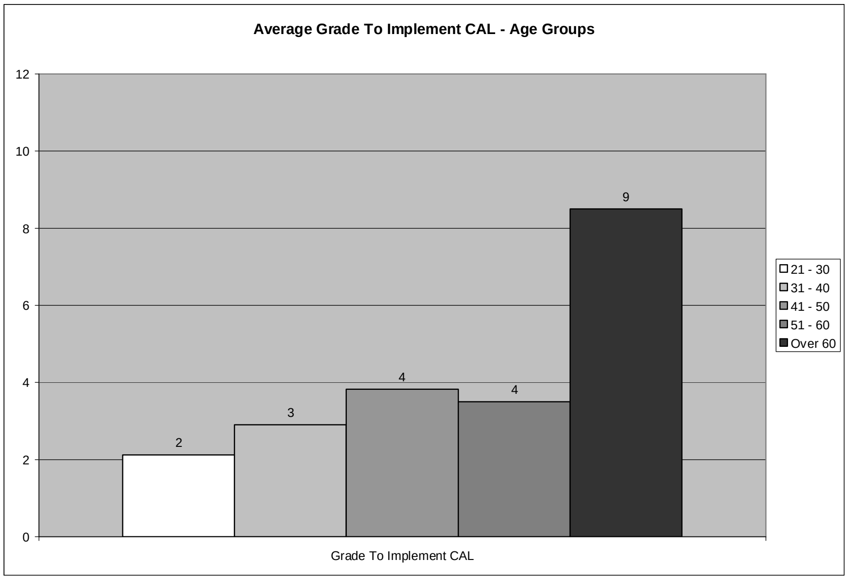
4.3.3.4 Age Groups

Figure 127



Teachers in age groups ranging from ages 21 to 60 agree strongly that Grade One is the optimal grade for CAL implementation, while teachers in the over 60 age group feel that Grade Seven and Grade Ten are the most relevant grades.

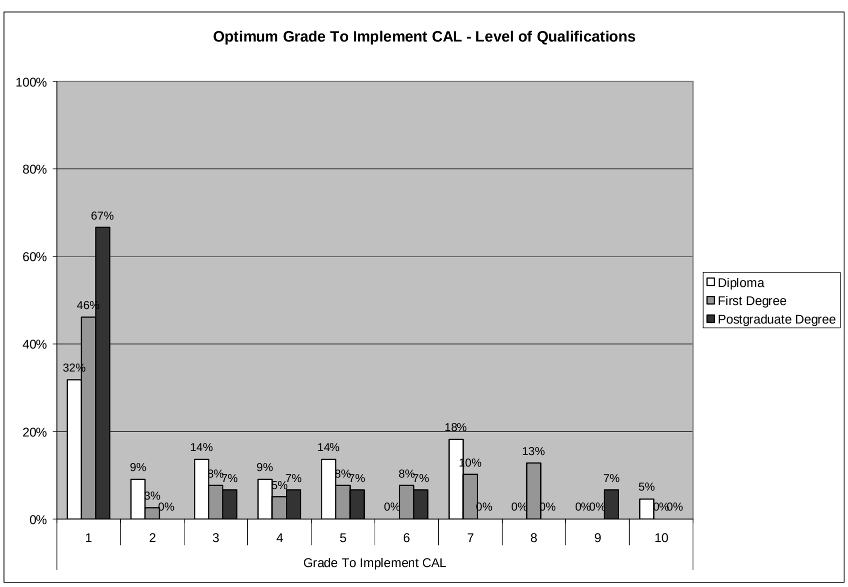
Figure 128



On average, teachers in the 21 to 30 age group indicate that Grade Two is the optimal grade for CAL implementation, while teachers in the 31 to 40 age group indicate Grade Three. Teachers in age groups from 41 to 60 indicate Grade Four as the most relevant Grade for CAL implementation, while teachers in the over 60 age group indicate Grade Nine.

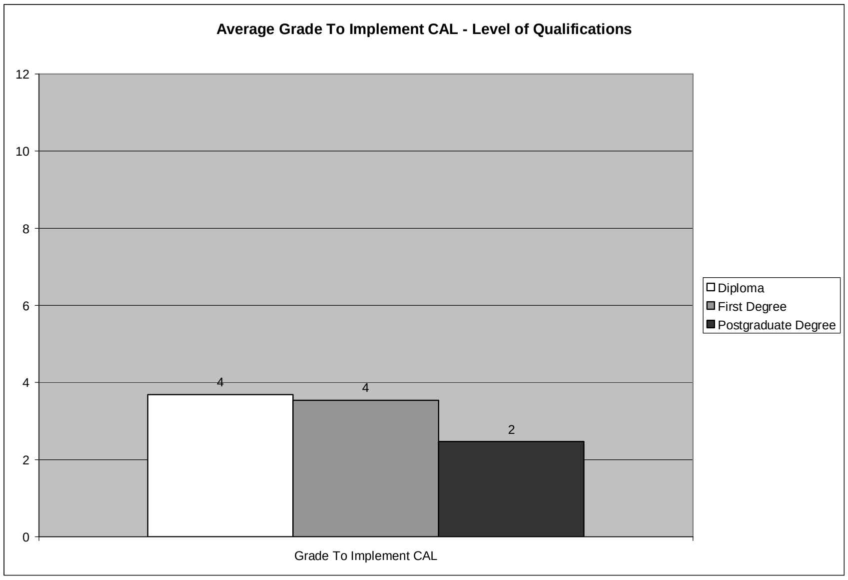
4.3.3.5 Level of Qualifications

Figure 129



Teachers in all qualifications groups strongly agree that Grade One is the optimal grade for CAL implementation. However, teachers with diplomas agree at lower levels at 32%, compared to the postgraduate degree teacher group who demonstrates 67% consensus.

Figure 130

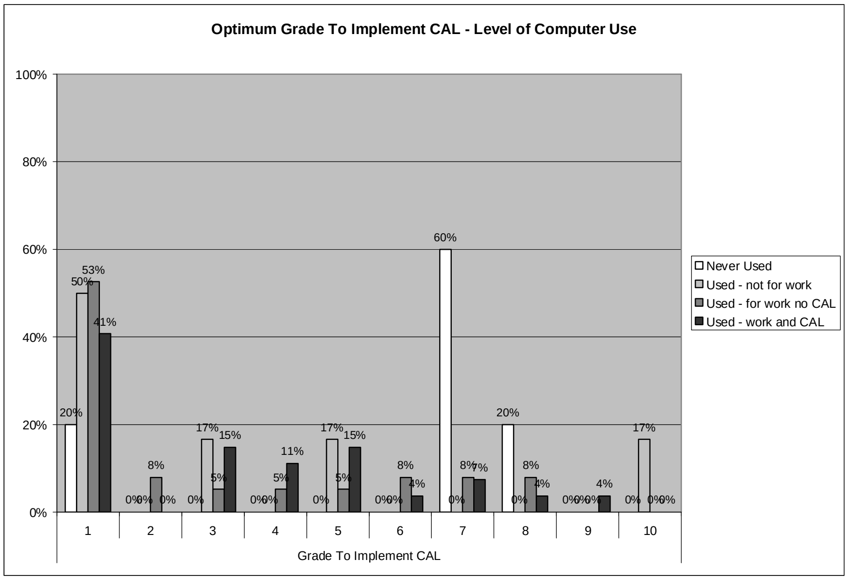


On average, teachers in both the diploma and degree qualification groups indicate that Grade Four is the optimal grade for CAL implementation, while teachers in the postgraduate qualification group believe Grade Two to be the most relevant.

4.3.3.6 Level of Computer Use

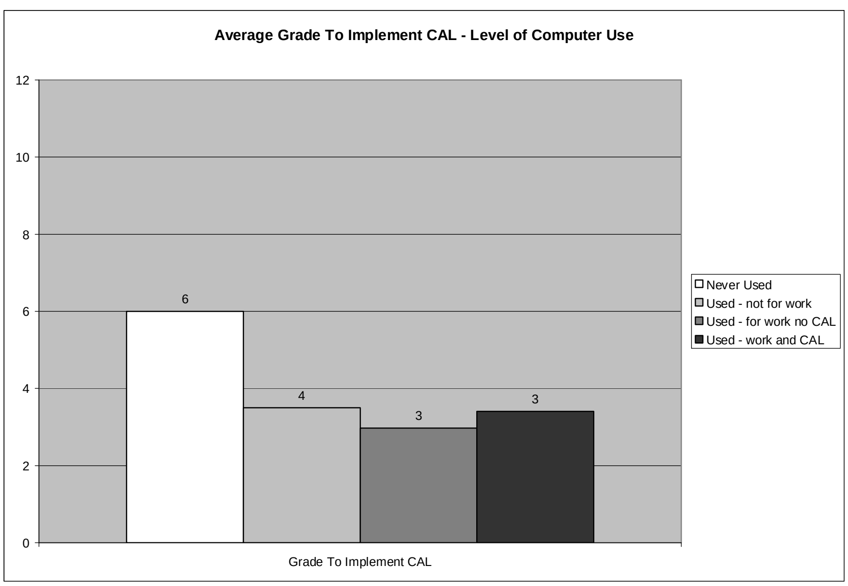
All teachers who have used computers to various degrees indicate overwhelmingly that Grade One is the optimal grade for CAL implementation, while teachers who have never used computers believe Grade Seven to be the optimal grade for implementation.

Figure 131



On average, teachers who have never used computers believe that Grade Six is the optimal grade for CAL implementation, while teachers who have used computers but not for work see Grade Four to be the most relevant. Teachers who have used computers in the work context in various degrees believe that Grade Three is the optimal grade for CAL implementation.

Figure 132



4.3.4 The Optimum Structure for CAL Implementation in Schools

This section reports on the structures that teachers believe to be most suitable for CAL implementation in schools. Items are sorted into categories and their relevant items that include:

- *Own computer*, including each learner having their own computer, each teacher having their own computer and having computers in classrooms for teachers only

- *Shared computer*, including having one computer per every five learners in the classroom, having one computer for teachers and one for learners, having the teacher and learners share a computer and having one computer for learners while the teacher uses a computer in the staffroom

- *No computers*, including having no computers in classrooms and having computer access only for learners who do Computer Science as a subject.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly satisfied, somewhat satisfied, somewhat dissatisfied and strongly dissatisfied. A totals column has been added to provide a summary of overall satisfaction and dissatisfaction.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly dissatisfied to 4 for strongly satisfied. In graph form, an average score in the following brackets are indicative of the following general levels:

- 1 to 1.75 indicates strong dissatisfaction

- 1.76 to 2.5 indicates general dissatisfaction

- 2.51 to 3.25 indicates general satisfaction

- 3.26 to 4 indicates strong satisfaction.

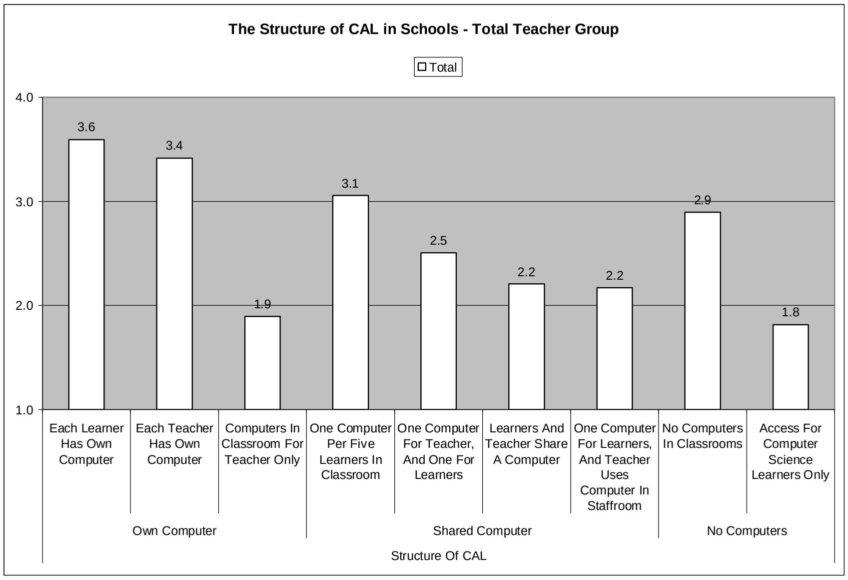
4.3.4.1 Total Teacher Group

Table 113: The Optimum Structure for CAL Implementation in Schools – Total Teacher Group

Categories	Items	Levels of Satisfaction: Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied	Totals: Satisfied	Dissatisfied
Own Computer	Each Learner Has Own Computer	74	16	7	4	89	11
	Each Teacher Has Own Computer	60	30	3	8	90	10
	Computers In Classroom For Teacher Only	5	18	37	39	24	76
Shared Computer	One Computer Per Five Learners In Classroom	32	45	18	4	77	23
	One Computer For Teacher, And One For Learners	16	43	18	23	58	42
	Learners And Teacher Share A Computer	8	32	32	27	40	60
	One Computer For Learners, And Teacher Uses Computer In Staffroom	9	29	32	30	38	62
No Computers	No Computers In Classrooms	25	45	25	5	70	30
	Access For Computer Science Learners Only	5	14	37	43	20	80

On average, the teacher group as a whole indicates a strong level of satisfaction for each teacher and learner having their own personal computers. However, 77% of teachers show general satisfaction for having one computer allocated for every five learners in the school, but indicate at 70% that they would prefer to have no computers in the classrooms. As a greater majority of teachers would prefer not to have computers in classrooms, this falls in line with the literature that indicates that unless classroom settings are physically or structurally changed, the integration of computers into classroom settings often proves unsuccessful (Ortega *et al.*, 2001). However, literature indicates that when computers are situated outside of the classroom setting, there is a lesser chance of computers being integrated into the educational process (Bitter *et al.*, 1993). Also having computers outside of the classroom context does not allow the active and exploratory learning styles proposed by CAL theories to emerge in school systems where learners become passive respondents in limited and rigid computer access opportunities (Addison *et al.*, 1997).

Figure 133



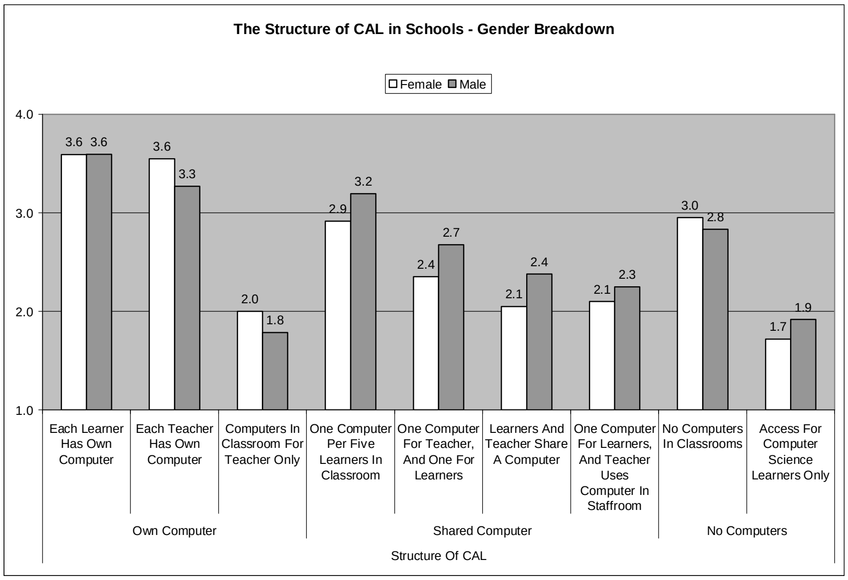
4.3.4.2 Gender Breakdown

Table 114: The Optimum Structure for CAL Implementation in Schools – Gender Breakdown

Categories	Items	Gender Breakdown	Levels of Satisfaction: Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied	Totals: Satisfied	Dissatisfied
Own Computer	Each Learner Has Own Computer	Female	69	21	10	0	90	10
		Male	78	11	3	8	89	11
	Each Teacher Has Own Computer	Female	63	33	3	3	95	5
		Male	57	27	3	14	84	16
	Computers In Classroom For Teacher Only	Female	5	26	33	36	31	69
		Male	5	11	41	43	16	84
Shared Computer	One Computer Per Five Learners In Classroom	Female	29	40	26	6	69	31
		Male	36	50	11	3	86	14
	One Computer For Teacher, And One For Learners	Female	10	40	25	25	50	50
		Male	22	46	11	22	68	32
	Learners And Teacher Share A Computer	Female	5	25	40	30	30	70
		Male	11	41	24	24	51	49
	One Computer For Learners, And Teacher Uses Computer In Staffroom	Female	8	25	38	30	33	68
		Male	11	33	25	31	44	56
No Computers	No Computers In Classrooms	Female	28	45	23	5	73	28
		Male	22	44	28	6	67	33
	Access For Computer Science Learners Only	Female	8	5	38	49	13	87
		Male	3	24	35	38	27	73

On average, both female and male teacher groups express strong, homogenous views that: each teacher and learner should have their own computers; one computer be allocated for every five learners in schools; and that no computers be stored in classrooms. However, male teachers show general levels of satisfaction for teachers having a computer and learners sharing a single computer in classrooms.

Figure 134



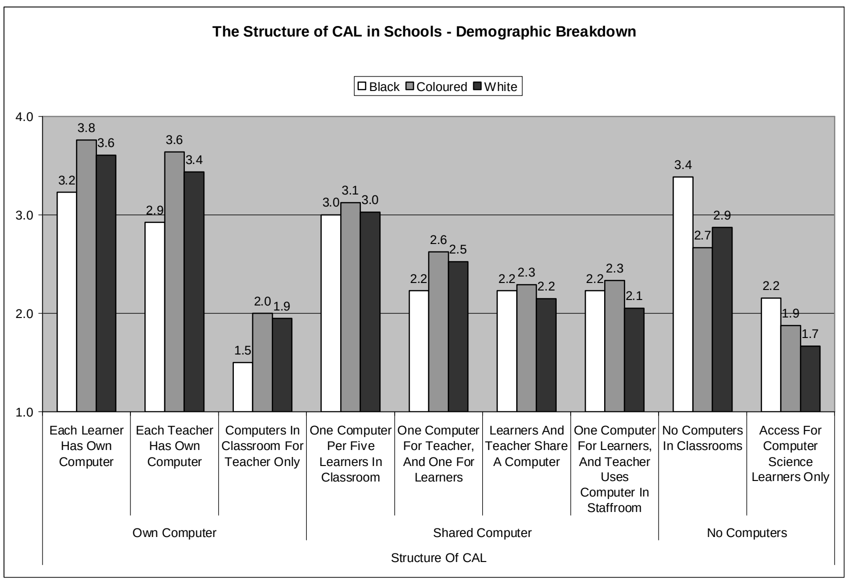
4.3.4.3 Demographic Breakdown

Table 115: The Optimum Structure for CAL Implementation in Schools – Demographic Breakdown

Categories	Items	Demographic Breakdown	Levels of Satisfaction: Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied	Totals: Satisfied	Dissatisfied
Own Computer	Each Learner Has Own Computer	Black	54	31	0	15	85	15
		Coloured	84	8	8	0	92	8
		White	74	16	8	3	89	11
	Each Teacher Has Own Computer	Black	54	15	0	31	69	31
		Coloured	72	24	0	4	96	4
		White	54	38	5	3	92	8
	Computers In Classroom For Teacher Only	Black	0	17	17	67	17	83
		Coloured	12	12	40	36	24	76
		White	3	23	41	33	26	74
Shared Computer	One Computer Per Five Learners In Classroom	Black	33	42	17	8	75	25
		Coloured	29	54	17	0	83	17
		White	34	40	20	6	74	26
	One Computer For Teacher, And One For Learners	Black	8	38	23	31	46	54
		Coloured	21	42	17	21	63	38
		White	15	45	18	23	60	40
	Learners And Teacher Share A Computer	Black	0	46	31	23	46	54
		Coloured	13	33	25	29	46	54
		White	8	28	38	28	35	65
	One Computer For Learners, And Teacher Uses Computer In Staffroom	Black	15	31	15	38	46	54
		Coloured	13	29	38	21	42	58
		White	5	28	33	33	33	67
No Computers	No Computers In Classrooms	Black	38	62	0	0	100	0
		Coloured	17	42	33	8	58	42
		White	26	41	28	5	67	33
	Access For Computer Science Learners Only	Black	8	38	15	38	46	54
		Coloured	8	17	29	46	25	75
		White	3	5	49	44	8	92

On average, the views of expressed by teachers in all demographic groups fall at similar levels. However, teachers in the Coloured and White demographic groups feel more strongly that each teacher and learner should have their own computers, while teachers who belong to the Black demographic group express stronger levels of satisfaction for having no computers in classrooms.

Figure 135



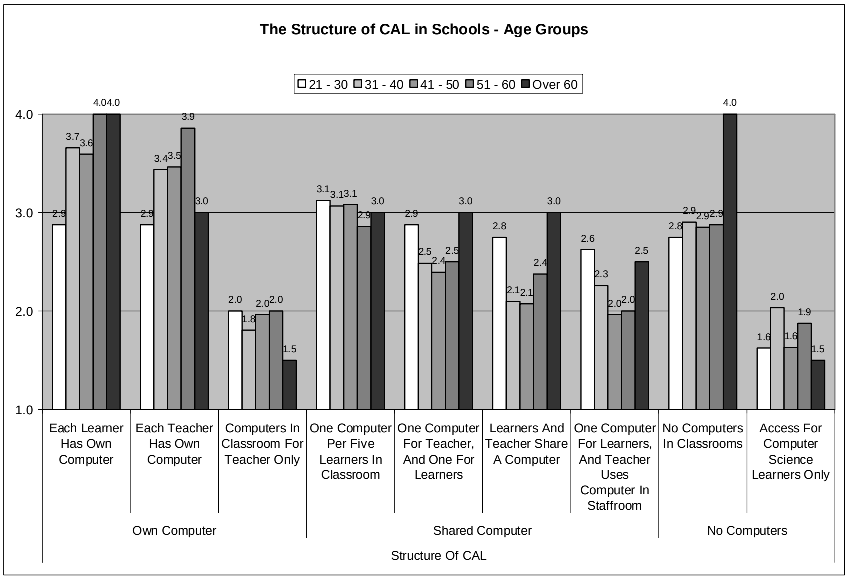
4.3.4.4 Age Groups

Teachers in the 21 to 30 age group express lower levels of general satisfaction for teachers and learners having their own computers, while other age groups generally display strong levels of satisfaction. While teachers from other age groups display lower degrees of general satisfaction, teachers in the over 60 age group demonstrate very strongly the view that computers should not be kept in classrooms.

Table 116: The Optimum Structure for CAL Implementation in Schools – Age Group Breakdown

Categories	Items	Age Groups	Levels of Satisfaction				Totals	
			Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied	Satisfied	Dissatisfied
Own Computer	Each Learner Has Own Computer	21 - 30	50	13	13	25	63	38
		31 - 40	75	19	3	3	94	6
		41 - 50	70	19	11	0	89	11
		51 - 60	100	0	0	0	100	0
		Over 60	100	0	0	0	100	0
	Each Teacher Has Own Computer	21 - 30	38	38	0	25	75	25
		31 - 40	63	28	0	9	91	9
		41 - 50	57	36	4	4	93	7
		51 - 60	86	14	0	0	100	0
		Over 60	50	0	50	0	50	50
	Computers In Classroom For Teacher Only	21 - 30	13	13	38	38	25	75
		31 - 40	0	23	35	42	23	77
		41 - 50	11	14	36	39	25	75
		51 - 60	0	29	43	29	29	71
		Over 60	0	0	50	50	0	100
Shared Computer	One Computer Per Five Learners In Classroom	21 - 30	13	88	0	0	100	0
		31 - 40	37	40	17	7	77	23
		41 - 50	33	46	17	4	79	21
		51 - 60	29	29	43	0	57	43
		Over 60	50	0	50	0	50	50
	One Computer For Teacher, And One For Learners	21 - 30	13	63	25	0	75	25
		31 - 40	16	42	16	26	58	42
		41 - 50	18	32	21	29	50	50
		51 - 60	13	50	13	25	63	38
		Over 60	0	100	0	0	100	0
	Learners And Teacher Share A Computer	21 - 30	0	75	25	0	75	25
		31 - 40	3	35	29	32	39	61
		41 - 50	11	18	39	32	29	71
		51 - 60	13	38	25	25	50	50
		Over 60	50	0	50	0	50	50
	One Computer For Learners, And Teacher Uses Computer In Staffroom	21 - 30	13	50	25	13	63	38
		31 - 40	13	29	29	29	42	58
		41 - 50	7	21	32	39	29	71
		51 - 60	0	29	43	29	29	71
		Over 60	0	50	50	0	50	50
No Computers	No Computers In Classrooms	21 - 30	25	38	25	13	63	38
		31 - 40	23	52	19	6	74	26
		41 - 50	22	44	30	4	67	33
		51 - 60	25	38	38	0	63	38
		Over 60	100	0	0	0	100	0
	Access For Computer Science Learners Only	21 - 30	0	13	38	50	13	88
		31 - 40	10	19	35	35	29	71
		41 - 50	4	11	30	56	15	85
		51 - 60	0	13	63	25	13	88
		Over 60	0	0	50	50	0	100

Figure 136



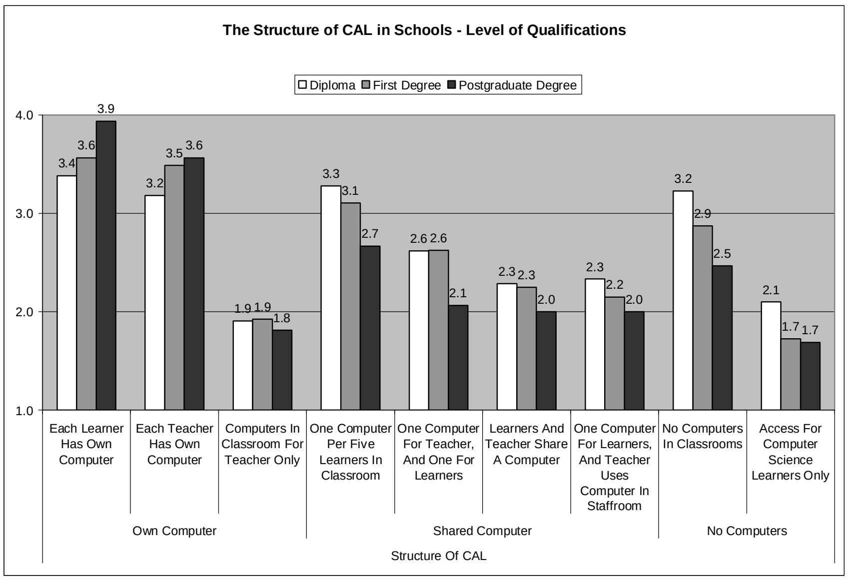
4.3.4.5 Level of Qualifications

Table 117: The Optimum Structure for CAL Implementation in Schools – Level of Qualification Breakdown

Categories	Items	Level of Qualifications	Levels of Satisfaction: Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied	Totals: Satisfied	Dissatisfied
Own Computer	Each Learner Has Own Computer	Diploma	62	24	5	10	86	14
		First Degree	72	15	10	3	87	13
		Postgraduate Degree	94	6	0	0	100	0
	Each Teacher Has Own Computer	Diploma	50	32	5	14	82	18
		First Degree	62	31	3	5	92	8
		Postgraduate Degree	69	25	0	6	94	6
	Computers In Classroom For Teacher Only	Diploma	0	24	43	33	24	76
		First Degree	8	18	33	41	26	74
		Postgraduate Degree	6	13	38	44	19	81
Shared Computer	One Computer Per Five Learners In Classroom	Diploma	44	39	17	0	83	17
		First Degree	34	47	13	5	82	18
		Postgraduate Degree	13	47	33	7	60	40
	One Computer For Teacher, And One For Learners	Diploma	10	52	29	10	62	38
		First Degree	23	40	15	23	63	38
		Postgraduate Degree	6	38	13	44	44	56
	Learners And Teacher Share A Computer	Diploma	10	33	33	24	43	57
		First Degree	10	30	35	25	40	60
		Postgraduate Degree	0	38	25	38	38	63
	One Computer For Learners, And Teacher Uses Computer In Staffroom	Diploma	10	33	38	19	43	57
		First Degree	10	30	25	35	40	60
		Postgraduate Degree	7	20	40	33	27	73
No Computers	No Computers In Classrooms	Diploma	32	59	9	0	91	9
		First Degree	28	38	26	8	67	33
		Postgraduate Degree	7	40	47	7	47	53
	Access For Computer Science Learners Only	Diploma	10	20	40	30	30	70
		First Degree	5	15	28	53	20	80
		Postgraduate Degree	0	6	56	38	6	94

On average, teachers who have degrees feel more strongly than teachers in the diploma qualification group that each teacher and learner should have their own computer to use. However, teachers with diplomas express stronger levels of satisfaction for having one computer allocated for every five learners, but indicate a preference for having no computers in classrooms.

Figure 137



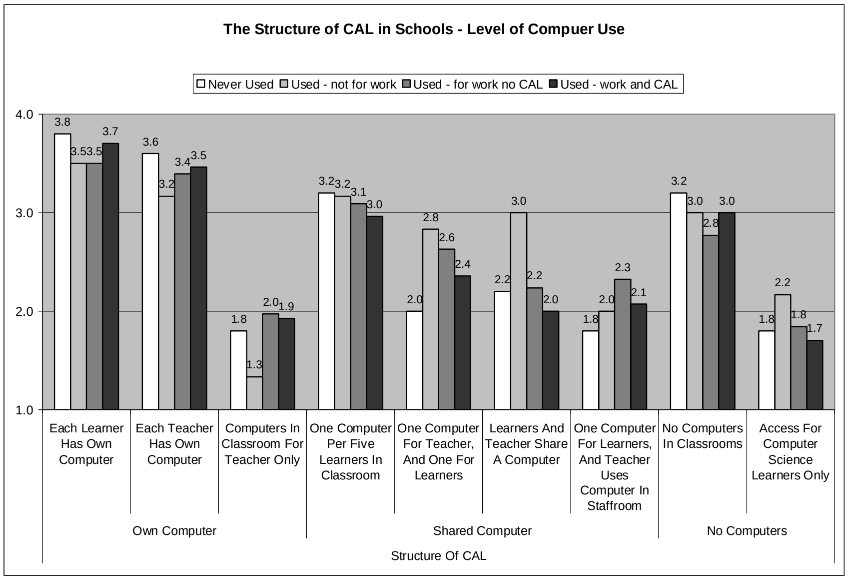
4.3.4.6 Level of Computer Use

On average, teachers with experience in all degrees of computer use express higher levels of satisfaction for each teacher and learner having their own computers, as well as for having one computer allocated for every five learners to use, but indicate a preference for having no computers in classrooms. However, teachers who have used computers but not for work activities show levels of general satisfaction for teachers having a personal computer while learners share a single computer in classrooms, but also accept a scenario where learners and their teacher share a single computer.

Table 118: The Optimum Structure for CAL Implementation in Schools – Level of Computer Use Breakdown

Categories	Items	Level of Computer Use	Levels of Satisfaction: Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied	Totals: Satisfied	Dissatisfied
Own Computer	Each Learner Has Own Computer	Never Used	80	20	0	0	100	0
		Used - not for work	83	0	0	17	83	17
		Used - for work no CAL	71	13	11	5	84	16
		Used - work and CAL	74	22	4	0	96	4
	Each Teacher Has Own Computer	Never Used	60	40	0	0	100	0
		Used - not for work	67	0	17	17	67	33
		Used - for work no CAL	61	29	0	11	89	11
		Used - work and CAL	57	36	4	4	93	7
	Computers In Classroom For Teacher Only	Never Used	0	20	40	40	20	80
		Used - not for work	0	0	33	67	0	100
		Used - for work no CAL	8	22	30	41	30	70
		Used - work and CAL	4	18	46	32	21	79
Shared Computer	One Computer Per Five Learners In Classroom	Never Used	20	80	0	0	100	0
		Used - not for work	17	83	0	0	100	0
		Used - for work no CAL	39	36	18	6	76	24
		Used - work and CAL	30	41	26	4	70	30
	One Computer For Teacher, And One For Learners	Never Used	0	40	20	40	40	60
		Used - not for work	17	50	33	0	67	33
		Used - for work no CAL	18	47	13	21	66	34
		Used - work and CAL	14	36	21	29	50	50
	Learners And Teacher Share A Computer	Never Used	0	40	40	20	40	60
		Used - not for work	33	33	33	0	67	33
		Used - for work no CAL	5	39	29	26	45	55
		Used - work and CAL	7	21	36	36	29	71
	One Computer For Learners, And Teacher Uses Computer In Staffroom	Never Used	0	20	40	40	20	80
		Used - not for work	0	33	33	33	33	67
		Used - for work no CAL	11	38	24	27	49	51
		Used - work and CAL	11	18	39	32	29	71
No Computers	No Computers In Classrooms	Never Used	40	40	20	0	80	20
		Used - not for work	33	50	0	17	83	17
		Used - for work no CAL	23	38	31	8	62	38
		Used - work and CAL	23	54	23	0	77	23
	Access For Computer Science Learners Only	Never Used	0	20	40	40	20	80
		Used - not for work	17	17	33	33	33	67
		Used - for work no CAL	5	16	37	42	21	79
		Used - work and CAL	4	11	37	48	15	85

Figure 138



4.3.5 The Software Most Suitable for CAL implementation

4.3.5.1 The Software Suited to CAL in General

This section reports on the software that teachers believe to be suited to CAL implementation and use in South African schools. Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: very suitable, somewhat suitable, somewhat unsuitable and very unsuitable. A totals column provides a summary of overall suitable and unsuitable responses.

It is also reported in this section which single software teachers believe to be most suited to CAL implementation and use in South African schools. Results are demonstrated in graph format, indicating the percentage distribution of responses per software item.

4.3.5.1.1 Total Teacher Group

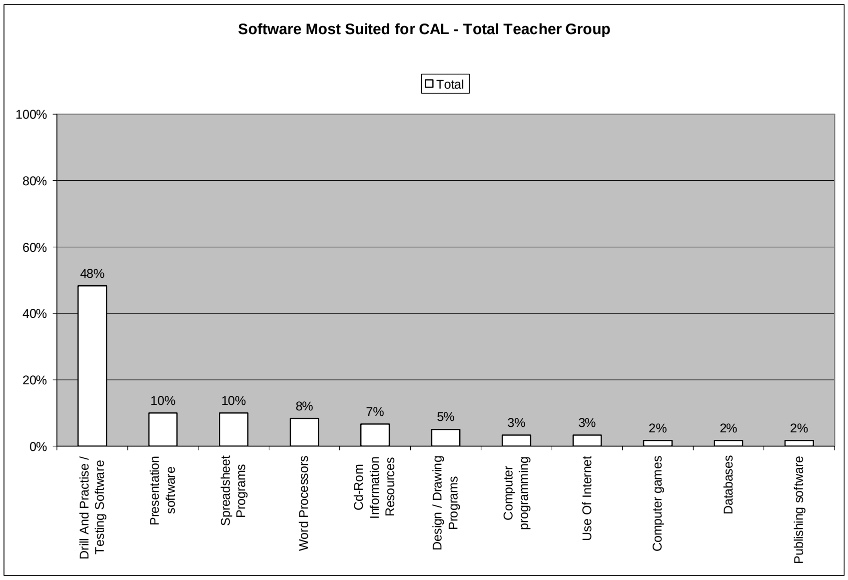
Table 119: The Software Most Suitable for CAL Implementation – Total Teacher Group

	Category Breakdown				Totals	
Software	Very Suitable	Somewhat Suitable	Somewhat Unsuitable	Very Unsuitable	Suitable	Unsuitable
Word Proc.	27	42	15	16	69	31
Spreadsheets	35	45	9	11	80	20
E-Mail	16	29	36	18	45	55
Internet	31	48	10	10	79	21
CD-Rom Based Software	41	43	7	9	84	16
Games	24	24	19	33	48	52
Admin	21	28	26	25	49	51
Presentation	23	47	18	13	69	31
Drill & Testing	58	27	8	7	85	15
Publishing	16	34	30	20	50	50
Databases	19	41	26	15	59	41
Simulation	19	44	21	15	63	37
Programming	16	49	20	16	65	35
Design	28	43	19	11	70	30
Web Design	14	25	39	22	39	61

Teachers believe the following software to be suitable for CAL implementation and use in South African schools:

- Drill & Testing software at 85%
- CD-Rom based software at 84%
- Spreadsheets at 80%
- Internet software at 79%
- Design software at 70%
- Word Processors at 69%
- Presentation software at 69%
- Programming software at 65%
- Simulation software at 63%.

Figure 139



However, the teaching group as a whole indicates at a majority of 48% agreement that Drill & Practice and Testing software are the most suitable for CAL implementation and use. The literature indicates that the use of educational technologies help to free up teachers' time by automating tasks that would usually be manual, allowing teachers to dedicate more resources to providing individual time to learners, teaching and administration activities (Baillie *et al.*, 2000; Hitchcock, 2000; Johnson, 2003). The use of drill and practice software helps learners to exercise material that has been taught, in an electronic and automated environment, until required skills have been refined or committed to memory (Bitter *et al.*, 1993; Brown, 1997; Hughes, 1998; Ortega *et al.*, 2001). Previous studies in South African schools also report that drill and practice applications feature most prominently in educational computing at schools, particularly in the Mathematics and Language learning areas (NCETDE, 1998). The literature, however, indicates that generally most teachers are unaware of how to optimize the use of educational technologies, and that the use of CAL systems is usually reserved to more directive and less complex drill and practice systems, usually in the initial development period as teachers and learners become accustomed to using educational technologies (NCETDE, 1998). Further inquiry is therefore required to determine the validity of these findings in the educational context.

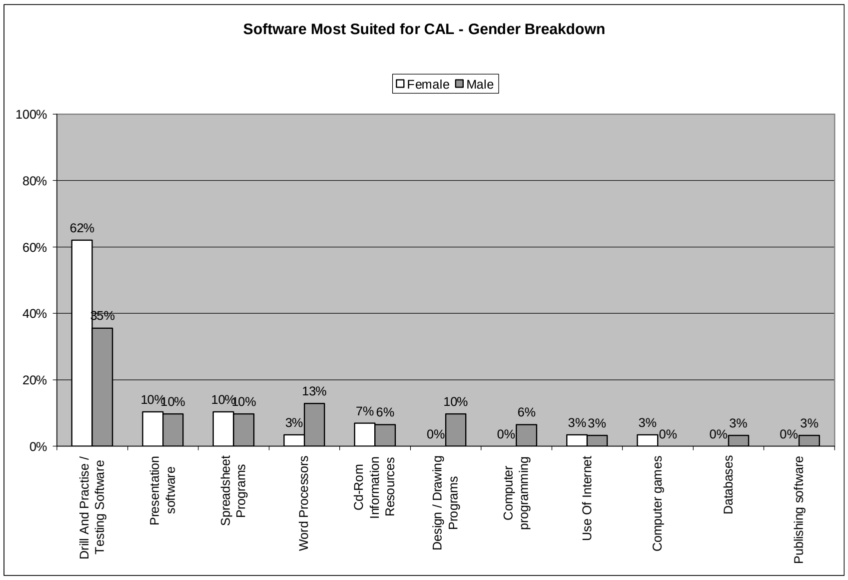
4.3.5.1.2 Gender Breakdown

Table 120: The Software Most Suitable for CAL Implementation – Gender Breakdown

Software	Gender Breakdown	Category Breakdown				Totals	
		Very Suitable	Somewhat Suitable	Somewhat Unsuitable	Very Unsuitable	Suitable	Unsuitable
Word Proc.	Female	18	33	21	27	52	48
	Male	35	50	9	6	85	15
Spreadsheets	Female	19	55	6	19	74	26
	Male	50	35	12	3	85	15
E-Mail	Female	4	26	48	22	30	70
	Male	29	32	25	14	61	39
Internet	Female	7	64	11	18	71	29
	Male	53	33	10	3	87	13
CD-Rom Based Software	Female	24	52	8	16	76	24
	Male	55	35	6	3	90	10
Games	Female	13	23	20	43	37	63
	Male	36	25	18	21	61	39
Admin	Female	8	23	35	35	31	69
	Male	33	33	19	15	67	33
Presentation	Female	16	45	19	19	61	39
	Male	29	48	16	6	77	23
Drill & Testing	Female	50	27	17	7	77	23
	Male	66	28	0	7	93	7
Publishing	Female	7	21	43	29	29	71
	Male	25	46	18	11	71	29
Databases	Female	8	46	19	27	54	46
	Male	29	36	32	4	64	36
Simulation	Female	9	39	30	22	48	52
	Male	28	48	14	10	76	24
Programming	Female	0	52	28	20	52	48
	Male	31	46	12	12	77	23
Design	Female	19	50	19	12	69	31
	Male	36	36	18	11	71	29
Web Design	Female	0	17	54	29	17	83
	Male	26	33	26	15	59	41

The male teacher group has selected a wide range of software that fall at high suitability levels; and indicates that Drill & Testing software, CD-Rom based software, Internet software, Word Processors, Spreadsheets, Presentation software, Programming software, Simulation software, Publishing software and Design software all have high suitability levels of 70% and above. The female teaching group however has been more selective in their responses, indicating only that Drill & Testing software, CD-Rom based software, Spreadsheets and Internet software have suitability levels of 70% and above.

Figure 140



Both female and male teacher groups indicate that that Drill & Practice and Testing software are the most suitable for CAL implementation and use, though male teachers agree at lower levels at 35%.

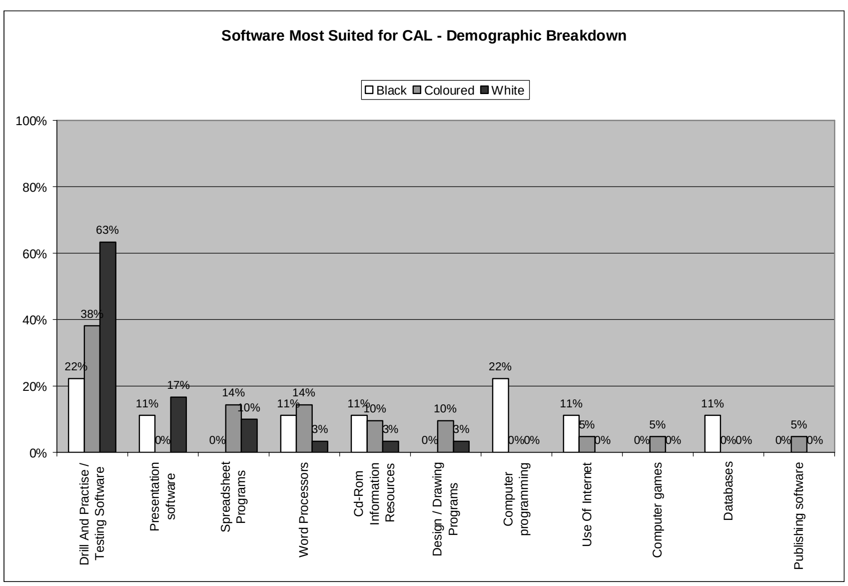
4.3.5.1.3 Demographic Breakdown

The Black demographic group indicates that all the listed software have suitability levels of 70% and above. The Coloured demographic group of teachers also selects a wide range of software as suitable for CAL implementation and suggests that the use of Publishing software, Web Design software, e-mail and Administration software have a suitability of below 70%. The White demographic group, however, feel that only the use of CD-Rom based software, Drill & Testing software and the Internet has a suitability level of 70% and above.

Table 121: The Software Most Suitable for CAL Implementation – Demographic Breakdown

Software	Demographic Breakdown	Category Breakdown: Very Suitable	Somewhat Suitable	Somewhat Unsuitable	Very Unsuitable	Totals: Suitable	Unsuitable
Word Proc.	Black	36	55	0	9	91	9
	Coloured	43	35	13	9	78	22
	White	12	42	21	24	55	45
Spreadsheets	Black	45	45	0	9	91	9
	Coloured	64	27	5	5	91	9
	White	13	56	16	16	69	31
E-Mail	Black	20	50	10	20	70	30
	Coloured	39	22	22	17	61	39
	White	0	26	56	19	26	74
Internet	Black	45	45	0	9	91	9
	Coloured	58	26	11	5	84	16
	White	7	64	14	14	71	29
CD-Rom Based Software	Black	60	30	0	10	90	10
	Coloured	55	30	5	10	85	15
	White	23	58	12	8	81	19
Games	Black	20	50	0	30	70	30
	Coloured	61	11	11	17	72	28
	White	3	23	30	43	27	73
Admin	Black	22	56	0	22	78	22
	Coloured	41	18	24	18	59	41
	White	7	26	37	30	33	67
Presentation	Black	18	64	9	9	82	18
	Coloured	28	56	11	6	83	17
	White	21	36	24	18	58	42
Drill & Testing	Black	50	40	0	10	90	10
	Coloured	63	26	5	5	89	11
	White	57	23	13	7	80	20
Publishing	Black	10	70	10	10	80	20
	Coloured	29	35	24	12	65	35
	White	10	21	41	28	31	69
Databases	Black	30	60	0	10	90	10
	Coloured	29	47	24	0	76	24
	White	7	30	37	26	37	63
Simulation	Black	30	40	20	10	70	30
	Coloured	29	41	18	12	71	29
	White	8	48	24	20	56	44
Programming	Black	11	78	0	11	89	11
	Coloured	38	44	6	13	81	19
	White	4	42	35	19	46	54
Design	Black	20	70	0	10	90	10
	Coloured	47	35	6	12	82	18
	White	19	37	33	11	56	44
Web Design	Black	10	70	0	20	80	20
	Coloured	25	38	25	13	63	38
	White	8	0	64	28	8	92

Figure 141



Both Coloured and White teacher groups indicate that Drill & Practise and Testing software are the most suitable for CAL implementation and use, though Coloured teachers agree at lower levels at 38%. Teachers who belong to the Black demographic group, however, feel equally at 22% that Drill & Practise and Testing software and Computer Programming software are the most suitable for CAL implementation and use.

4.3.5.1.4 Age Groups

Teachers in the 31 to 50 age groups tend to view a wider range of software as suitable for CAL implementation and use, while the 21 to 30 age group and the age groups above 50 are more selective in determining the suitability of software. However, the use of Spreadsheets, CD-Rom based software, Drill & Testing Software and the Internet feature as highly relevant across all age groups.

Figure 142

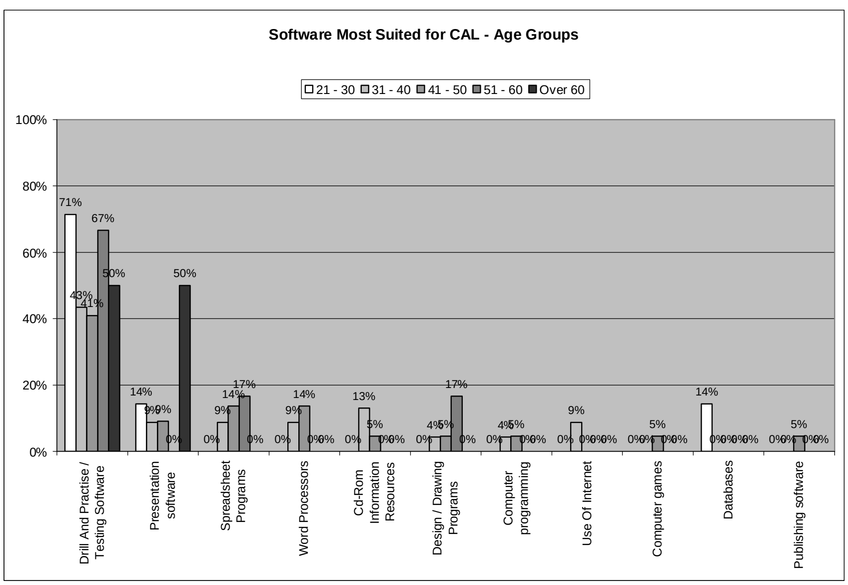


Table 122: The Software Most Suitable for CAL Implementation – Age Group Breakdown

Software	Age Group	Category Breakdown				Totals	
		Very Suitable	Somewhat Suitable	Somewhat Unsuitable	Very Unsuitable	Suitable	Unsuitable
Word Proc.	21 - 30	13	50	25	13	63	38
	31 - 40	36	36	14	14	71	29
	41 - 50	25	46	13	17	71	29
	51 - 60	20	40	20	20	60	40
	Over 60	0	50	0	50	50	50
Spreadsheets	21 - 30	13	88	0	0	100	0
	31 - 40	50	32	7	11	82	18
	41 - 50	32	45	9	14	77	23
	51 - 60	0	60	40	0	60	40
	Over 60	50	0	0	50	50	50
E-Mail	21 - 30	0	57	43	0	57	43
	31 - 40	15	30	25	30	45	55
	41 - 50	30	25	35	10	55	45
	51 - 60	0	0	83	17	0	100
	Over 60	0	50	0	50	50	50
Internet	21 - 30	14	86	0	0	100	0
	31 - 40	36	36	14	14	73	27
	41 - 50	43	38	10	10	81	19
	51 - 60	0	83	17	0	83	17
	Over 60	0	50	0	50	50	50
CD-Rom Based Software	21 - 30	14	86	0	0	100	0
	31 - 40	57	22	9	13	78	22
	41 - 50	42	42	5	11	84	16
	51 - 60	20	80	0	0	100	0
	Over 60	0	50	50	0	50	50
Games	21 - 30	13	50	13	25	63	38
	31 - 40	38	19	10	33	57	43
	41 - 50	24	19	24	33	43	57
	51 - 60	0	17	50	33	17	83
	Over 60	0	50	0	50	50	50
Admin	21 - 30	29	29	43	0	57	43
	31 - 40	21	26	21	32	47	53
	41 - 50	25	35	25	15	60	40
	51 - 60	0	0	40	60	0	100
	Over 60	0	50	0	50	50	50
Presentation	21 - 30	25	38	25	13	63	38
	31 - 40	29	42	17	13	71	29
	41 - 50	23	55	14	9	77	23
	51 - 60	0	50	33	17	50	50
	Over 60	0	50	0	50	50	50
Drill & Testing	21 - 30	57	43	0	0	100	0
	31 - 40	45	32	9	14	77	23
	41 - 50	68	18	14	0	86	14
	51 - 60	67	17	0	17	83	17
	Over 60	50	50	0	0	100	0
Publishing	21 - 30	13	25	50	13	38	63
	31 - 40	20	35	25	20	55	45
	41 - 50	19	38	29	14	57	43
	51 - 60	0	20	40	40	20	80
	Over 60	0	50	0	50	50	50
Databases	21 - 30	14	43	43	0	57	43
	31 - 40	24	43	24	10	67	33
	41 - 50	21	42	16	21	63	37
	51 - 60	0	20	60	20	20	80
	Over 60	0	50	0	50	50	50
Simulation	21 - 30	0	57	43	0	57	43
	31 - 40	25	30	25	20	55	45
	41 - 50	21	53	16	11	74	26
	51 - 60	25	50	0	25	75	25
	Over 60	0	50	0	50	50	50
Programming	21 - 30	13	50	38	0	63	38
	31 - 40	18	53	6	24	71	29
	41 - 50	21	47	16	16	68	32
	51 - 60	0	20	60	20	20	80
	Over 60	0	100	0	0	100	0
Design	21 - 30	14	71	14	0	86	14
	31 - 40	38	33	10	19	71	29
	41 - 50	26	53	16	5	79	21
	51 - 60	20	0	60	20	20	80
	Over 60	0	50	50	0	50	50
Web Design	21 - 30	14	14	71	0	29	71
	31 - 40	17	39	17	28	56	44
	41 - 50	11	26	42	21	37	63
	51 - 60	0	0	80	20	0	100
	Over 60	50	0	0	50	50	50

Teachers in age groups from age 21 to 60 indicate that Drill & Practise and Testing software are the most suitable for CAL implementation and use. Teachers who belong to the over 60 age group, however, feel equally at 50% that Drill & Practise and Testing software and Presentation software are the most suitable for CAL implementation and use.

4.3.5.1.5 Level of Qualifications

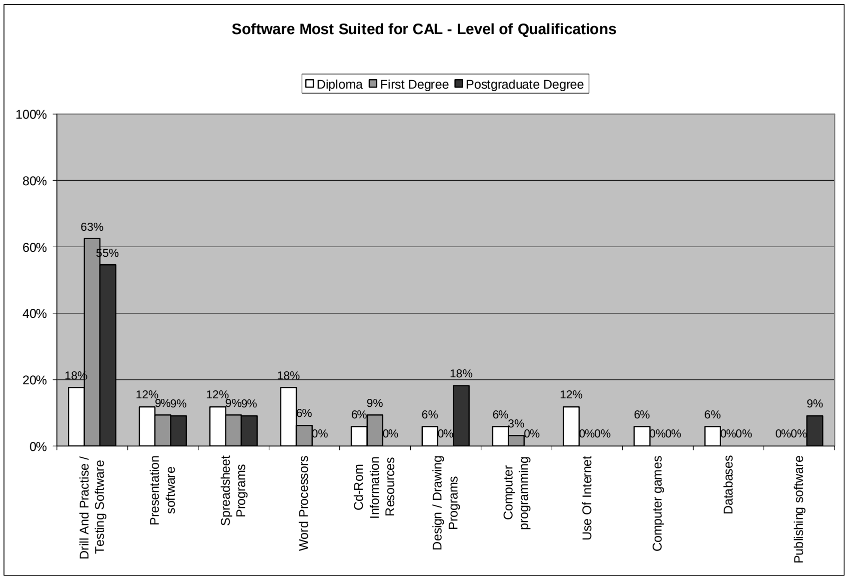
Table 123: The Software Most Suitable for CAL Implementation – Level of Qualification Breakdown

Software	Level of Qualifications	Category Breakdown				Totals	
		Very Suitable	Somewhat Suitable	Somewhat Unsuitable	Very Unsuitable	Suitable	Unsuitable
Word Proc.	Diploma	37	53	5	5	89	11
	First Degree	24	36	21	18	61	39
	Postgraduate Degree	20	40	13	27	60	40
Spreadsheets	Diploma	59	35	0	6	94	6
	First Degree	36	39	15	9	76	24
	Postgraduate Degree	7	67	7	20	73	27
E-Mail	Diploma	25	44	31	0	69	31
	First Degree	14	21	39	25	36	64
	Postgraduate Degree	9	27	36	27	36	64
Internet	Diploma	47	53	0	0	100	0
	First Degree	31	41	17	10	72	28
	Postgraduate Degree	8	58	8	25	67	33
CD-Rom Based Software	Diploma	47	53	0	0	100	0
	First Degree	40	37	13	10	77	23
	Postgraduate Degree	36	45	0	18	82	18
Games	Diploma	25	31	19	25	56	44
	First Degree	23	23	20	33	47	53
	Postgraduate Degree	25	17	17	42	42	58
Admin	Diploma	14	57	21	7	71	29
	First Degree	25	18	32	25	43	57
	Postgraduate Degree	18	18	18	45	36	64
Presentation	Diploma	18	76	6	0	94	6
	First Degree	25	34	28	13	59	41
	Postgraduate Degree	23	38	8	31	62	38
Drill & Testing	Diploma	44	50	6	0	94	6
	First Degree	70	20	7	3	90	10
	Postgraduate Degree	46	15	15	23	62	38
Publishing	Diploma	13	60	20	7	73	27
	First Degree	11	25	46	18	36	64
	Postgraduate Degree	31	23	8	38	54	46
Databases	Diploma	27	60	7	7	87	13
	First Degree	22	30	41	7	52	48
	Postgraduate Degree	0	42	17	42	42	58
Simulation	Diploma	27	53	20	0	80	20
	First Degree	19	35	31	15	54	46
	Postgraduate Degree	9	55	0	36	64	36
Programming	Diploma	15	77	8	0	92	8
	First Degree	19	44	22	15	63	37
	Postgraduate Degree	9	27	27	36	36	64
Design	Diploma	38	50	13	0	88	13
	First Degree	26	44	19	11	70	30
	Postgraduate Degree	18	27	27	27	45	55
Web Design	Diploma	21	50	14	14	71	29
	First Degree	12	19	50	19	31	69
	Postgraduate Degree	9	9	45	36	18	82

Teachers in the diploma qualification category select a wide range of software as suitable for CAL implementation and use, while teachers who have first and postgraduate degrees are more selective in their software allocations.

However, the use of Spreadsheets, CD-Rom based software, Drill & Testing Software and the Internet feature highly across all qualification groups.

Figure 143



Teachers who have degrees indicate overwhelmingly that Drill & Practise and Testing software are the most suitable for CAL implementation and use. Teachers in the diploma qualification group feel equally at very low levels that Drill & Practise and Testing software and Word Processors are the most suitable for CAL implementation and use.

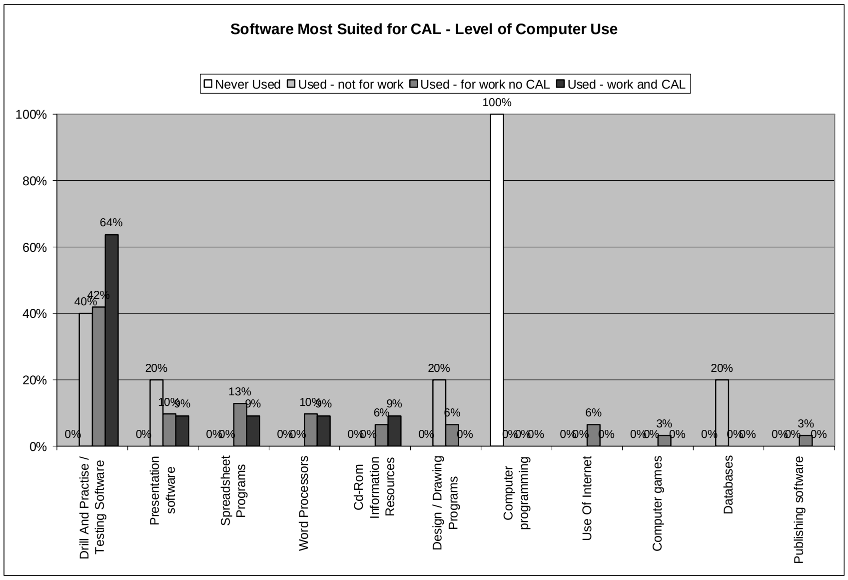
4.3.5.1.6 Level of Computer Use

Teachers who have never used computers, or have used computers but not for work purposes, select a larger variety of software as highly suitable for CAL implementation and use. However, teachers who have used computers for work purposes and those who have used computers for CAL purposes indicate more specifically that Drill & Testing software, CD-Rom based software, Spreadsheet software and the Internet are highly suitable for CAL implementation and use at levels of 70% and above.

Table 124: The Software Most Suitable for CAL Implementation – Level of Computer Use Breakdown

Software	Level of Computer Use	Category Breakdown				Totals	
		Very Suitable	Somewhat Suitable	Somewhat Unsuitable	Very Unsuitable	Suitable	Unsuitable
Word Proc.	Never Used	67	33	0	0	100	0
	Used - not for work	25	50	25	0	75	25
	Used - for work no CAL	25	44	14	17	69	31
	Used - work and CAL	25	38	17	21	63	38
Spreadsheets	Never Used	67	33	0	0	100	0
	Used - not for work	75	25	0	0	100	0
	Used - for work no CAL	37	40	9	14	77	23
	Used - work and CAL	22	57	13	9	78	22
E-Mail	Never Used	33	33	33	0	67	33
	Used - not for work	20	40	0	40	60	40
	Used - for work no CAL	15	27	42	15	42	58
	Used - work and CAL	14	29	38	19	43	57
Internet	Never Used	67	33	0	0	100	0
	Used - not for work	40	60	0	0	100	0
	Used - for work no CAL	36	36	14	14	71	29
	Used - work and CAL	18	64	9	9	82	18
CD-Rom Based Software	Never Used	67	33	0	0	100	0
	Used - not for work	33	67	0	0	100	0
	Used - for work no CAL	41	41	7	10	83	17
	Used - work and CAL	38	43	10	10	81	19
Games	Never Used	33	33	0	33	67	33
	Used - not for work	25	50	25	0	75	25
	Used - for work no CAL	28	31	10	31	59	41
	Used - work and CAL	18	9	32	41	27	73
Admin	Never Used	33	67	0	0	100	0
	Used - not for work	25	50	0	25	75	25
	Used - for work no CAL	28	20	28	24	48	52
	Used - work and CAL	10	29	33	29	38	62
Presentation	Never Used	33	67	0	0	100	0
	Used - not for work	25	75	0	0	100	0
	Used - for work no CAL	25	44	13	19	69	31
	Used - work and CAL	17	43	30	9	61	39
Drill & Testing	Never Used	25	75	0	0	100	0
	Used - not for work	60	40	0	0	100	0
	Used - for work no CAL	61	21	7	11	82	18
	Used - work and CAL	59	23	14	5	82	18
Publishing	Never Used	33	33	33	0	67	33
	Used - not for work	33	67	0	0	100	0
	Used - for work no CAL	21	21	32	25	43	57
	Used - work and CAL	5	45	32	18	50	50
Databases	Never Used	67	33	0	0	100	0
	Used - not for work	33	67	0	0	100	0
	Used - for work no CAL	22	30	26	22	52	48
	Used - work and CAL	5	52	33	10	57	43
Simulation	Never Used	33	33	33	0	67	33
	Used - not for work	50	50	0	0	100	0
	Used - for work no CAL	23	42	15	19	65	35
	Used - work and CAL	5	47	32	16	53	47
Programming	Never Used	33	67	0	0	100	0
	Used - not for work	33	67	0	0	100	0
	Used - for work no CAL	19	42	23	15	62	38
	Used - work and CAL	5	53	21	21	58	42
Design	Never Used	67	33	0	0	100	0
	Used - not for work	33	33	33	0	67	33
	Used - for work no CAL	29	46	14	11	75	25
	Used - work and CAL	20	40	25	15	60	40
Web Design	Never Used	33	67	0	0	100	0
	Used - not for work	67	33	0	0	100	0
	Used - for work no CAL	12	28	36	24	40	60
	Used - work and CAL	5	15	55	25	20	80

Figure 144



Teachers who have used computers at various levels indicate strongly that Drill & Practise and Testing software are the most suitable for CAL implementation and use. However, teachers who have never used computers feel that Computer Programming software is the most suitable software for the same purpose.

4.3.5.2 The Software Suited for CAL in Grade 10 Mathematics

This section reports on the software that teachers believe to be suited to CAL implementation and use specifically for the delivery of the Grade 10 Mathematics learning area in the South African education system. Results are presented in tabular form as a percentage proportion of ‘Yes’ and ‘No’ answers in a response scale format. Tables present information for an indication of the following facets:

- teachers’ basic capability on the specified software

- the extent that teachers have used the software for general work purposes

- the extent that teachers have used the software specifically to teach Grade 10 Mathematics

- the extent that teachers believe the software to be suitable for teaching Grade 10 Mathematics specifically.

In addition, a weighted average has been calculated by assigning values to the ratings. In graph form, an average score in the following brackets are indicative of the following general levels:

- 1 to 1.75 indicates very low levels

- 1.76 to 2.5 indicates general lower levels

- 2.51 to 3.25 indicates general higher levels

- 3.26 to 4 indicates very high levels.

Software that scores high across all the facets would therefore be highly suitable for CAL implementation as it would imply that a larger scope of teachers are capable and have experience using the software in the school context, including at an instructional level, and believe that the software is suitable and relevant to the instruction of the learning area.

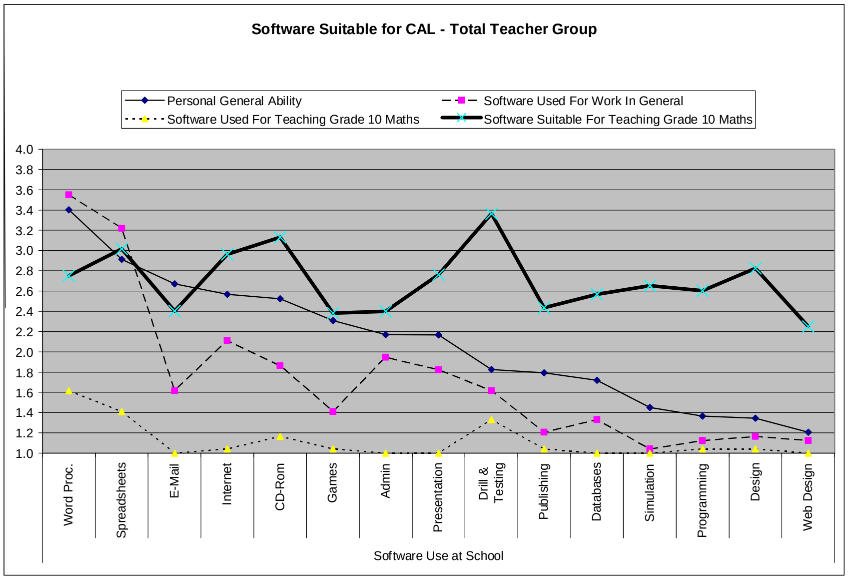
4.3.5.2.1 Total Teacher Group

Table 125: The Software Most Suitable for CAL in Grade 10 Mathematics – Total Teacher Group

Software	Level of Use	Software Use	
		Yes	No
Word Proc.	Capable on Software	96	4
	Used for Work	70	30
	To Teach Grade 10 Maths	10	90
	Suitability to Teach Grade 10 Maths	69	31
Spreadsheets	Capable on Software	74	26
	Used for Work	50	50
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	80	20
E-Mail	Capable on Software	66	34
	Used for Work	10	90
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	45	55
Internet	Capable on Software	60	40
	Used for Work	20	80
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	79	21
CD-Rom Based Software	Capable on Software	60	40
	Used for Work	20	80
	To Teach Grade 10 Maths	10	90
	Suitability to Teach Grade 10 Maths	84	16
Games	Capable on Software	45	55
	Used for Work	10	90
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	48	52
Admin	Capable on Software	46	54
	Used for Work	30	70
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	49	51
Presentation	Capable on Software	35	65
	Used for Work	10	90
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	69	31
Drill & Testing	Capable on Software	32	68
	Used for Work	30	70
	To Teach Grade 10 Maths	30	70
	Suitability to Teach Grade 10 Maths	85	15
Publishing	Capable on Software	24	76
	Used for Work	10	90
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	50	50
Databases	Capable on Software	23	77
	Used for Work	10	90
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	59	41
Simulation	Capable on Software	11	89
	Used for Work	0	100
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	63	37
Programming	Capable on Software	10	90
	Used for Work	0	100
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	65	35
Design	Capable on Software	10	90
	Used for Work	0	100
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	70	30
Web Design	Capable on Software	5	95
	Used for Work	0	100
	To Teach Grade 10 Maths	0	100
	Suitability to Teach Grade 10 Maths	39	61

The teacher group as a whole indicates that Drill & Testing software at 85%, CD-Rom based software at 84%, Spreadsheet software at 80%, Internet use at 79% and Design software at 70% are the most suitable software for CAL implementation and use for the Grade 10 Mathematics learning area.

Figure 145



Spreadsheet software demonstrates higher levels amongst learners in personal general ability, general work experience and suitability, but has been used at very low incidences for teaching Grade 10 Mathematics. Teachers also demonstrate higher levels of personal general ability and suitability in the use of CD-Rom based software, but show low levels of use in the school context. Drill & Testing software, however, indicated as the most suitable software for teaching Grade 10 Mathematics, at low levels in both teacher capability and experience.

4.3.5.2.2 Gender Breakdown

Table 126: The Software Most Suitable for CAL in Grade 10 Mathematics – Gender Breakdown (*Continued Overleaf*)

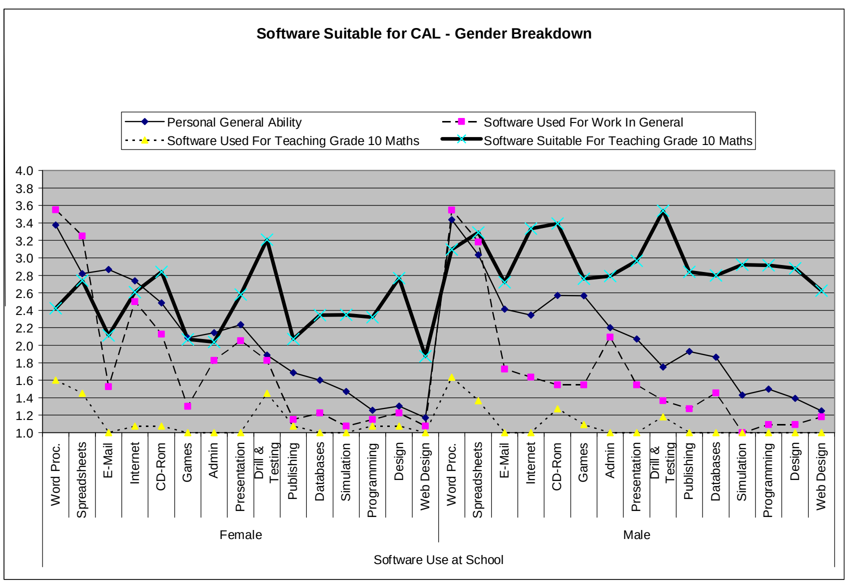
Software	Gender Breakdown	Level of Use	Software Use Yes	No
Word Proc.	Female	Capable on Software	98	3
		Used for Work	60	40
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	52	48
	Male	Capable on Software	94	6
		Used for Work	80	20
		To Teach Grade 10 Maths	20	80
		Suitability to Teach Grade 10 Maths	85	15
Spreadsheets	Female	Capable on Software	69	31
		Used for Work	60	40
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	74	26
	Male	Capable on Software	80	20
		Used for Work	40	60
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	85	15
E-Mail	Female	Capable on Software	76	24
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	30	70
	Male	Capable on Software	52	48

		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	61	39
Internet	Female	Capable on Software	68	32
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	Male	Capable on Software	48	52
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	87	13
CD-Rom Based Software	Female	Capable on Software	60	40
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	76	24
	Male	Capable on Software	61	39
		Used for Work	20	80
		To Teach Grade 10 Maths	20	80
		Suitability to Teach Grade 10 Maths	90	10
Games	Female	Capable on Software	31	69
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	37	63
	Male	Capable on Software	60	40
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	61	39
Admin	Female	Capable on Software	49	51
		Used for Work	40	60
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	31	69
	Male	Capable on Software	43	57
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
Presentation	Female	Capable on Software	39	61
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	61	39
	Male	Capable on Software	29	71
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	77	23
Drill & Testing	Female	Capable on Software	37	63
		Used for Work	20	80
		To Teach Grade 10 Maths	40	60
		Suitability to Teach Grade 10 Maths	77	23
	Male	Capable on Software	25	75
		Used for Work	40	60
		To Teach Grade 10 Maths	20	80
		Suitability to Teach Grade 10 Maths	93	7
Publishing	Female	Capable on Software	20	80
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	29	71
	Male	Capable on Software	29	71
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
Databases	Female	Capable on Software	20	80
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	54	46
	Male	Capable on Software	28	72
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	64	36
Simulation	Female	Capable on Software	12	88
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	48	52
	Male	Capable on Software	11	89
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	76	24
Programming	Female	Capable on Software	9	91
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	52	48
	Male	Capable on Software	11	89

		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	77	23
Design	Female	Capable on Software	9	91
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	69	31
	Male	Capable on Software	11	89
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
Web Design	Female	Capable on Software	3	97
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	17	83
	Male	Capable on Software	7	93
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	59	41

The male teacher group indicates that a greater variety of software is highly suitable for CAL implementation and use for teaching Grade 10 Mathematics, while the female teacher group is more selective with an allocation of fewer, more specific software. However, Spreadsheet software, the Internet, CD-Rom based software, Drill & Testing software and Word Processors feature as highly suitable in both teacher groups.

Figure 146



Teachers from both gender groups indicate higher levels of general ability and experience in the use of Spreadsheet software, though low levels of use have occurred in the teaching context, despite indications of higher suitability. Teachers in the male teacher group generally show higher levels in general for Word Processing software, while female teachers demonstrate greater experience in the use of Drill & Testing software.

4.3.5.2.3 Demographic Breakdown

Table 127: The Software Most Suitable for CAL in Grade 10 Mathematics – Demographic Breakdown (*Continued Overleaf*)

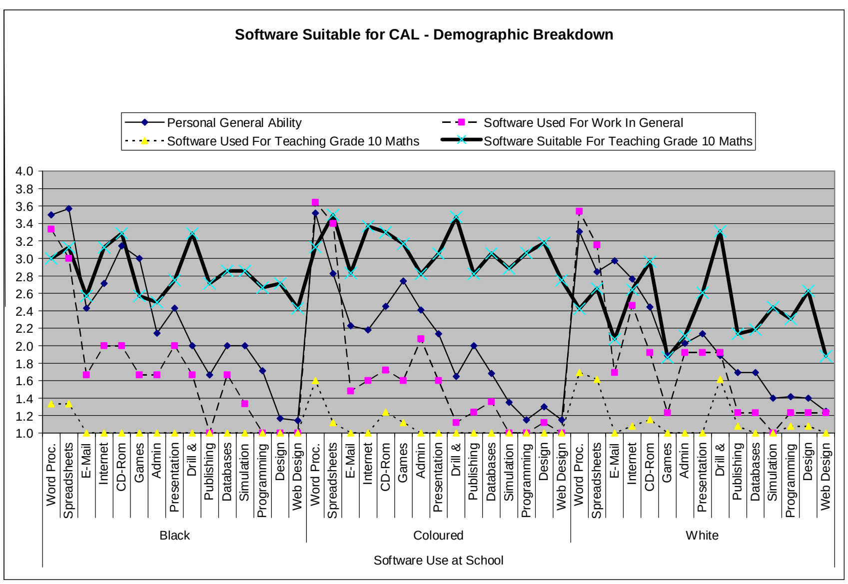
Software	Demographic Breakdown	Level of Use	Software Use Yes	Software Use No
Word Proc.	Black	Capable on Software	100	0
		Used for Work	54	46
		To Teach Grade 10 Maths	8	92
		Suitability to Teach Grade 10 Maths	91	9
	Coloured	Capable on Software	100	0
		Used for Work	88	12
		To Teach Grade 10 Maths	20	80
		Suitability to Teach Grade 10 Maths	78	22
	White	Capable on Software	92	8
		Used for Work	83	18
		To Teach Grade 10 Maths	23	78
		Suitability to Teach Grade 10 Maths	55	45
Spreadsheets	Black	Capable on Software	100	0
		Used for Work	46	54
		To Teach Grade 10 Maths	8	92
		Suitability to Teach Grade 10 Maths	91	9
	Coloured	Capable on Software	70	30
		Used for Work	80	20
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	91	9
	White	Capable on Software	72	28
		Used for Work	70	30
		To Teach Grade 10 Maths	20	80
		Suitability to Teach Grade 10 Maths	69	31
E-Mail	Black	Capable on Software	57	43
		Used for Work	15	85
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	70	30
	Coloured	Capable on Software	45	55
		Used for Work	16	84
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	61	39
	White	Capable on Software	79	21
		Used for Work	23	78
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	26	74
Internet	Black	Capable on Software	71	29
		Used for Work	23	77
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	91	9
	Coloured	Capable on Software	41	59
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	84	16
	White	Capable on Software	68	32
		Used for Work	48	53
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	71	29
CD-Rom Based Software	Black	Capable on Software	86	14
		Used for Work	23	77
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	90	10
	Coloured	Capable on Software	55	45
		Used for Work	24	76
		To Teach Grade 10 Maths	8	92
		Suitability to Teach Grade 10 Maths	85	15
	White	Capable on Software	58	42
		Used for Work	30	70
		To Teach Grade 10 Maths	5	95
		Suitability to Teach Grade 10 Maths	81	19
Games	Black	Capable on Software	71	29
		Used for Work	15	85
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	70	30
	Coloured	Capable on Software	65	35
		Used for Work	20	80
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	72	28
	White	Capable on Software	26	74
		Used for Work	8	93
		To Teach Grade 10 Maths	0	100

		Suitability to Teach Grade 10 Maths	27	73
Admin	Black	Capable on Software	29	71
		Used for Work	15	85
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	78	22
	Coloured	Capable on Software	55	45
		Used for Work	36	64
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	59	41
	White	Capable on Software	44	56
		Used for Work	30	70
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	33	67
Presentation	Black	Capable on Software	57	43
		Used for Work	23	77
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	82	18
	Coloured	Capable on Software	27	73
		Used for Work	20	80
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	83	17
	White	Capable on Software	35	65
		Used for Work	30	70
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	58	42
Drill & Testing	Black	Capable on Software	43	57
		Used for Work	15	85
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	90	10
	Coloured	Capable on Software	25	75
		Used for Work	4	96
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	89	11
	White	Capable on Software	33	67
		Used for Work	30	70
		To Teach Grade 10 Maths	20	80
		Suitability to Teach Grade 10 Maths	80	20
Publishing	Black	Capable on Software	17	83
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	80	20
	Coloured	Capable on Software	33	67
		Used for Work	8	92
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	65	35
	White	Capable on Software	19	81
		Used for Work	8	93
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	31	69
Databases	Black	Capable on Software	50	50
		Used for Work	15	85
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	90	10
	Coloured	Capable on Software	18	82
		Used for Work	12	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	76	24
	White	Capable on Software	22	78
		Used for Work	8	93
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	37	63
Simulation	Black	Capable on Software	29	71
		Used for Work	8	92
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	70	30
	Coloured	Capable on Software	10	90
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	White	Capable on Software	9	91
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	56	44
Programming	Black	Capable on Software	14	86
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	89	11
	Coloured	Capable on Software	5	95
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100

		Suitability to Teach Grade 10 Maths	81	19
	White	Capable on Software	11	89
		Used for Work	8	93
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	46	54
Design	Black	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	90	10
	Coloured	Capable on Software	15	85
		Used for Work	4	96
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	82	18
	White	Capable on Software	9	91
		Used for Work	8	93
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	56	44
Web Design	Black	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	80	20
	Coloured	Capable on Software	5	95
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	63	38
	White	Capable on Software	6	94
		Used for Work	8	93
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	8	92

The Black and Coloured demographic teacher groups indicate a greater variety of software as highly suitable for CAL implementation and use for teaching Grade 10 Mathematics, while the White demographic teaching group is more selective with an allocation of fewer, relevant software. However, the use of the Internet, of CD-Rom software and Drill & Testing software feature as highly suitable in all teacher demographic groups.

Figure 147



Teachers from all demographic groups show high levels of suitability, capability and general experience in the use of Spreadsheet software, though the use for instruction falls low. Teachers from all groups generally indicate higher levels of suitability and capability for Internet use, but demonstrate lower levels of experience. Levels for Drill & Practise software are generally low, despite an indication of high suitability.

4.3.5.2.4 Age Groups

Table 128: The Software Most Suitable for CAL in Grade 10 Mathematics – Age Group Breakdown (*Continued Overleaf*)

			Software Use	
Software	**Age Groups**	**Level of Use**	Yes	No
Word Proc.	21 - 30	Capable on Software	100	0
		Used for Work	88	13
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	63	38
	31 - 40	Capable on Software	100	0
		Used for Work	75	25
		To Teach Grade 10 Maths	19	81
		Suitability to Teach Grade 10 Maths	71	29
	41 - 50	Capable on Software	100	0
		Used for Work	86	14
		To Teach Grade 10 Maths	29	71
		Suitability to Teach Grade 10 Maths	71	29
	51 - 60	Capable on Software	75	25
		Used for Work	75	25
		To Teach Grade 10 Maths	13	88
		Suitability to Teach Grade 10 Maths	60	40
	Over 60	Capable on Software	50	50
		Used for Work	50	50
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Spreadsheets	21 - 30	Capable on Software	100	0
		Used for Work	88	13
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	31 - 40	Capable on Software	64	36
		Used for Work	72	28
		To Teach Grade 10 Maths	9	91
		Suitability to Teach Grade 10 Maths	82	18
	41 - 50	Capable on Software	79	21
		Used for Work	68	32
		To Teach Grade 10 Maths	25	75
		Suitability to Teach Grade 10 Maths	77	23
	51 - 60	Capable on Software	75	25
		Used for Work	50	50
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	60	40
	Over 60	Capable on Software	50	50
		Used for Work	50	50
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
E-Mail	21 - 30	Capable on Software	100	0
		Used for Work	38	63
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	57	43
	31 - 40	Capable on Software	57	43
		Used for Work	22	78
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	45	55
	41 - 50	Capable on Software	70	30
		Used for Work	14	86
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	55	45
	51 - 60	Capable on Software	57	43
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	0	100

	Over 60	Capable on Software	50	50
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Internet	21 - 30	Capable on Software	100	0
		Used for Work	75	25
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	31 - 40	Capable on Software	57	43
		Used for Work	25	75
		To Teach Grade 10 Maths	3	97
		Suitability to Teach Grade 10 Maths	73	27
	41 - 50	Capable on Software	61	39
		Used for Work	39	61
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	81	19
	51 - 60	Capable on Software	43	57
		Used for Work	25	75
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	83	17
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
CD-Rom Based Software	21 - 30	Capable on Software	86	14
		Used for Work	25	75
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	31 - 40	Capable on Software	62	38
		Used for Work	22	78
		To Teach Grade 10 Maths	6	94
		Suitability to Teach Grade 10 Maths	78	22
	41 - 50	Capable on Software	55	45
		Used for Work	36	64
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	84	16
	51 - 60	Capable on Software	67	33
		Used for Work	25	75
		To Teach Grade 10 Maths	13	88
		Suitability to Teach Grade 10 Maths	100	0
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Games	21 - 30	Capable on Software	71	29
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	63	38
	31 - 40	Capable on Software	52	48
		Used for Work	19	81
		To Teach Grade 10 Maths	3	97
		Suitability to Teach Grade 10 Maths	57	43
	41 - 50	Capable on Software	33	67
		Used for Work	7	93
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	43	57
	51 - 60	Capable on Software	17	83
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	17	83
	Over 60	Capable on Software	100	0
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Admin	21 - 30	Capable on Software	71	29
		Used for Work	38	63
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	57	43
	31 - 40	Capable on Software	36	64
		Used for Work	19	81
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	47	53
	41 - 50	Capable on Software	50	50
		Used for Work	39	61
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	60	40
	51 - 60	Capable on Software	57	43
		Used for Work	38	63
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	0	100

	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Presentation	21 - 30	Capable on Software	71	29
		Used for Work	50	50
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	63	38
	31 - 40	Capable on Software	39	61
		Used for Work	22	78
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	41 - 50	Capable on Software	26	74
		Used for Work	29	71
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	77	23
	51 - 60	Capable on Software	17	83
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Drill & Testing	21 - 30	Capable on Software	43	57
		Used for Work	38	63
		To Teach Grade 10 Maths	25	75
		Suitability to Teach Grade 10 Maths	100	0
	31 - 40	Capable on Software	31	69
		Used for Work	16	84
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	77	23
	41 - 50	Capable on Software	27	73
		Used for Work	14	86
		To Teach Grade 10 Maths	11	89
		Suitability to Teach Grade 10 Maths	86	14
	51 - 60	Capable on Software	33	67
		Used for Work	38	63
		To Teach Grade 10 Maths	38	63
		Suitability to Teach Grade 10 Maths	83	17
	Over 60	Capable on Software	50	50
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
Publishing	21 - 30	Capable on Software	29	71
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	38	63
	31 - 40	Capable on Software	31	69
		Used for Work	6	94
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	55	45
	41 - 50	Capable on Software	14	86
		Used for Work	7	93
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	57	43
	51 - 60	Capable on Software	33	67
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	20	80
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Databases	21 - 30	Capable on Software	57	43
		Used for Work	25	75
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	57	43
	31 - 40	Capable on Software	22	78
		Used for Work	9	91
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
	41 - 50	Capable on Software	18	82
		Used for Work	7	93
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	63	37
	51 - 60	Capable on Software	17	83
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	20	80

	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Simulation	21 - 30	Capable on Software	14	86
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	57	43
	31 - 40	Capable on Software	19	81
		Used for Work	3	97
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	55	45
	41 - 50	Capable on Software	5	95
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	74	26
	51 - 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	75	25
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Programming	21 - 30	Capable on Software	43	57
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	63	38
	31 - 40	Capable on Software	12	88
		Used for Work	3	97
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	41 - 50	Capable on Software	0	100
		Used for Work	4	96
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	68	32
	51 - 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	20	80
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
Design	21 - 30	Capable on Software	17	83
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	86	14
	31 - 40	Capable on Software	8	92
		Used for Work	3	97
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	41 - 50	Capable on Software	10	90
		Used for Work	11	89
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	79	21
	51 - 60	Capable on Software	17	83
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	20	80
	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50
Web Design	21 - 30	Capable on Software	14	86
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	29	71
	31 - 40	Capable on Software	8	92
		Used for Work	3	97
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	56	44
	41 - 50	Capable on Software	0	100
		Used for Work	4	96
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	37	63
	51 - 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	0	100

	Over 60	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	50	50

Teachers in age groups ranging from ages 31 to 50 indicate a greater variety of software as highly suitable for CAL implementation and use for teaching Grade 10 Mathematics, while other age groups are more selective with an indication of less specific and relevant software. However, the use of Spreadsheet software, the Internet, CD-Rom software and Drill & Testing software feature as highly suitable in most teacher age groups.

Figure 148

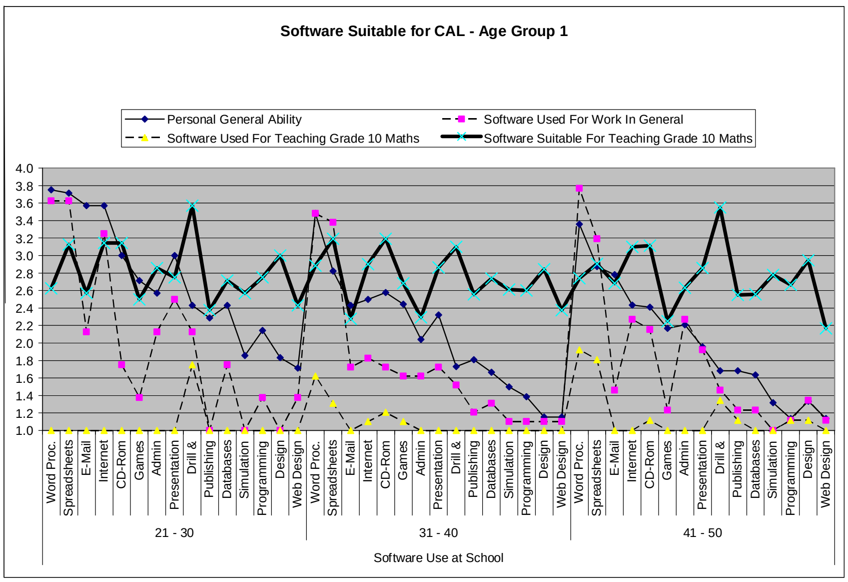
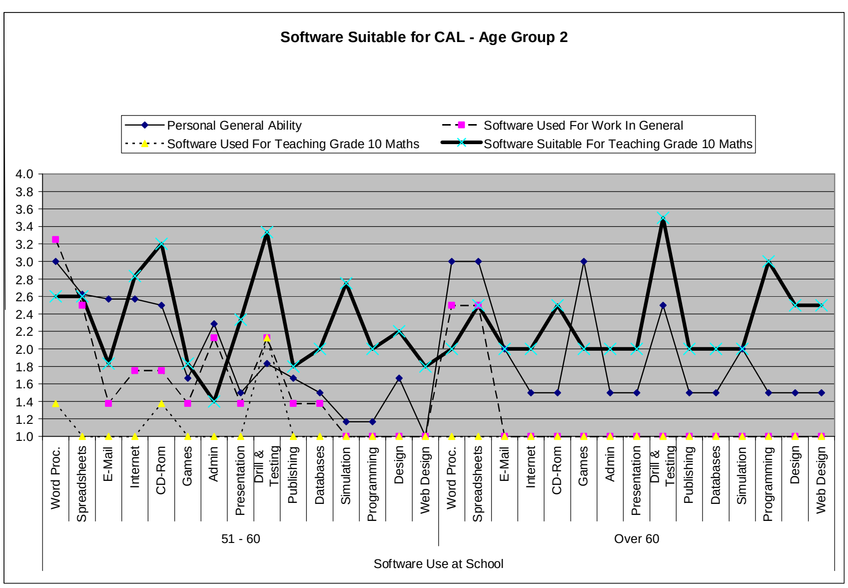


Figure 149



In general, the levels of personal general software ability and experience tend to be higher for teachers in lower age groups, though teachers in older age groups show greater personal ability in the use of Drill & Testing software. However, levels of software use for teaching Grade 10 Mathematics are low across the board.

4.3.5.2.5 Level of Qualifications

Table 129: The Software Most Suitable for CAL in Grade 10 Mathematics – Level of Qualification Breakdown (*Continued Overleaf*)

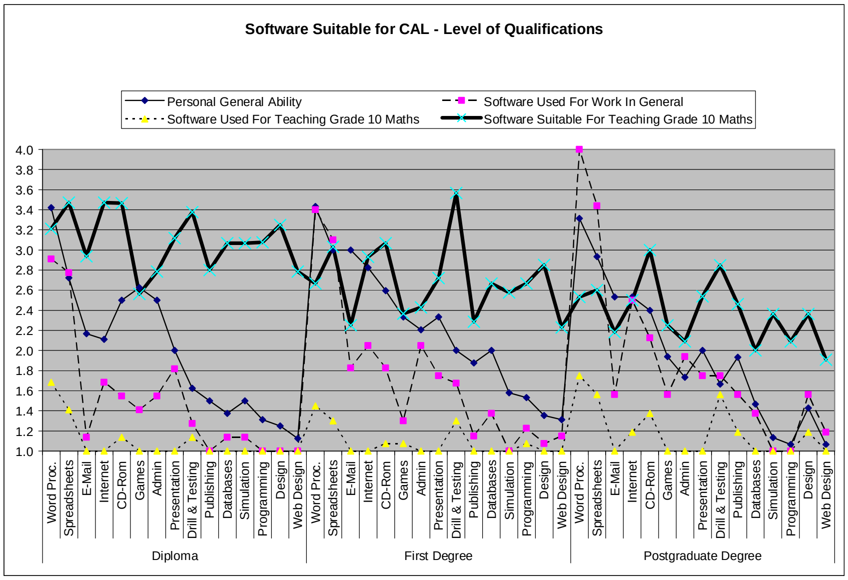
Software	Level of Qualifications	Level of Use	Software Use	
			Yes	No
Word Proc.	Diploma	Capable on Software	95	5
		Used for Work	64	36
		To Teach Grade 10 Maths	23	77
		Suitability to Teach Grade 10 Maths	89	11
	First Degree	Capable on Software	97	3
		Used for Work	80	20
		To Teach Grade 10 Maths	15	85
		Suitability to Teach Grade 10 Maths	61	39
	Postgraduate Degree	Capable on Software	94	6
		Used for Work	100	0
		To Teach Grade 10 Maths	25	75
		Suitability to Teach Grade 10 Maths	60	40
Spreadsheets	Diploma	Capable on Software	61	39
		Used for Work	59	41
		To Teach Grade 10 Maths	14	86
		Suitability to Teach Grade 10 Maths	94	6
	First Degree	Capable on Software	81	19
		Used for Work	70	30
		To Teach Grade 10 Maths	10	90
		Suitability to Teach Grade 10 Maths	76	24
	Postgraduate Degree	Capable on Software	73	27
		Used for Work	81	19
		To Teach Grade 10 Maths	19	81
		Suitability to Teach Grade 10 Maths	73	27
E-Mail	Diploma	Capable on Software	56	44
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	69	31
	First Degree	Capable on Software	74	26
		Used for Work	28	73
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	36	64
	Postgraduate Degree	Capable on Software	60	40
		Used for Work	19	81
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	36	64
Internet	Diploma	Capable on Software	44	56
		Used for Work	23	77
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	First Degree	Capable on Software	68	32
		Used for Work	35	65
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	72	28
	Postgraduate Degree	Capable on Software	60	40
		Used for Work	50	50
		To Teach Grade 10 Maths	6	94
		Suitability to Teach Grade 10 Maths	67	33
CD-Rom Based Software	Diploma	Capable on Software	56	44
		Used for Work	18	82
		To Teach Grade 10 Maths	5	95
		Suitability to Teach Grade 10 Maths	100	0
	First Degree	Capable on Software	63	38
		Used for Work	28	73
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	77	23
	Postgraduate Degree	Capable on Software	60	40

		Used for Work	38	63
		To Teach Grade 10 Maths	13	88
		Suitability to Teach Grade 10 Maths	82	18
Games	Diploma	Capable on Software	56	44
		Used for Work	14	86
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	56	44
	First Degree	Capable on Software	45	55
		Used for Work	10	90
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	47	53
	Postgraduate Degree	Capable on Software	31	69
		Used for Work	19	81
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	42	58
Admin	Diploma	Capable on Software	63	38
		Used for Work	18	82
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	First Degree	Capable on Software	44	56
		Used for Work	35	65
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	43	57
	Postgraduate Degree	Capable on Software	33	67
		Used for Work	31	69
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	36	64
Presentation	Diploma	Capable on Software	28	72
		Used for Work	27	73
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	94	6
	First Degree	Capable on Software	39	61
		Used for Work	25	75
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	59	41
	Postgraduate Degree	Capable on Software	33	67
		Used for Work	25	75
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	62	38
Drill & Testing	Diploma	Capable on Software	25	75
		Used for Work	9	91
		To Teach Grade 10 Maths	5	95
		Suitability to Teach Grade 10 Maths	94	6
	First Degree	Capable on Software	38	63
		Used for Work	23	78
		To Teach Grade 10 Maths	10	90
		Suitability to Teach Grade 10 Maths	90	10
	Postgraduate Degree	Capable on Software	27	73
		Used for Work	25	75
		To Teach Grade 10 Maths	19	81
		Suitability to Teach Grade 10 Maths	62	38
Publishing	Diploma	Capable on Software	19	81
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	73	27
	First Degree	Capable on Software	22	78
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	36	64
	Postgraduate Degree	Capable on Software	33	67
		Used for Work	19	81
		To Teach Grade 10 Maths	6	94
		Suitability to Teach Grade 10 Maths	54	46
Databases	Diploma	Capable on Software	6	94
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	87	13
	First Degree	Capable on Software	36	64
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	52	48
	Postgraduate Degree	Capable on Software	13	87
		Used for Work	13	88
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	42	58
Simulation	Diploma	Capable on Software	13	88
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	80	20
	First Degree	Capable on Software	13	87

		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	54	46
	Postgraduate Degree	Capable on Software	7	93
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	64	36
Programming	Diploma	Capable on Software	6	94
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	92	8
	First Degree	Capable on Software	16	84
		Used for Work	8	93
		To Teach Grade 10 Maths	3	98
		Suitability to Teach Grade 10 Maths	63	37
	Postgraduate Degree	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	36	64
Design	Diploma	Capable on Software	6	94
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	88	13
	First Degree	Capable on Software	10	90
		Used for Work	3	98
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	70	30
	Postgraduate Degree	Capable on Software	14	86
		Used for Work	19	81
		To Teach Grade 10 Maths	6	94
		Suitability to Teach Grade 10 Maths	45	55
Web Design	Diploma	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	First Degree	Capable on Software	9	91
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	31	69
	Postgraduate Degree	Capable on Software	0	100
		Used for Work	6	94
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	18	82

Teachers who fall in the diploma qualification group indicate a greater variety of software as highly suitable for CAL implementation and use for teaching Grade 10 Mathematics, while teachers who have first and postgraduate degrees are more selective. However, the use of Spreadsheet software, the Internet, CD-Rom based software and Drill & Testing software tend to feature as highly suitable in all the teacher qualification groups.

Figure 150



In general, teachers who fall in the diploma category generally tend to view software as more suitable for teaching Grade 10 Mathematics than teachers with first and postgraduate degrees, though teachers with degrees indicate higher levels of ability and software use. However, levels of software use for teaching Grade 10 Mathematics are low across the board. Teachers in the postgraduate degree group have personal abilities and levels of general work use of Word Processor and Spreadsheet software at higher levels than they believe to be suitable for teaching Grade 10 Mathematics.

4.3.5.2.6 Level of Computer Use

Table 130: The Software Most Suitable for CAL in Grade 10 Mathematics – Level of Computer Use Breakdown (*Continued Overleaf*)

Software	Level of Computer Use	Level of Use	Software Use	
			Yes	No
Word Proc.	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	83	17
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	75	25
	Used - for work no CAL	Capable on Software	95	5
		Used for Work	90	10
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	69	31
	Used - work and CAL	Capable on Software	100	0
		Used for Work	96	4
		To Teach Grade 10 Maths	54	46
		Suitability to Teach Grade 10 Maths	63	38

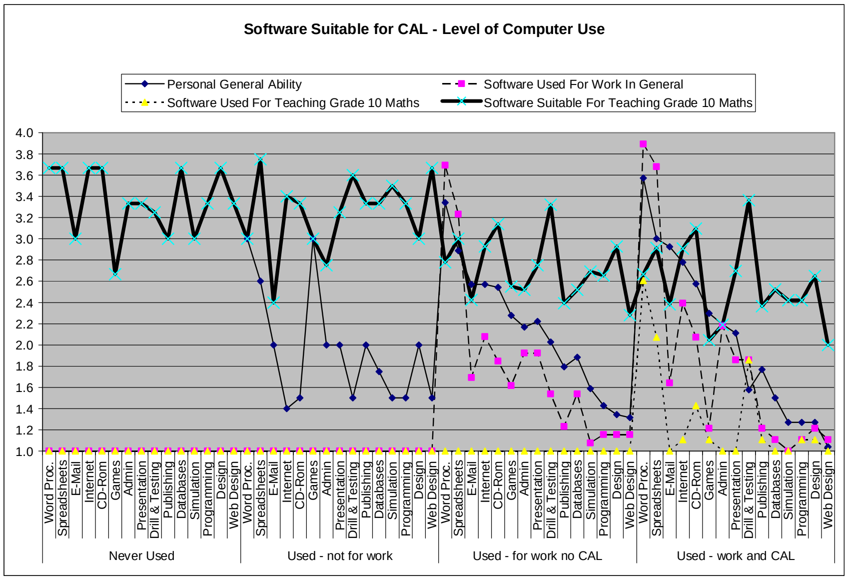
Spreadsheets	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	60	40
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	69	31
		Used for Work	74	26
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	77	23
	Used - work and CAL	Capable on Software	82	18
		Used for Work	89	11
		To Teach Grade 10 Maths	36	64
		Suitability to Teach Grade 10 Maths	78	22
E-Mail	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
	Used - not for work	Capable on Software	40	60
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	60	40
	Used - for work no CAL	Capable on Software	63	37
		Used for Work	23	77
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	42	58
	Used - work and CAL	Capable on Software	74	26
		Used for Work	21	79
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	43	57
Internet	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	60	40
		Used for Work	36	64
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	71	29
	Used - work and CAL	Capable on Software	70	30
		Used for Work	46	54
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	82	18
CD-Rom Based Software	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	63	37
		Used for Work	28	72
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	83	17
	Used - work and CAL	Capable on Software	62	38
		Used for Work	36	64
		To Teach Grade 10 Maths	14	86
		Suitability to Teach Grade 10 Maths	81	19
Games	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
	Used - not for work	Capable on Software	100	0
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	75	25
	Used - for work no CAL	Capable on Software	42	58
		Used for Work	21	79
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	59	41
	Used - work and CAL	Capable on Software	44	56
		Used for Work	7	93
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	27	73
Admin	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	33	67
		Used for Work	0	100

		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	75	25
	Used - for work no CAL	Capable on Software	47	53
		Used for Work	31	69
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	48	52
	Used - work and CAL	Capable on Software	46	54
		Used for Work	39	61
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	38	62
Presentation	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	33	67
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	33	67
		Used for Work	31	69
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	69	31
	Used - work and CAL	Capable on Software	37	63
		Used for Work	29	71
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	61	39
Drill & Testing	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	43	57
		Used for Work	18	82
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	82	18
	Used - work and CAL	Capable on Software	19	81
		Used for Work	29	71
		To Teach Grade 10 Maths	29	71
		Suitability to Teach Grade 10 Maths	82	18
Publishing	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
	Used - not for work	Capable on Software	33	67
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	21	79
		Used for Work	8	92
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	43	57
	Used - work and CAL	Capable on Software	27	73
		Used for Work	7	93
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	50	50
Databases	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	25	75
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	29	71
		Used for Work	18	82
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	52	48
	Used - work and CAL	Capable on Software	15	85
		Used for Work	4	96
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	57	43
Simulation	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
	Used - not for work	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	15	85
		Used for Work	3	97
		To Teach Grade 10 Maths	0	100

		Suitability to Teach Grade 10 Maths	65	35
	Used - work and CAL	Capable on Software	8	92
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	53	47
Programming	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	11	89
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	62	38
	Used - work and CAL	Capable on Software	8	92
		Used for Work	4	96
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	58	42
Design	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	33	67
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	67	33
	Used - for work no CAL	Capable on Software	9	91
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	75	25
	Used - work and CAL	Capable on Software	8	92
		Used for Work	7	93
		To Teach Grade 10 Maths	4	96
		Suitability to Teach Grade 10 Maths	60	40
Web Design	Never Used	Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - not for work	Capable on Software	0	100
		Used for Work	0	100
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	100	0
	Used - for work no CAL	Capable on Software	9	91
		Used for Work	5	95
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	40	60
	Used - work and CAL	Capable on Software	0	100
		Used for Work	4	96
		To Teach Grade 10 Maths	0	100
		Suitability to Teach Grade 10 Maths	20	80

Teachers who have never used computers, or have used computers but not for work purposes, select a greater variety of software as highly suitable for CAL implementation and use in teaching Grade 10 Mathematics, while teachers who have used computers for work purposes are more selective. However, the use of Spreadsheet software, the Internet, CD-Rom based software and Drill & Testing software tend to feature as highly suitable in all computer use groups.

Figure 151



In general, teachers who have used computers but not for work purposes have lower computer abilities than teachers who have used computers in the school context, but tend to have higher evaluations, along with teachers who have never used computers, of suitability of software for teaching Grade 10 Mathematics. Teachers who have used computers in the work context and for CAL generally demonstrate higher levels of software use in schools in general than teachers who have used computers in schools but not for CAL. Teachers who have used computers for work and CAL indicate a greater match between personal ability, software use and their evaluations of suitability.

4.3.6 The Levels of CAL Most Suited to the Implementation of CAL in South African Schools

4.3.6.1 Attitudes to the General levels of CAL

This section reports on the attitudes and preferences teachers have of the different levels of CAL. Items are sorted into categories and their relevant items, set out as follows:

- *Demonstrations*, including each learner using the computer to do practice examples and using the computer to demonstrate examples
- *Teaching*, including using the computer to perform a usual lesson
- *Tutorials*, including allowing learners to learn independently off computer tutorials and allowing learners to learn off a computer tutorial with a teacher
- *Word Processing*, including using the computer to type up assignments
- *Internet and e-mail*, including using the computer to search for information off the Internet and allowing teachers and learners to communicate via computer
- *Testing and assessment*, including using the computer for testing purposes and using computers for marking and assessment purposes.

Results are presented in tabular form as a percentage proportion of answers in rating scale format, including the following ratings: strongly disagree, disagree, agree and strongly agree. A totals column has been added to provide a summary of overall agreement and disagreement.

A weighted average has also been calculated by assigning values to the ratings, from 1 for strongly disagree to 4 for strongly agree. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.75 indicates strong disagreement
- 1.76 to 2.5 indicates general disagreement
- 2.51 to 3.25 indicates general agreement

- 3.26 to 4 indicates strong agreement.

4.3.6.1.1 Total Teacher Group

Table 131: Teachers' Attitudes toward the General Levels of CAL – Total Teacher Group

Categories	Items	Levels of Agreement				Totals	
		Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Demonstrations	Each Learner Does Practice Examples	42	56	0	1	99	1
	To Demonstrate Examples	30	60	10	0	90	10
Teaching	Teach A Usual Lesson On Computer	23	58	17	3	81	19
Tutorials	Learners Learn Independently Off Computer Tutorial	23	54	23	0	77	23
	Learners Learn Off Computer Tutorial With Teacher	12	40	40	8	52	48
Word Processing	Type Up Assignments	52	48	0	0	100	0
Internet and e-mail	Search For Information On Internet	55	45	0	0	100	0
	Teachers And Learners Communicate Via Computer	23	51	21	5	74	26
Testing and Assessment	Computer Based Testing	25	65	9	1	90	10
	Computer Used To Mark And Assess Work	21	58	18	3	79	21

Though teachers indicate general agreement at various degrees for all the items, the strongest levels of agreement are shown for:

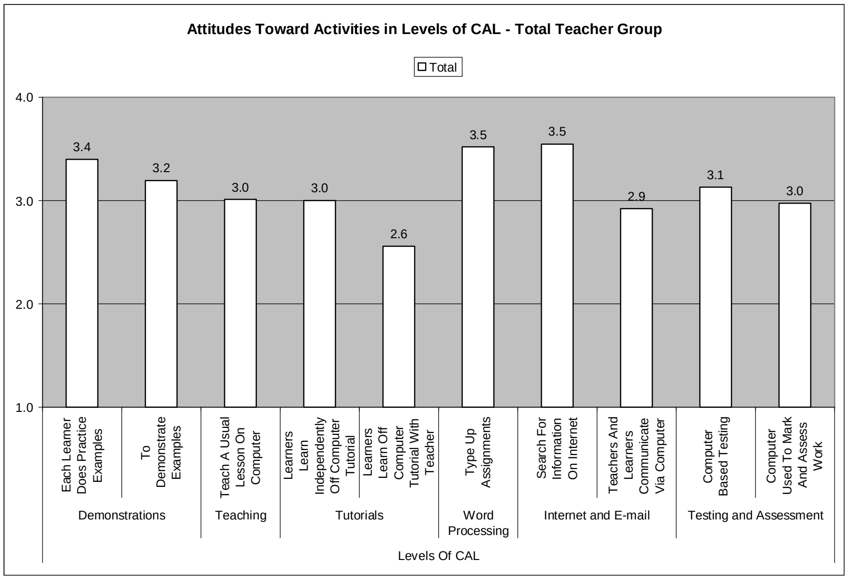
- Using computers to search for information on the Internet at 55% strong agreement, as reflected in the literature (French *et al.*, 1999; Heide *et al.*, 2001; Loschert, 2003)

- Using computers for word processing purposes such as typing up assignments at 52% strong agreement, a function of word processing software indicated in the literature (Bitter *et al.*, 1993; Heide *et al.*, 2001)

- Allowing learners to perform examples on computer at 42% strong agreement, a function of general CAL delivery software, such as spreadsheets (Heide *et al.*, 2001; Merrill *et al.*, 1996), as well as drill and practice software (Bitter *et al.*, 1993; Brown, 1997; Heide *et al.*, 2001; Hughes, 1998; Ortega *et al.*, 2001)

- Using computers to demonstrate examples to learners at 30% strong agreement, a function of general CAL delivery software, such as presentation software (Heide *et al.*, 2001; Mayer, 2000).

Figure 152



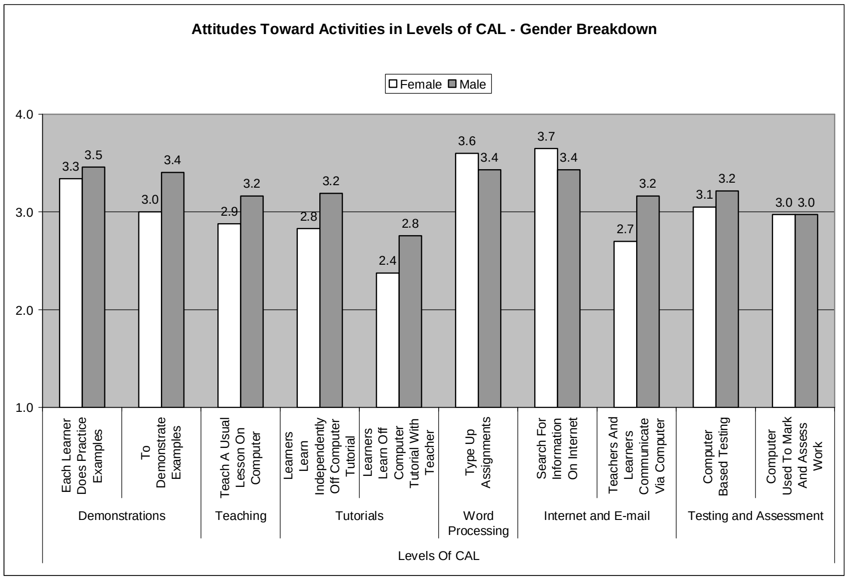
4.3.6.1.2 Gender Breakdown

Table 132: Teachers' Attitudes toward the General Levels of CAL – Gender Breakdown

Categories	Items	Gender Breakdown	Levels of Agreement				Totals	
			Strongly Agree	Agree	Disagree	Strongly Disagree	Agree	Disagree
Demonstrations	Each Learner Does Practice Examples	Female	34	66	0	0	100	0
		Male	51	46	0	3	97	3
	To Demonstrate Examples	Female	18	65	18	0	83	18
		Male	43	54	3	0	97	3
Teaching	Teach A Usual Lesson On Computer	Female	17	56	24	2	73	27
		Male	30	59	8	3	89	11
Tutorials	Learners Learn Independently Off Computer Tutorial	Female	15	54	32	0	68	32
		Male	32	54	14	0	86	14
	Learners Learn Off Computer Tutorial With Teacher	Female	5	38	48	10	43	58
		Male	19	43	32	5	62	38
Word Processing	Type Up Assignments	Female	60	40	0	0	100	0
		Male	43	57	0	0	100	0
Internet and e-mail	Search For Information On Internet	Female	65	35	0	0	100	0
		Male	43	57	0	0	100	0
	Teachers And Learners Communicate Via Computer	Female	15	48	30	8	63	38
		Male	32	54	11	3	86	14
Testing and Assessment	Computer Based Testing	Female	18	70	13	0	88	13
		Male	32	59	5	3	92	8
	Computer Used To Mark And Assess Work	Female	15	68	18	0	83	18
		Male	27	49	19	5	76	24

On average, teachers in the male gender group display higher levels of agreement than teachers in the female gender group, though female teachers agree more strongly that computers can be used for typing up assignments and searching for information on the Internet. Teachers in the male gender group on average agree at stronger levels that computers can be used to demonstrate examples and that learners can use computers to complete tutorials with the teacher.

Figure 153



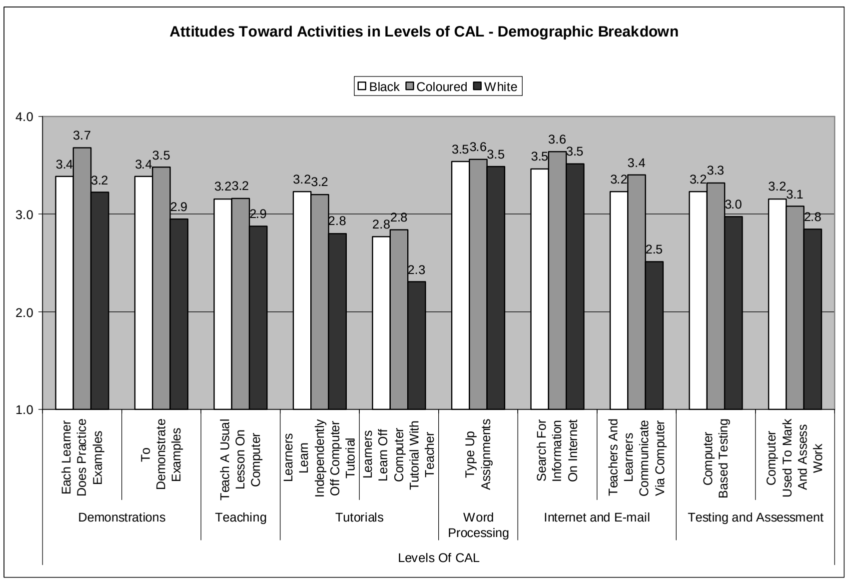
4.3.6.1.3 Demographic Breakdown

Table 133: Teachers' Attitudes toward the General Levels of CAL – Demographic Breakdown

Categories	Items	Demographic Breakdown	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Demonstrations	Each Learner Does Practice Examples	Black	38	62	0	0	100	0
		Coloured	68	32	0	0	100	0
		White	28	70	0	3	98	3
	To Demonstrate Examples	Black	38	62	0	0	100	0
		Coloured	48	52	0	0	100	0
		White	15	64	21	0	79	21
Teaching	Teach A Usual Lesson On Computer	Black	23	69	8	0	92	8
		Coloured	36	48	12	4	84	16
		White	15	60	23	3	75	25
Tutorials	Learners Learn Independently Off Computer Tutorial	Black	23	77	0	0	100	0
		Coloured	36	48	16	0	84	16
		White	15	50	35	0	65	35
	Learners Learn Off Computer Tutorial With Teacher	Black	15	46	38	0	62	38
		Coloured	24	40	32	4	64	36
		White	3	38	46	13	41	59
Word Processing	Type Up Assignments	Black	54	46	0	0	100	0
		Coloured	56	44	0	0	100	0
		White	49	51	0	0	100	0
Internet and e-mail	Search For Information On Internet	Black	46	54	0	0	100	0
		Coloured	64	36	0	0	100	0
		White	51	49	0	0	100	0
	Teachers And Learners Communicate Via Computer	Black	31	62	8	0	92	8
		Coloured	48	44	8	0	92	8
		White	5	51	33	10	56	44
Testing and Assessment	Computer Based Testing	Black	31	62	8	0	92	8
		Coloured	40	56	0	4	96	4
		White	13	72	15	0	85	15
	Computer Used To Mark And Assess Work	Black	31	54	15	0	85	15
		Coloured	32	52	8	8	84	16
		White	10	64	26	0	74	26

Teachers who fall in the White demographic group on average agree at lower levels than teachers from other demographic groups, while teachers who fall in the Black and Coloured teacher groups generally agree at high levels. Teachers in the White demographic group on average disagree that learners learn off a computer tutorial with the aid of teachers and that teachers and learners communicate via computer.

Figure 154



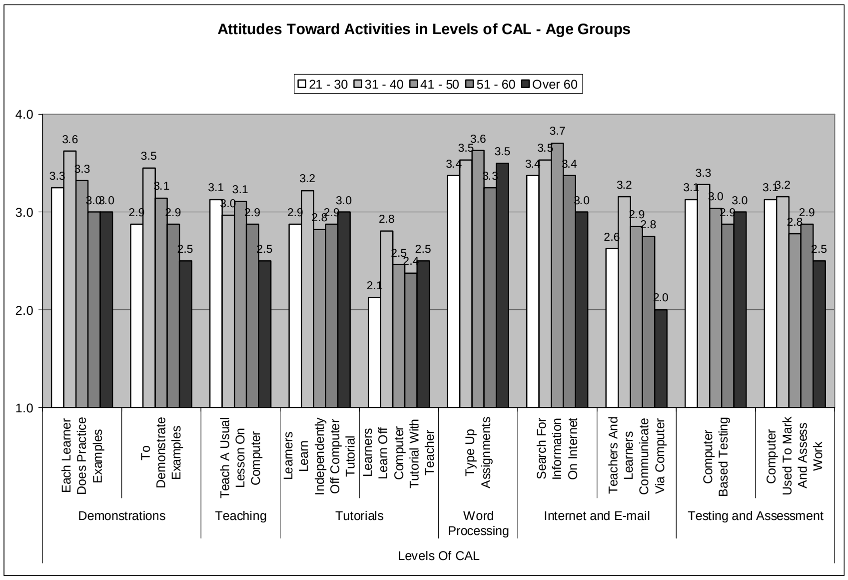
4.3.6.1.4 Age Groups

Though teachers in the over 60 age group on average indicate lower levels of agreement to items, teachers from various age groups tend to present similar views regarding the levels of CAL. Teachers in the 31 to 40 age group generally present higher levels of agreement across the board. Teachers from all age groups indicate high levels of consensus that computers can be used to demonstrate examples, for typing up assignments and for searching for information on the Internet.

Table 134: Teachers' Attitudes toward the General Levels of CAL – Age Group Breakdown

Categories	Items	Age Groups	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Demonstrations	Each Learner Does Practice Examples	21 - 30	25	75	0	0	100	0
		31 - 40	63	38	0	0	100	0
		41 - 50	32	68	0	0	100	0
		51 - 60	25	63	0	13	88	13
		Over 60	0	100	0	0	100	0
	To Demonstrate Examples	21 - 30	13	63	25	0	75	25
		31 - 40	45	55	0	0	100	0
		41 - 50	29	57	14	0	86	14
		51 - 60	0	88	13	0	88	13
		Over 60	0	50	50	0	50	50
Teaching	Teach A Usual Lesson On Computer	21 - 30	25	63	13	0	88	13
		31 - 40	25	50	22	3	75	25
		41 - 50	29	57	11	4	86	14
		51 - 60	0	88	13	0	88	13
		Over 60	0	50	50	0	50	50
Tutorials	Learners Learn Independently Off Computer Tutorial	21 - 30	25	38	38	0	63	38
		31 - 40	34	53	13	0	88	13
		41 - 50	14	54	32	0	68	32
		51 - 60	13	63	25	0	75	25
		Over 60	0	100	0	0	100	0
	Learners Learn Off Computer Tutorial With Teacher	21 - 30	0	25	63	13	25	75
		31 - 40	19	45	32	3	65	35
		41 - 50	11	36	43	11	46	54
		51 - 60	0	50	38	13	50	50
		Over 60	0	50	50	0	50	50
Word Processing	Type Up Assignments	21 - 30	38	63	0	0	100	0
		31 - 40	53	47	0	0	100	0
		41 - 50	63	37	0	0	100	0
		51 - 60	25	75	0	0	100	0
		Over 60	50	50	0	0	100	0
Internet and e-mail	Search For Information On Internet	21 - 30	38	63	0	0	100	0
		31 - 40	53	47	0	0	100	0
		41 - 50	70	30	0	0	100	0
		51 - 60	38	63	0	0	100	0
		Over 60	0	100	0	0	100	0
	Teachers And Learners Communicate Via Computer	21 - 30	0	63	38	0	63	38
		31 - 40	31	56	9	3	88	13
		41 - 50	26	41	26	7	67	33
		51 - 60	13	50	38	0	63	38
		Over 60	0	50	0	50	50	50
Testing and Assessment	Computer Based Testing	21 - 30	13	88	0	0	100	0
		31 - 40	34	63	0	3	97	3
		41 - 50	26	52	22	0	78	22
		51 - 60	0	88	13	0	88	13
		Over 60	0	100	0	0	100	0
	Computer Used To Mark And Assess Work	21 - 30	13	88	0	0	100	0
		31 - 40	28	63	6	3	91	9
		41 - 50	22	37	37	4	59	41
		51 - 60	0	88	13	0	88	13
		Over 60	0	50	50	0	50	50

Figure 155



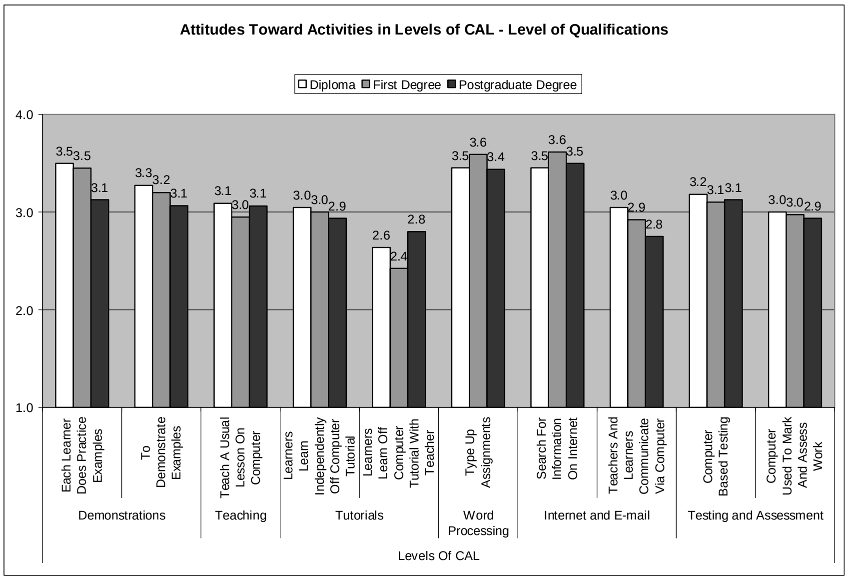
4.3.6.1.5 Level of Qualifications

Table 135: Teachers' Attitudes toward the General Levels of CAL – Level of Qualification Breakdown

Categories	Items	Level of Qualifications	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Demonstrations	Each Learner Does Practice Examples	Diploma	50	50	0	0	100	0
		First Degree	45	55	0	0	100	0
		Postgraduate Degree	25	69	0	6	94	6
	To Demonstrate Examples	Diploma	36	55	9	0	91	9
		First Degree	33	55	13	0	88	13
		Postgraduate Degree	13	80	7	0	93	7
Teaching	Teach A Usual Lesson On Computer	Diploma	23	64	14	0	86	14
		First Degree	25	50	20	5	75	25
		Postgraduate Degree	19	69	13	0	88	13
Tutorials	Learners Learn Independently Off Computer Tutorial	Diploma	23	59	18	0	82	18
		First Degree	28	45	28	0	73	28
		Postgraduate Degree	13	69	19	0	81	19
	Learners Learn Off Computer Tutorial With Teacher	Diploma	14	41	41	5	55	45
		First Degree	15	25	48	13	40	60
		Postgraduate Degree	0	80	20	0	80	20
Word Processing	Type Up Assignments	Diploma	45	55	0	0	100	0
		First Degree	59	41	0	0	100	0
		Postgraduate Degree	44	56	0	0	100	0
Internet and e-mail	Search For Information On Internet	Diploma	45	55	0	0	100	0
		First Degree	62	38	0	0	100	0
		Postgraduate Degree	50	50	0	0	100	0
	Teachers And Learners Communicate Via Computer	Diploma	23	59	18	0	82	18
		First Degree	28	46	15	10	74	26
		Postgraduate Degree	13	50	38	0	63	38
Testing and Assessment	Computer Based Testing	Diploma	27	64	9	0	91	9
		First Degree	26	62	10	3	87	13
		Postgraduate Degree	19	75	6	0	94	6
	Computer Used To Mark And Assess Work	Diploma	18	64	18	0	82	18
		First Degree	26	49	23	3	74	26
		Postgraduate Degree	13	75	6	6	88	13

On average, the degrees of agreement between the various teacher qualification groups are at similar levels. Teachers from all qualification groups demonstrate high levels of agreement that computers can be used to demonstrate examples, for typing up assignments and for searching for information on the Internet.

Figure 156



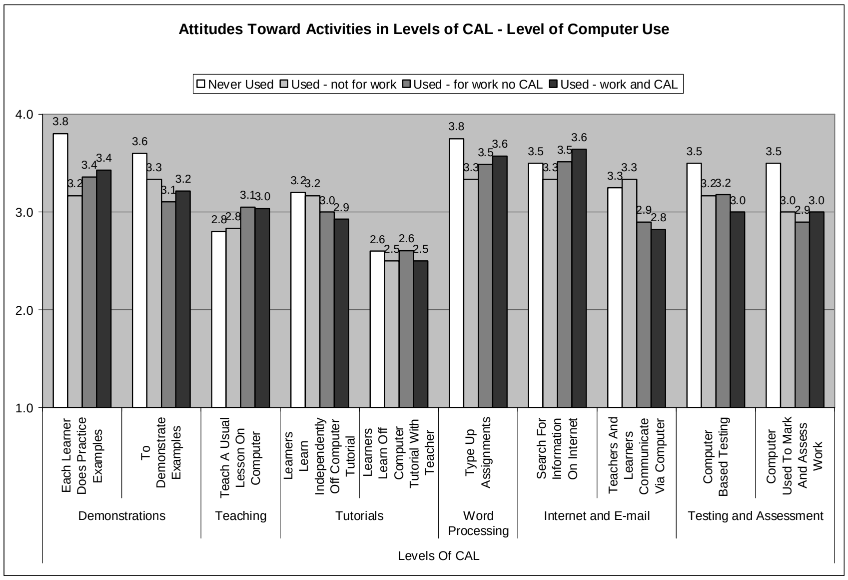
4.3.6.1.6 Level of Computer Use

On average, teachers who have never used computers demonstrate higher levels of agreement regarding the relevance of various levels of CAL, than teachers who have used computers. Teachers who have used computers on average express various degrees of agreement at similar levels. However, teachers with all levels of experience of computer use agree at higher levels that computers can be used to demonstrate examples, to perform practice examples, for typing up assignments and for searching for information on the Internet.

Table 136: Teachers' Attitudes toward the General Levels of CAL – Level of Computer Use Breakdown

Categories	Items	Level of Computer Use	Levels of Agreement: Strongly Agree	Agree	Disagree	Strongly Disagree	Totals: Agree	Disagree
Demonstrations	Each Learner Does Practice Examples	Never Used	80	20	0	0	100	0
		Used - not for work	17	83	0	0	100	0
		Used - for work no CAL	36	64	0	0	100	0
		Used - work and CAL	50	46	0	4	96	4
	To Demonstrate Examples	Never Used	80	0	20	0	80	20
		Used - not for work	33	67	0	0	100	0
		Used - for work no CAL	24	63	13	0	87	13
		Used - work and CAL	29	64	7	0	93	7
Teaching	Teach A Usual Lesson On Computer	Never Used	20	60	0	20	80	20
		Used - not for work	17	67	0	17	83	17
		Used - for work no CAL	21	64	15	0	85	15
		Used - work and CAL	29	46	25	0	75	25
Tutorials	Learners Learn Independently Off Computer Tutorial	Never Used	40	40	20	0	80	20
		Used - not for work	17	83	0	0	100	0
		Used - for work no CAL	23	54	23	0	77	23
		Used - work and CAL	21	50	29	0	71	29
	Learners Learn Off Computer Tutorial With Teacher	Never Used	20	40	20	20	60	40
		Used - not for work	0	67	17	17	67	33
		Used - for work no CAL	13	39	42	5	53	47
		Used - work and CAL	11	36	46	7	46	54
Word Processing	Type Up Assignments	Never Used	75	25	0	0	100	0
		Used - not for work	33	67	0	0	100	0
		Used - for work no CAL	49	51	0	0	100	0
		Used - work and CAL	57	43	0	0	100	0
Internet and e-mail	Search For Information On Internet	Never Used	50	50	0	0	100	0
		Used - not for work	33	67	0	0	100	0
		Used - for work no CAL	51	49	0	0	100	0
		Used - work and CAL	64	36	0	0	100	0
	Teachers And Learners Communicate Via Computer	Never Used	25	75	0	0	100	0
		Used - not for work	33	67	0	0	100	0
		Used - for work no CAL	23	54	13	10	77	23
		Used - work and CAL	21	39	39	0	61	39
Testing and Assessment	Computer Based Testing	Never Used	50	50	0	0	100	0
		Used - not for work	17	83	0	0	100	0
		Used - for work no CAL	23	72	5	0	95	5
		Used - work and CAL	25	54	18	4	79	21
	Computer Used To Mark And Assess Work	Never Used	50	50	0	0	100	0
		Used - not for work	17	67	17	0	83	17
		Used - for work no CAL	18	56	23	3	74	26
		Used - work and CAL	21	61	14	4	82	18

Figure 157



4.3.6.2 The Levels of CAL Most Suited to the Grade 10 Mathematics Curriculum

This section reports on the attitudes and preferences teachers have for the levels of CAL that are most suited to the Grade 10 Mathematics curriculum. The views of the levels of CAL most suited and least suited to the Grade 10 Mathematics curriculum are also reported in this section. The levels of CAL are set out as follows from the level of CAL with the least to the highest degree of involvement:

- *Level One*, where computers are only used to demonstrate examples to learners

- *Level Two*, where learners perform supervised exercises on computer

- *Level Three*, where teachers prepare lessons and teach on computer while learners perform supervised exercises on computer

- *Level Four*, where teachers use computer tutorial software to teach lessons while learners perform supervised exercises on computer

- *Level Five*, where learners learn independently off computer tutorial software and other media and perform unsupervised exercises on computer.

Results are presented in tabular form as a percentage distribution of responses set out across the different levels of CAL per each curriculum item. In addition, a weighted average has been calculated by assigning values to the ratings, from 1 for CAL Level One to 5 for the CAL Level Five. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.8 indicates a preference for CAL Level One
- 1.81 to 2.6 indicates a preference for CAL Level Two
- 2.61 to 3.4 indicates a preference for CAL Level Three
- 3.41 to 4.2 indicates a preference for CAL Level Four
- 4.21 to 5 indicates a preference for CAL Level Five.

Also in tabular form, a percentage proportional breakdown is demonstrated for the levels of CAL that teachers believe to be most and least suited to the Grade 10 Mathematics curriculum.

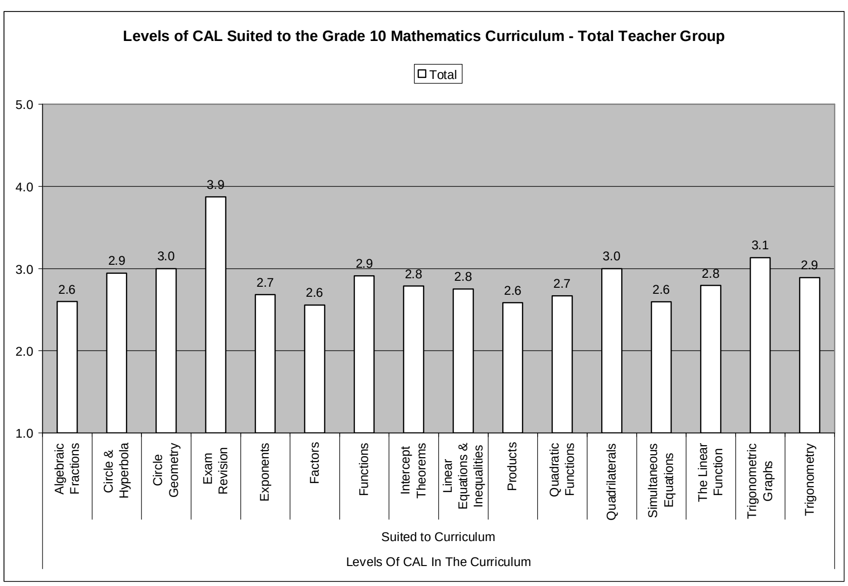
4.3.6.2.1 Total Teacher Group

Table 137: The Levels of CAL Suited to the Grade 10 Mathematics Curriculum – Total Teacher Group

Items	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Algebraic Fractions	13	47	16	16	9
Circle & Hyperbola	7	30	35	16	12
Circle Geometry	12	28	25	22	14
Examination Revision	4	19	9	23	46
Exponents	7	48	23	13	9
Factors	10	54	14	13	9
Functions	4	37	31	16	10
Intercept Theorems	14	32	26	20	9
Linear Equations & Inequalities	10	35	31	16	7
Products	11	51	13	16	9
Quadratic Functions	6	48	28	12	7
Quadrilaterals	9	29	29	18	15
Simultaneous Equations	12	45	25	10	9
The Linear Function	9	37	28	19	7
Trigonometric Graphs	6	28	25	29	12
Trigonometry	4	40	31	14	11

In general, the greater distribution of scores falls in the CAL Level Two and Level Three categories.

Figure 158



On average, however, a greater propensity for CAL Level Three is demonstrated across the board, except for the purposes of Examination Revision where teachers feel that learners can be more independent at CAL Level Four.

Table 138: The Level of CAL Most Suited to the Grade 10 Mathematics Curriculum – Total Teacher Group

Items	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Most Suited to Curriculum	3	51	27	11	8
Least Suited to Curriculum	24	1	3	3	69

In general however, teachers as a group feel that CAL Level Two is the level most suited to the Grade 10 Mathematics curriculum, while CAL Level Five is shown to be the least suited.

The results suggest that to a lesser extent teachers would personally prefer to have a greater degree of technological freedom and access to materials in creating and developing teaching material, an instructional strategy that is characteristic of a Constructivist teaching orientation (Semple, 2000). However, the results suggest that teachers would prefer learners to have less freedom in using technological media in the instructional process, using the computer only to perform supervised exercises, a process characteristic of the Behavioural Learning theory (Boyle, 1997; Kotze *et al.*, 1996). The results therefore suggest that teachers prefer an instructional context that allows lower levels of learner control, as learners would learn in a responsive, more passive and controlled manner (Brown, 1997; Overbaugh, 1994; Yang, 1993). The directive learning and programme controlled strategy would suit learners who have a field dependent cognitive learning style and enjoy learning environments that are slower paced, more directive and programme controlled (Anderson, 2001), but would be unsuited to learners who have field independent learning styles and enjoy independent and unstructured learning environments (Anderson, 2001; Wolfe, 2001). Also, low self regulatory learners would benefit in a directive and programme controlled environment, while high self regulatory learners would feel incompatible and frustrated (Eom, *et al.*, 2000).

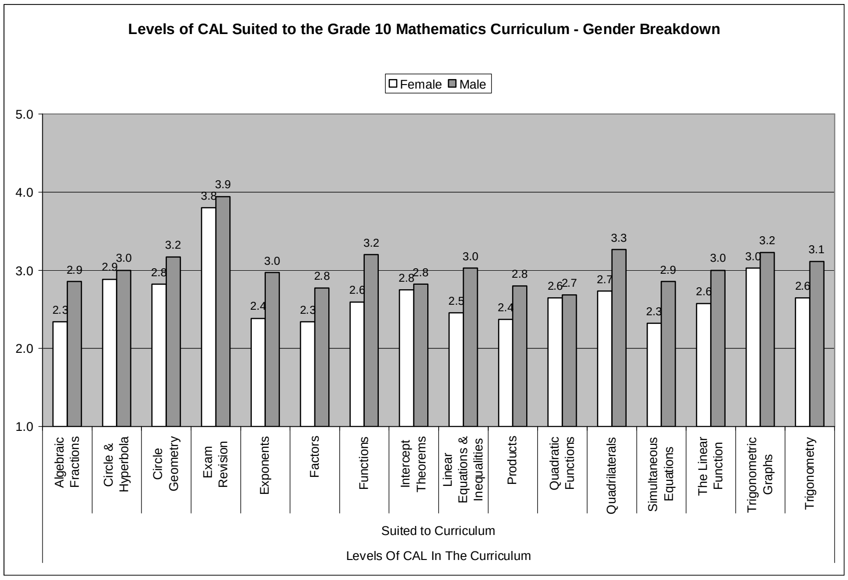
4.3.6.2.2 Gender Breakdown

Table 139: The Levels of CAL Suited to the Grade 10 Mathematics Curriculum – Gender Breakdown

Items	Gender Breakdown	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Algebraic Fractions	Female	14	54	14	17	0
	Male	11	40	17	14	17
Circle & Hyperbola	Female	6	38	24	26	6
	Male	9	23	46	6	17
Circle Geometry	Female	12	35	21	24	9
	Male	11	20	29	20	20
Examination Revision	Female	6	17	9	29	40
	Male	3	20	9	17	51
Exponents	Female	9	59	18	15	0
	Male	6	37	29	11	17
Factors	Female	9	63	14	14	0
	Male	11	46	14	11	17
Functions	Female	6	50	22	22	0
	Male	3	26	40	11	20
Intercept Theorems	Female	13	34	25	22	6
	Male	15	29	26	18	12
Linear Equations & Inequalities	Female	9	52	24	15	0
	Male	11	20	37	17	14
Products	Female	9	63	11	17	0
	Male	14	40	14	14	17
Quadratic Functions	Female	3	53	24	18	3
	Male	9	43	31	6	11
Quadrilaterals	Female	9	41	24	21	6
	Male	9	18	35	15	24
Simultaneous Equations	Female	12	62	12	12	3
	Male	11	29	37	9	14
The Linear Function	Female	9	42	30	18	0
	Male	9	31	26	20	14
Trigonometric Graphs	Female	6	30	21	39	3
	Male	6	26	29	20	20
Trigonometry	Female	3	52	25	17	3
	Male	4	29	37	11	19

In general again, the greater distribution of scores fall in the CAL Level Two and Level Three categories.

Figure 159



On average, teachers in the female gender group generally vary their preferences in the CAL Level Two and Three categories across the various curriculum items, while teachers in the male gender group feel that CAL Level Three would suit all the curriculum items. Teachers from both gender groups, however, agree that CAL Level Four is most suited for Examination revision.

Table 140: The Level of CAL Most Suited to the Grade 10 Mathematics Curriculum – Gender Breakdown

Items	Gender Breakdown	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Most Suited to Curriculum	Female	3	64	19	14	0
	Male	3	38	35	8	16
Least Suited to Curriculum	Female	15	0	0	0	85
	Male	32	3	5	5	54

Teachers who belong in the female gender group overwhelmingly indicate that CAL Level Two is the most suited for the Grade 10 Mathematics Curriculum, while male teachers feel that CAL Level Two and Three are both similarly suited to the curriculum. Female and Male teachers indicate that CAL Level Five is least suited to the Grade 10 Mathematics curriculum, though male teachers also demonstrate that CAL Level One is unsuited.

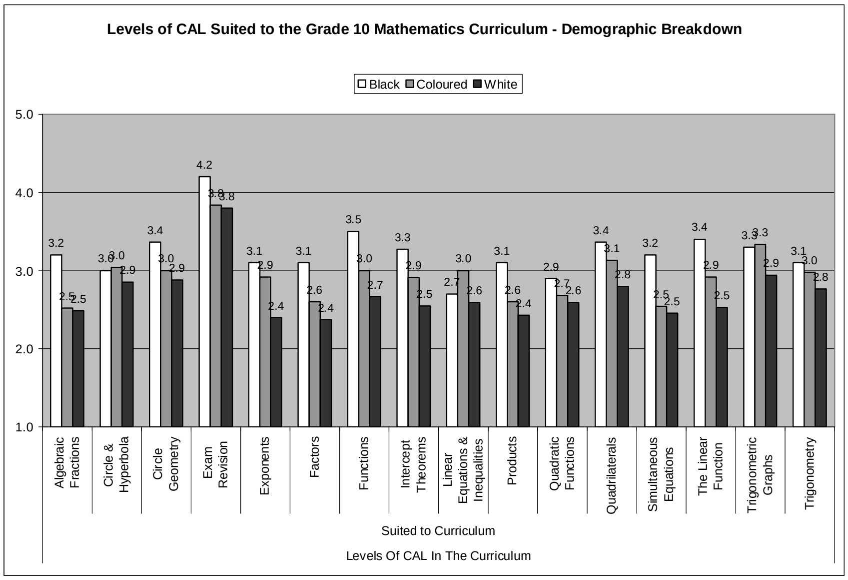
4.3.6.2.3 Demographic Breakdown

Table 141: The Levels of CAL Suited to the Grade 10 Mathematics Curriculum – Demographic Breakdown

Items	Demographic Breakdown	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Algebraic Fractions	Black	20	20	10	20	30
	Coloured	12	48	20	16	4
	White	11	54	14	14	6
Circle & Hyperbola	Black	10	30	30	10	20
	Coloured	0	28	48	16	8
	White	12	32	26	18	12
Circle Geometry	Black	9	9	36	27	18
	Coloured	12	24	28	24	12
	White	12	36	18	18	15
Examination Revision	Black	0	20	0	20	60
	Coloured	4	16	16	20	44
	White	6	20	6	26	43
Exponents	Black	10	20	40	10	20
	Coloured	0	46	25	21	8
	White	11	57	17	9	6
Factors	Black	20	20	20	10	30
	Coloured	4	60	12	20	4
	White	11	60	14	9	6
Functions	Black	0	20	40	10	30
	Coloured	4	33	29	25	8
	White	6	45	30	12	6
Intercept Theorems	Black	9	18	27	27	18
	Coloured	5	36	27	27	5
	White	21	33	24	12	9
Linear Equations & Inequalities	Black	20	20	40	10	10
	Coloured	4	33	29	25	8
	White	12	41	29	12	6
Products	Black	30	10	10	20	30
	Coloured	4	60	12	20	4
	White	11	57	14	11	6
Quadratic Functions	Black	10	20	50	10	10
	Coloured	0	56	24	16	4
	White	9	50	24	9	9
Quadrilaterals	Black	18	9	18	27	27
	Coloured	0	30	39	17	13
	White	12	35	26	15	12
Simultaneous Equations	Black	10	10	50	10	20
	Coloured	8	54	17	17	4
	White	14	49	23	6	9
The Linear Function	Black	10	10	30	30	20
	Coloured	0	42	29	25	4
	White	15	41	26	12	6
Trigonometric Graphs	Black	0	20	40	30	10
	Coloured	0	29	25	29	17
	White	12	29	21	29	9
Trigonometry	Black	5	20	50	10	15
	Coloured	2	40	28	17	13
	White	4	46	28	13	9

In general, the greater distribution of scores falls in the CAL Level Two, Three and Four categories.

Figure 160



On average, teachers in the Black demographic group indicate a greater propensity for the use of CAL Level Three and Four, while teachers in the Coloured demographic group indicate a general preference for CAL Level Three. The White demographic group, however, indicate greater preference for CAL Level Two and Three. Teachers from all demographic groups agree that CAL Level Four is most suited for Examination revision.

Table 142: The Level of CAL Most Suited to the Grade 10 Mathematics Curriculum – Demographic Breakdown

Items	Demographic Breakdown	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Most Suited to Curriculum	Black	0	42	25	8	25
	Coloured	0	52	32	12	4
	White	6	53	25	11	6
Least Suited to Curriculum	Black	25	8	8	8	50
	Coloured	36	0	0	0	64
	White	15	0	3	3	79

At a majority, teachers from all demographic groups indicate that CAL Level Two is the most suited to the Grade 10 Mathematics curriculum, while some suitability is also indicated for CAL Level Three and Five, though at lower levels. Teachers from all demographic groups indicate that CAL Level Five, and CAL Level One to a lesser degree, are least suited to the curriculum.

4.3.6.2.4 Age Groups

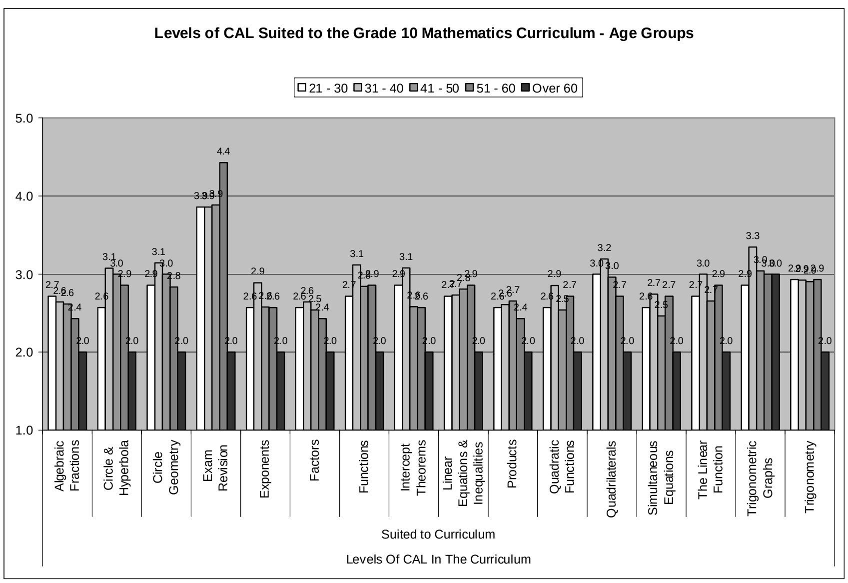
Table 143: The Levels of CAL Suited to the Grade 10 Mathematics Curriculum – Age Group Breakdown (*Continued Overleaf*)

Items	Age Groups	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Algebraic Fractions	21 - 30	0	57	29	0	14
	31 - 40	14	46	7	25	7
	41 - 50	12	42	27	12	8
	51 - 60	29	43	0	14	14
	Over 60	0	100	0	0	0
Circle & Hyperbola	21 - 30	29	29	14	14	14
	31 - 40	4	26	41	19	11
	41 - 50	4	35	31	19	12
	51 - 60	14	14	57	0	14
	Over 60	0	100	0	0	0
Circle Geometry	21 - 30	14	29	29	14	14
	31 - 40	14	14	29	29	14
	41 - 50	8	35	23	19	15
	51 - 60	17	33	17	17	17
	Over 60	0	100	0	0	0
Examination Revision	21 - 30	0	14	14	43	29
	31 - 40	4	18	11	25	43
	41 - 50	8	15	8	19	50
	51 - 60	0	14	0	14	71
	Over 60	0	100	0	0	0
Exponents	21 - 30	0	71	14	0	14
	31 - 40	4	37	33	19	7
	41 - 50	8	54	19	12	8
	51 - 60	29	29	14	14	14
	Over 60	0	100	0	0	0
Factors	21 - 30	0	71	14	0	14
	31 - 40	11	50	11	21	7
	41 - 50	8	54	23	8	8
	51 - 60	29	43	0	14	14
	Over 60	0	100	0	0	0
Functions	21 - 30	14	43	14	14	14
	31 - 40	4	23	38	27	8
	41 - 50	0	52	24	12	12
	51 - 60	14	14	57	0	14
	Over 60	0	100	0	0	0
Intercept Theorems	21 - 30	14	29	29	14	14
	31 - 40	8	31	19	31	12
	41 - 50	17	33	29	17	4
	51 - 60	29	14	43	0	14
	Over 60	0	100	0	0	0
Linear Equations & Inequalities	21 - 30	14	29	43	0	14
	31 - 40	12	38	19	27	4
	41 - 50	8	31	42	12	8
	51 - 60	14	29	29	14	14
	Over 60	0	100	0	0	0
Products	21 - 30	0	71	14	0	14
	31 - 40	14	50	4	25	7
	41 - 50	8	46	27	12	8
	51 - 60	29	43	0	14	14
	Over 60	0	100	0	0	0
Quadratic Functions	21 - 30	0	71	14	0	14
	31 - 40	4	41	30	19	7
	41 - 50	8	50	27	12	4
	51 - 60	14	29	43	0	14

	Over 60	0	100	0	0	0
Quadrilaterals	21 - 30	0	29	57	0	14
	31 - 40	4	27	27	31	12
	41 - 50	15	27	23	15	19
	51 - 60	14	29	43	0	14
	Over 60	0	100	0	0	0
Simultaneous Equations	21 - 30	0	71	14	0	14
	31 - 40	11	41	22	15	11
	41 - 50	15	42	27	12	4
	51 - 60	14	29	43	0	14
	Over 60	0	100	0	0	0
The Linear Function	21 - 30	14	29	43	0	14
	31 - 40	4	31	31	31	4
	41 - 50	12	42	23	15	8
	51 - 60	14	29	29	14	14
	Over 60	0	100	0	0	0
Trigonometric Graphs	21 - 30	29	14	14	29	14
	31 - 40	0	23	31	35	12
	41 - 50	4	35	27	23	12
	51 - 60	14	29	14	29	14
	Over 60	0	50	0	50	0
Trigonometry	21 - 30	0	43	36	7	14
	31 - 40	4	33	37	18	8
	41 - 50	2	44	29	12	13
	51 - 60	14	29	21	21	14
	Over 60	0	100	0	0	0

In general again, the greater distribution of scores fall in the CAL Level Two and Three categories.

Figure 161



On average, teachers in age groups from ages 21 to 40 generally indicate a preference for CAL Level Three. Teachers in the age 41 to 60 age groups generally indicate a variation of suitability between CAL Level Two and Three, while teachers over the age of 60 show an overwhelming preference for CAL Level Two.

Table 144: The Level of CAL Most Suited to the Grade 10 Mathematics Curriculum – Age Group Breakdown

Items	**Age Groups**	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Most Suited to Curriculum	21 - 30	0	38	50	0	13
	31 - 40	0	52	21	21	7
	41 - 50	4	58	27	4	8
	51 - 60	13	38	25	13	13
	Over 60	0	50	50	0	0
Least Suited to Curriculum	21 - 30	13	13	0	0	75
	31 - 40	29	0	4	4	64
	41 - 50	23	0	0	4	73
	51 - 60	29	0	0	0	71
	Over 60	0	0	50	0	50

At a majority, teachers from the various age groups generally indicate that CAL Level Two is the most suited to the Grade 10 Mathematics curriculum. However, some suitability is also indicated for CAL Level Three, more significantly so for the age 21 to 30 and over 60 age groups. Teachers from all age groups indicate that CAL Level Five, and CAL Level One to a lesser degree, are least suited to the curriculum.

4.3.6.2.5 Level of Qualifications

In general, the greater distribution of scores falls in the CAL Level Two and Level Three categories.

Table 145: The Levels of CAL Suited to the Grade 10 Mathematics Curriculum – Level of Qualification Breakdown

Items	Level of Qualifications	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Algebraic Fractions	Diploma	20	50	15	10	5
	First Degree	14	43	14	17	11
	Postgraduate Degree	0	53	20	20	7
Circle & Hyperbola	Diploma	5	50	30	10	5
	First Degree	9	26	29	21	15
	Postgraduate Degree	7	13	53	13	13
Circle Geometry	Diploma	10	33	29	19	10
	First Degree	15	27	24	15	18
	Postgraduate Degree	7	20	20	40	13
Examination Revision	Diploma	10	20	10	15	45
	First Degree	3	17	6	20	54
	Postgraduate Degree	0	20	13	40	27
Exponents	Diploma	10	35	40	15	0
	First Degree	9	59	12	6	15
	Postgraduate Degree	0	40	27	27	7
Factors	Diploma	20	50	15	15	0
	First Degree	9	57	11	9	14
	Postgraduate Degree	0	53	20	20	7
Functions	Diploma	5	40	40	15	0
	First Degree	3	41	22	19	16
	Postgraduate Degree	7	27	40	13	13
Intercept Theorems	Diploma	10	25	30	25	10
	First Degree	19	35	19	16	10
	Postgraduate Degree	7	33	33	20	7
Linear Equations & Inequalities	Diploma	15	40	30	15	0
	First Degree	9	39	30	12	9
	Postgraduate Degree	7	20	33	27	13
Products	Diploma	25	45	10	20	0
	First Degree	9	54	11	11	14
	Postgraduate Degree	0	53	20	20	7
Quadratic Functions	Diploma	5	45	35	10	5
	First Degree	9	50	21	12	9
	Postgraduate Degree	0	47	33	13	7
Quadrilaterals	Diploma	14	33	33	14	5
	First Degree	9	25	25	22	19
	Postgraduate Degree	0	33	33	13	20
Simultaneous Equations	Diploma	20	40	25	10	5
	First Degree	12	47	21	9	12
	Postgraduate Degree	0	47	33	13	7
The Linear Function	Diploma	5	35	30	30	0
	First Degree	12	39	27	9	12
	Postgraduate Degree	7	33	27	27	7
Trigonometric Graphs	Diploma	0	40	30	20	10
	First Degree	9	24	21	33	12
	Postgraduate Degree	7	20	27	33	13
Trigonometry	Diploma	5	54	28	5	8
	First Degree	5	36	35	14	11
	Postgraduate Degree	0	30	27	27	17

On average, teachers in the diploma qualification group indicate a preference for both CAL Level Two and Level Three as suited to the various curriculum items, while teachers who have first and postgraduate degrees generally indicate an inclination for CAL Level Three.

Figure 162

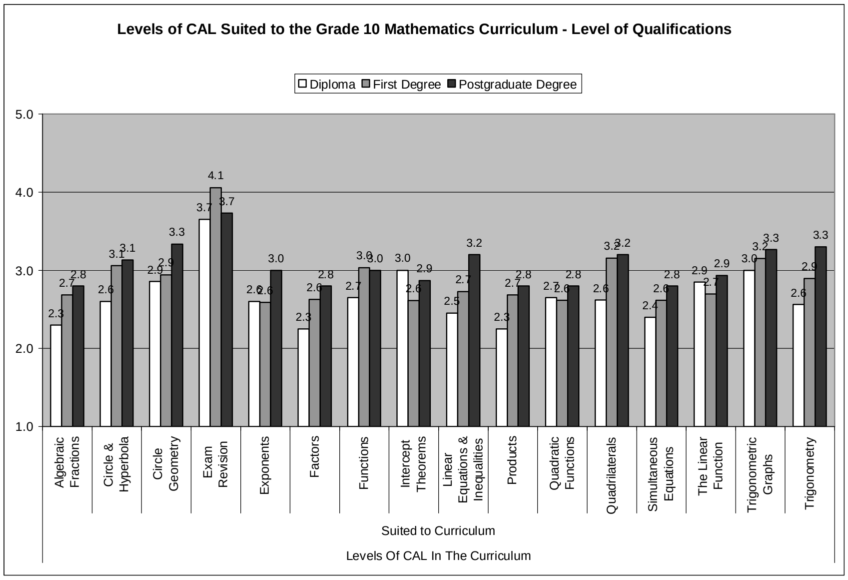


Table 146: The Level of CAL Most Suited to the Grade 10 Mathematics Curriculum – Level of Qualification Breakdown

Items	Level of Qualifications	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Most Suited to Curriculum	Diploma	5	52	29	10	5
	First Degree	3	56	22	8	11
	Postgraduate Degree	0	38	38	19	6
Least Suited to Curriculum	Diploma	24	5	10	5	57
	First Degree	17	0	0	3	80
	Postgraduate Degree	40	0	0	0	60

At a majority, teachers who fall in the diploma and first degree qualification groups specify that CAL Level Two is the most suited to the Grade 10 Mathematics curriculum, while teachers with postgraduate degrees indicate that both CAL Level Two and Three are most suited to the curriculum. Teachers from all qualification groups indicate that CAL Level Five, and CAL Level One to a lesser degree, are least suited to the curriculum.

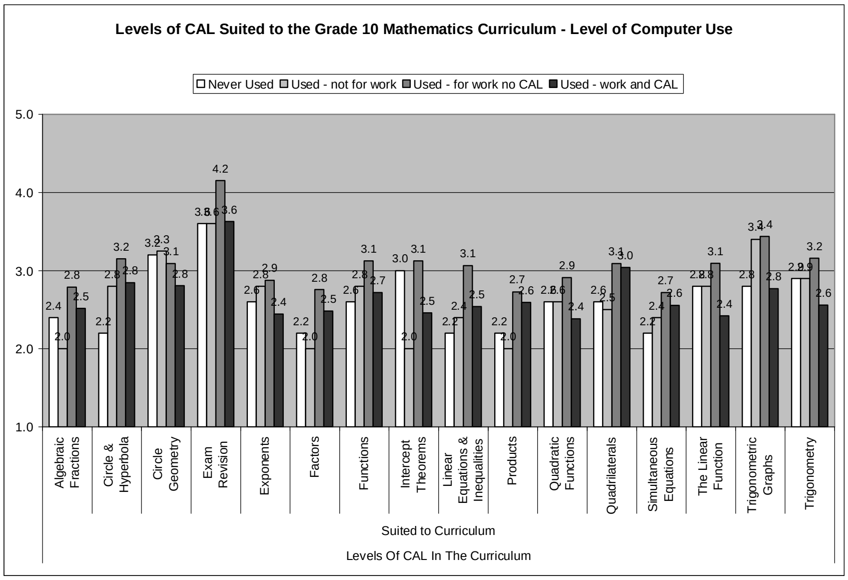
4.3.6.2.6 Level of Computer Use

In general, the greater distribution of scores falls in the CAL Level Two and Level Three categories, though some significance is also indicated in CAL Level Four to a lesser extent.

Table 147: The Levels of CAL Suited to the Grade 10 Mathematics Curriculum – Level of Computer Use Breakdown

Items	Level of Computer Use	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Algebraic Fractions	Never Used	40	20	20	0	20
	Used - not for work	40	40	0	20	0
	Used - for work no CAL	12	42	15	15	15
	Used - work and CAL	4	59	19	19	0
Circle & Hyperbola	Never Used	20	40	40	0	0
	Used - not for work	0	40	40	20	0
	Used - for work no CAL	3	30	33	15	18
	Used - work and CAL	12	27	35	19	8
Circle Geometry	Never Used	0	40	20	20	20
	Used - not for work	0	50	0	25	25
	Used - for work no CAL	18	15	26	24	18
	Used - work and CAL	8	38	27	19	8
Examination Revision	Never Used	0	40	0	20	40
	Used - not for work	0	40	0	20	40
	Used - for work no CAL	6	3	9	33	48
	Used - work and CAL	4	30	11	11	44
Exponents	Never Used	0	40	60	0	0
	Used - not for work	20	40	0	20	20
	Used - for work no CAL	6	47	16	16	16
	Used - work and CAL	7	52	30	11	0
Factors	Never Used	20	40	40	0	0
	Used - not for work	40	40	0	20	0
	Used - for work no CAL	9	52	9	15	15
	Used - work and CAL	4	63	19	11	4
Functions	Never Used	0	40	60	0	0
	Used - not for work	0	40	40	20	0
	Used - for work no CAL	6	34	19	22	19
	Used - work and CAL	4	40	40	12	4
Intercept Theorems	Never Used	0	40	20	40	0
	Used - not for work	40	40	0	20	0
	Used - for work no CAL	13	22	25	22	19
	Used - work and CAL	13	42	33	13	0
Linear Equations & Inequalities	Never Used	20	40	40	0	0
	Used - not for work	20	40	20	20	0
	Used - for work no CAL	6	31	28	19	16
	Used - work and CAL	12	38	35	15	0
Products	Never Used	40	20	20	20	0
	Used - not for work	40	40	0	20	0
	Used - for work no CAL	9	55	6	15	15
	Used - work and CAL	4	56	22	15	4
Quadratic Functions	Never Used	0	40	60	0	0
	Used - not for work	0	60	20	20	0
	Used - for work no CAL	6	39	27	12	15
	Used - work and CAL	8	58	23	12	0
Quadrilaterals	Never Used	20	20	40	20	0
	Used - not for work	0	75	0	25	0
	Used - for work no CAL	15	21	27	12	24
	Used - work and CAL	0	35	35	23	8
Simultaneous Equations	Never Used	20	40	40	0	0
	Used - not for work	20	40	20	20	0
	Used - for work no CAL	13	44	19	9	16
	Used - work and CAL	7	48	30	11	4
The Linear Function	Never Used	0	40	40	20	0
	Used - not for work	0	40	40	20	0
	Used - for work no CAL	6	31	25	22	16
	Used - work and CAL	15	42	27	15	0
Trigonometric Graphs	Never Used	0	40	40	20	0
	Used - not for work	0	40	0	40	20
	Used - for work no CAL	3	22	22	34	19
	Used - work and CAL	12	31	31	23	4
Trigonometry	Never Used	0	30	60	0	10
	Used - not for work	0	40	30	30	0
	Used - for work no CAL	6	30	25	17	21
	Used - work and CAL	2	54	33	10	2

Figure 163



Teachers who have used computers for work but not for CAL demonstrate an inclination for CAL Level Three. Teachers with other levels of computer use demonstrate a preference for both CAL Level Two and Three.

Table 148: The Level of CAL Most Suited to the Grade 10 Mathematics Curriculum – Level of Computer Use Breakdown

Items	**Level of Computer Use**	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Most Suited to Curriculum	Never Used	0	25	50	0	25
	Used - not for work	0	17	67	17	0
	Used - for work no CAL	3	50	19	14	14
	Used - work and CAL	4	63	26	7	0
Least Suited to Curriculum	Never Used	0	0	0	25	75
	Used - not for work	33	17	17	0	33
	Used - for work no CAL	34	0	3	3	60
	Used - work and CAL	12	0	0	0	88

Teachers who have never used computers or have used computers but not for work purposes specify that CAL Level Three is the most suited to the Grade 10 curriculum as a whole. Teachers who have used computers for work purposes report that CAL Level Two is the most suited. Teachers with all levels of computer use indicate that CAL Level Five, and CAL Level One to a lesser degree, are least suited to the curriculum. However, teachers who have used computers but not for work purposes see CAL Level One and Level Five as equally unsuited.

4.3.6.3 Perception of the Level of CAL Most Common in Schools in Five Years' Time

This section reports on what levels of CAL teachers perceive and expect to be the level of CAL most common in South African schools in five years' time. Results are presented in tabular form as a percentage distribution of answers set out across the different levels of CAL. In addition, a weighted average has been calculated by assigning values to the ratings, from 1 for CAL Level One to 5 for the CAL Level Five. The weighted average is presented in comparison to the levels of CAL that teachers have indicated as the most and least suited to the Grade 10 Mathematics curriculum. In graph form, an average score in the following categories are indicative of the following general levels:

- 1 to 1.8 indicates an inclination for CAL Level One
- 1.81 to 2.6 indicates an inclination for CAL Level Two
- 2.61 to 3.4 indicates an inclination for CAL Level Three
- 3.41 to 4.2 indicates an inclination for CAL Level Four
- 4.21 to 5 indicates an inclination for CAL Level Five.

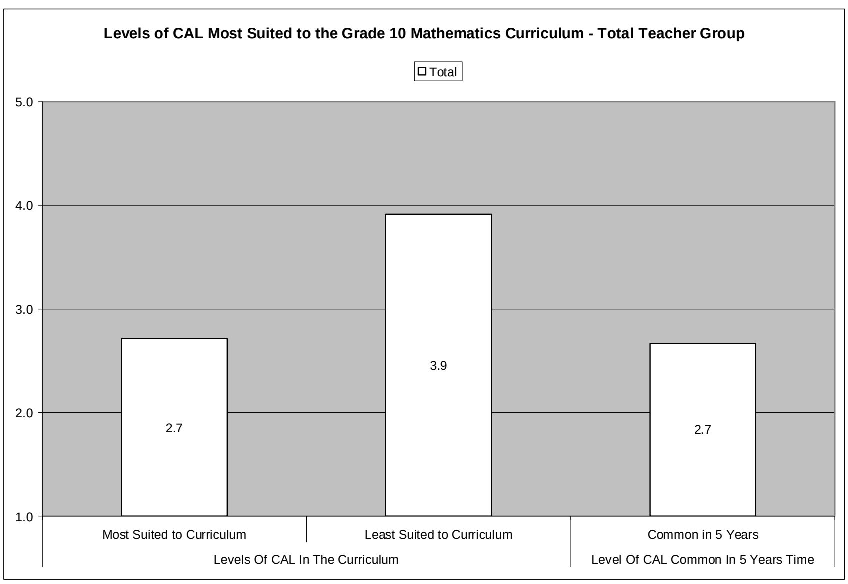
4.3.6.3.1 Total Teacher Group

Table 149: The Level of CAL Predicted to be Most Common in Schools in Five Years' Time – Total Teacher Group

Items	No Change	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Common in 5 Years	1	18	36	19	15	10

At 36%, the majority of teachers indicate that CAL Level Two is the expected level of CAL to be common in South African schools in five years' time.

Figure 164



At 2.7, the teaching group as a whole believes that the level of CAL most suited to the Grade 10 Mathematics curriculum is the level of CAL that will be common in schools in five years' time.

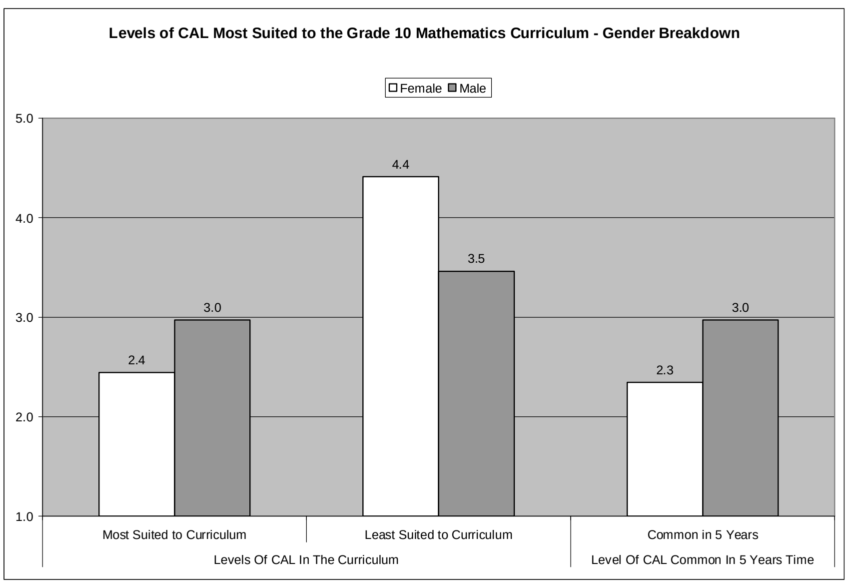
4.3.6.3.2 Gender Breakdown

Table 150: The Level of CAL Predicted to be Most Common in Schools in Five Years' Time – Gender Breakdown

Items	Gender Breakdown	No Change	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Common in 5 Years	Female	3	20	49	17	9	3
	Male	0	16	24	22	22	16

At 49%, teachers in the female gender group indicate that CAL Level Two is the expected level of CAL to be common in South African schools in five years' time, while male teachers are more divided showing similar propensities to CAL Level Two, Three and Four.

Figure 165



Teachers in the female gender group on average expect that CAL systems will be at CAL Level Two in five years' time, while male teachers indicate that CAL Level Three will be common in schools. Teachers in both gender groups believe that the level of CAL most suited to the Grade 10 Mathematics curriculum is the level of CAL that will be common in schools in five years' time.

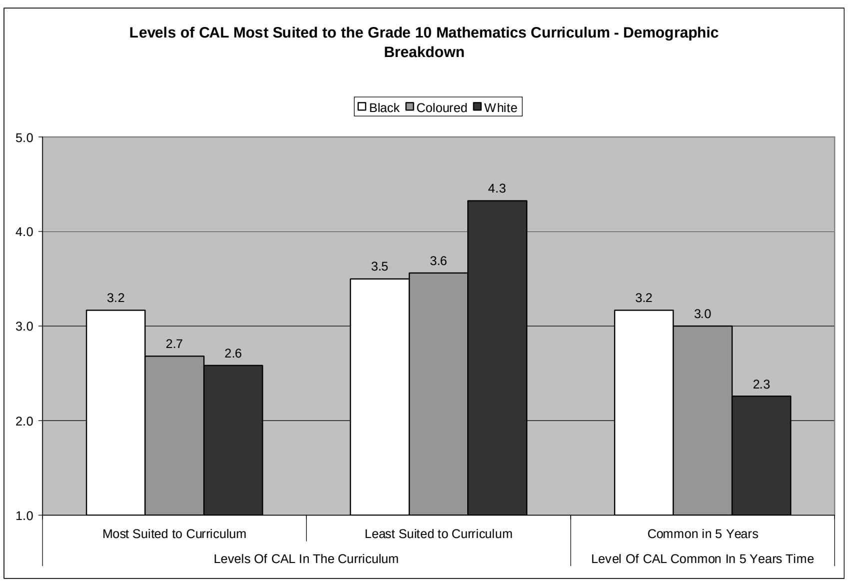
4.3.6.3.3 Demographic Breakdown

Table 151: The Level of CAL Predicted to be Most Common in Schools in Five Years' Time – Demographic Breakdown

Items	Demographic Breakdown	No Change	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Common in 5 Years	Black	0	8	25	25	25	17
	Coloured	0	8	36	20	20	16
	White	3	29	40	17	9	3

Teachers in the Coloured and White demographic groups indicate that CAL Level Two is the expected level of CAL to be common in South African schools in five years' time, while teachers who fall in the Black demographic group are more divided showing similar propensities to CAL Level Two, Three and Four.

Figure 166



Teachers in the White demographic group on average expect that CAL systems will be at CAL Level Two in five years' time. Teachers in the Black and Coloured demographic groups, however, indicate that CAL Level Three will be common in schools in the near future. Teachers in the Black demographic group believe that the level of CAL most suited to the Grade 10

Mathematics curriculum is the level of CAL that will be common in schools in five years' time. Teachers in the Coloured demographic group believe that the common level of CAL will be at a higher level than that which is best suited to the curriculum. Teachers in the White demographic group, however, indicate that the common level of CAL will be lower than what is suited and relevant to the curriculum.

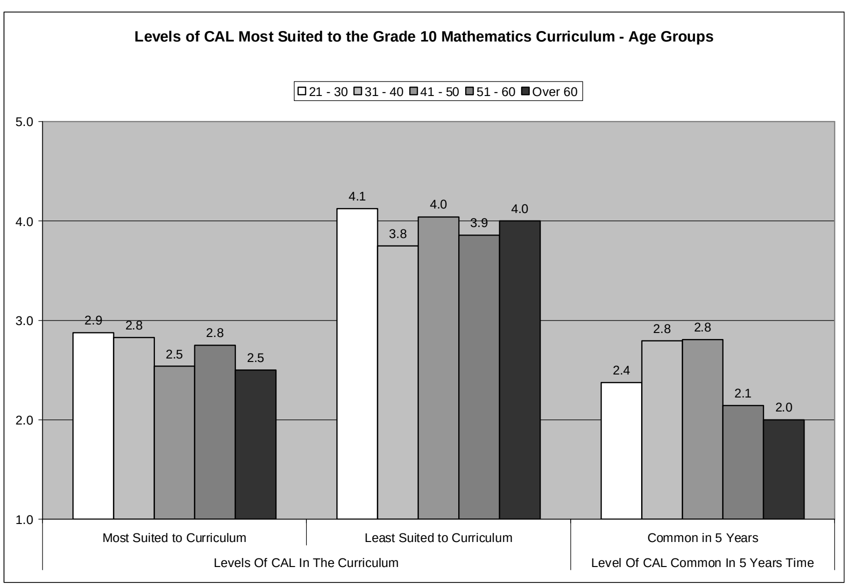
4.3.6.3.4 Age Groups

Table 152: The Level of CAL Predicted to be Most Common in Schools in Five Years' Time – Age Group Breakdown

Items	Age Groups	No Change	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Common in 5 Years	21 - 30	0	13	63	13	0	13
	31 - 40	3	21	31	17	14	14
	41 - 50	0	12	35	23	23	8
	51 - 60	0	29	43	14	14	0
	Over 60	0	50	0	50	0	0

Teachers in age groups from ages 21 to 60 report that CAL Level Two is the expected level of CAL to be common in South African schools in five years' time, while teachers who fall in the over 60 age group are more divided showing similar propensities to CAL Level One and Three.

Figure 167



Teachers in the 21 to 30, 51 to 60 and over 60 age groups on average feel that the CAL systems that will be common in five years' time will be at CAL Level Two, but that levels will be lower than what is most suited to the curriculum. However, teachers in age groups from ages 31 to 50 feel that CAL Level Three will be common in schools in five years' time - the level of CAL they evaluate as most suited to the curriculum.

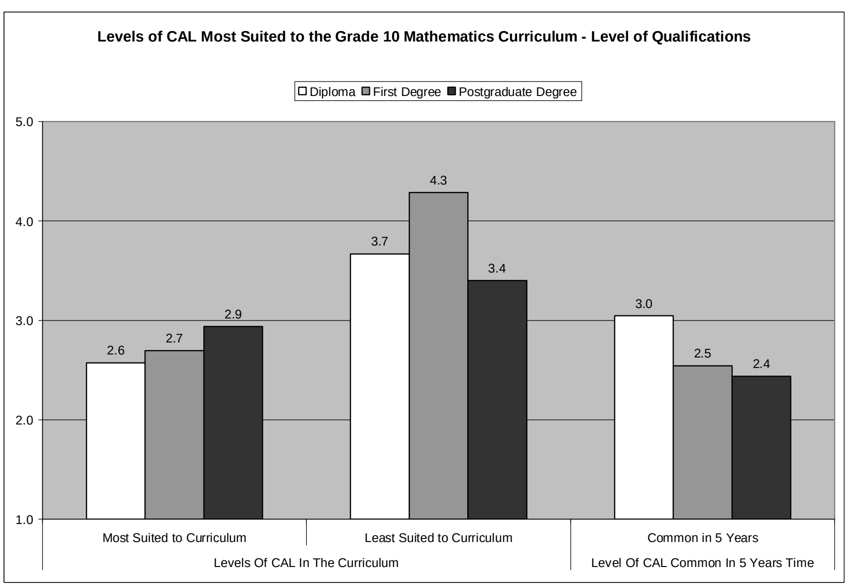
4.3.6.3.5 Level of Qualifications

Table 153: The Level of CAL Predicted to be Most Common in Schools in Five Years' Time – Level of Qualification Breakdown

Items	**Level of Qualifications**	No Change	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Common in 5 Years	Diploma	0	10	38	10	24	19
	First Degree	3	20	40	20	9	9
	Postgraduate Degree	0	25	25	31	19	0

Teachers in the diploma and first degree qualification groups report that CAL Level Two is the expected level of CAL that will be common in South African schools in five years' time, while teachers who fall in the postgraduate qualification group are more divided, showing similar inclinations for CAL Level One, Two and Three.

Figure 168



Teachers in the diploma qualification group report that CAL Level Three is the expected level of CAL to be common in South African schools in five years' time, while teachers who fall in the first and postgraduate qualification groups feel that CAL Two would be most prevalent. On average, teachers in the first and postgraduate degree qualification groups believe that the most prevalent CAL level will be lower than the level most suited to the curriculum.

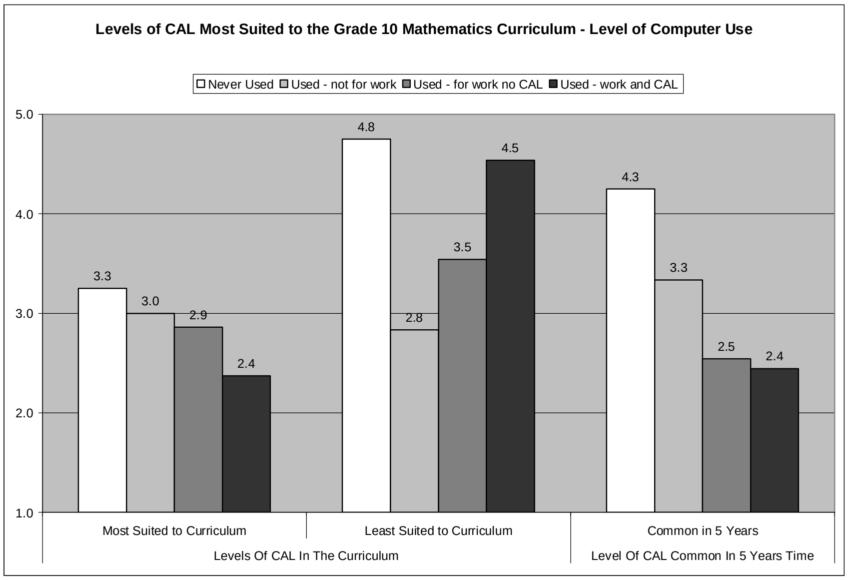
4.3.6.3.6 Level of Computer Use

Table 154: The Level of CAL Predicted to be Most Common in Schools in Five Years' Time – Level of Computer Use Breakdown

Items	Level of Computer Use	No Change	Computer Only Used To Demonstrate Examples.	Learners Do Supervised Exercises On Computer.	Teacher Prepares Lesson And Teaches On Computer & Learners Do Supervised Exercises On Computer	Teacher Uses Computer Tutorial Software To Teach Lesson & Learners Do Supervised Exercises On Computer	The Learner Learns Independently Off Computer Tutorial Software And Other Media & Does Unsupervised Exercises On Computer
Common in 5 Years	Never Used	0	0	0	0	75	25
	Used - not for work	0	0	33	33	0	33
	Used - for work no CAL	0	20	37	20	14	9
	Used - work and CAL	4	22	41	19	11	4

Teachers who have never used computers expect CAL Level Four to be the most common level of CAL in South African schools in five years' time, while teachers who have used computers but not for work purposes are undecided between CAL Level Two, Three and Five. Teachers who have used computers in the work context indicate that CAL Level Two is the expected level of CAL to be common in South African schools in five years' time.

Figure 169



On average, teachers who have not used computers or computers in the work context predict that CAL level Five and Three respectively will be the common levels of CAL in five years' time. Teachers who have used computers in the school context, however, see CAL Level Two as the prevalent level of CAL in the near future. In general, teachers with lower levels of experience view higher levels of CAL as suitable and common in the near future than teachers who have used computers.

4.4 CONCLUSION

The analysis section provided the detailed and meaningful presentation of the collected data in tabular and graphic formats of quantitative data presentation, as well as anecdotal commentaries throughout. Information in the literature review that was relevant to the findings presented was acknowledged and referenced. Analysis was performed across various variables that include the total teacher group as a whole, a gender breakdown, a demographic breakdown, age groups, level of qualification breakdown and level of computer use breakdown. A summary of the research findings can be found in Chapter 5, under the sections 5.2 and 5.3 entitled 'Conclusions About Each Research Question' and 'Conclusions About The Research Problem' respectively.

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

5.1 INTRODUCTION

This section provides a general conclusion to the study. Firstly, conclusions are provided to the set of research questions compiled for the study as stated in Section 2.5, providing an overall summary to the research findings. The research questions are stated within the following categories:

1. Teachers' current computer usage precedents in schools

2. Teachers' attitudes toward the use of computers in education

3. The needs and priorities for CAL implementation in South African schools

4. The structure and layout for CAL implementation in South African schools

5. The levels of CAL most suited to the implementation of CAL in South African schools

6. The levels of CAL that teachers foresee as being implemented in the future

A broad conclusion is presented in response to the specific research problem under study. As indicated in Chapter 1 of the study, the research question is stated as:

What are teachers' attitudes toward the implementation and integration of CAL systems in South African schools?

A response is then provided regarding the implications of the research findings for policy and practise; while lastly, suggestions are made of relevant topics for further research in the field of CAL.

5.2 CONCLUSIONS ABOUT EACH RESEARCH QUESTION

1. Teachers' current computer usage precedents in schools

1.1. What are the current teacher usage profiles of media in schools?

Teacher media use in schools is dominated by the use of chalk and white boards, showing a very strong integration in, and reliance upon, the traditional teaching method in the educational context. However, 55% of teachers also evaluate the use of chalk and white boards as the most effective teaching media, showing a greater preference for traditional media. The literature demonstrates that the ideological devotion to computer use in modern times has led to a tendency to use computer technologies at the expense of other traditionally effective media (Brabazon, 2000). As a variety of teaching and learning methods are required for curriculum delivery, many teachers have indicated that no single tool is able to cater for a variety of educational tasks, and therefore the use of educational technologies is seen as teaching tools amongst the traditional array of teaching media, and not as a replacement for them (Ortega *et al.*, 2001). The results therefore, provide some validation to these statements.

In general, the findings indicate that teachers tend to personally use electronic media at significantly lower levels than what they expect of the teaching group. However, the findings indicate that 24% of teachers evaluate computers as the most effective teaching media, despite very infrequent levels of personal use and low expectations of the general teacher. The findings suggest, as is demonstrated in the literature, a limited personal awareness and lack of facilitation of electronic media into school curricula and instructional contexts (Hobson *et al.*, 1998; Lai, 1996). Despite an ideological commitment to the use of computers, literature indicates that a majority of schools do not have structures and a computer culture to encourage the use of computer systems in schools (Lai, 1996). The results offer some justification to these statements.

1.2. What are the current patterns of teacher computer use in schools?

In general, 96% of the teachers surveyed have access to computers at school, while 82% have access to computers at home. However, despite high levels of personal access, teachers generally believe there to be a low availability of computers in schools in their own areas, as 95% of the teachers reported that in their opinion less than 60% of schools in their area have computers. Though research studies have demonstrated that schools in the Eastern Cape have very a low availability of computers in general at 8.8% (DOE, 2003c), the high availability figures in the study could demonstrate the disparities that exist in the availability of technologies between urban and rural areas (Hall, 1998). However, the surveyed teachers' low perceptions of the low availability of computers in their areas, despite high levels of personal access, suggest a low level of awareness of educational technology in the schools system amongst the teaching fraternity (Hobson *et al.*, 1998; Lai, 1996). The implementation of CAL into the school system therefore may have less to do with the implementation of computers in schools than the integration of computers into the school curriculum, as suggested in the literature (DOE, 2003c). This provides some validity to statements in literature that the implementation of computers absent from the school curricula may leave computers underutilised or unused (NCETDE, 1998).

In general, 94% of teachers have used computers before, 86% of teachers have used a computer for work related activities and 72% of teachers have used a computer at home for school related activities. As 36% of teachers have used the computer to teach or to assist in the teaching of Grade 10 Mathematics, the findings suggest that the use of computers to teach is not a priority of work related computer use, as is supported in previous research in South African schools (NCETDE, 1998).

As 59% of the teachers surveyed have received computer training, the teachers who are using computers and have not been trained seem to have taught themselves and developed their own computer skills over time. This suggests that teachers have the desire and need to use computers in the school context, and the literature indicates that, despite educational background, learners and teachers can demonstrate the ability to develop their own computers skills through relative technologies and independent trial and error learning processes (McCabe *et al.*, 2003).

In general, the majority of teachers who make use of computers at school use computers for periods of 5 hours or less per week. However, the majority of teachers who use computers at home spend 6 to 10 hours per week using computers. This disparity could indicate teachers who have access to computers at home have greater time and convenience opportunities to use computers, while not having the same at school. The lack of time and availability of computers in the school context may impact the implementation of CAL systems into schools, as is documented in the literature and evidenced here (NCETDE, 1998).

1.3. What are teachers' general computer abilities?

In general, 64% of teachers rate their general computer abilities as capable. On average, teachers as a group rate themselves as having fairly capable computer abilities. Teachers, however, feel that 52% of Grade 10 Mathematics learners have capable computer abilities, but on average rate learners as having fairly poor computer abilities. The literature indicates that lower computer abilities among teachers and learners affect the success of CAL implementation in schools, as well as the educational quality and success amongst teachers and learners (NCETDE, 1998). The findings indicate that a large proportion of teachers and learners are not rated as capable on computer systems, at 36% and 48% respectively, and could therefore affect the success of CAL implementation and integration in schools.

More specifically, teachers evaluate their computer abilities as capable in using spreadsheet software, e-mail packages, CD Rom informational packages and Internet search and navigational packages, while indicating very capable levels of computer ability in using word processing software. These findings support earlier research conducted in South African schools that found that teachers have capable computer abilities in using word processing software, spreadsheet software and CD Rom informational packages (NCETDE, 1998). The findings indicate, however, that teachers' computer abilities on traditional CAL instructive, simulation and drill software fall at very low levels. The results therefore suggest that teachers' computer skills have been developed through a functional task orientation to the use of computers in the school context, and are geared toward practical activities such as lesson preparation, gathering information and performing administrative tasks such as preparing mark and grade sheets or setting test papers, rather than for instructional purposes (McCabe *et al.*, 2003).

1.4. What are the reasons for teacher computer use in schools?

At 69%, the greatest reason for teacher computer use amongst the surveyed group is school administration and management, while 60% of the teachers use computers for lesson preparation, 44% use computers for searching for information on the Internet, 23% use e-mail facilities at school and 21% of teachers claim to have used computers as teaching tools. The findings suggest that the use of computers to teach is not a priority of work related computer use, as is supported in previous research in South African schools (NCETDE, 1998).

2. Teachers' attitudes toward the use of computers in education

2.1. What are teachers' attitudes toward the use of computers?

In general, the teachers surveyed indicate positive attitudes, at levels of agreement above 90%, toward the use of computers in society in general, in schools and specifically to teach. These findings support the claims in the literature that teachers generally feel positive about the use of educational technologies and the value that the use of computers provides to schools (MacArthur *et al.*, 2003; NCETDE, 1998; Valdez *et al.,* 2004).

Teachers indicate strong conviction that computers in education are inevitable and feel that CAL systems will not replace teachers. This finding is supported in the literature (Brown, 1997; Loschert, 2003). Teachers demonstrate high levels of agreement that computers in schools provide value, as is supported by other studies reported in the literature (MacArthur *et al.*, 2003; NCETDE, 1998; Valdez *et al.,* 2004), and therefore feel that the dedication of budgetary resources to the acquisition and use of computers is justified.

Regarding positive effects of CAL implementation, teachers as a group also indicate that they do not expect a heavier workload after the implementation of CAL systems and feel that CAL systems would save them time in lesson preparation and administration activities. Teachers demonstrate that the use of CAL systems would help improve teacher skills, help staff and learners improve computer skills, provide better job opportunities for learners and help develop a professional standard of work in schools, as illustrated in the literature (Forsyth, 2001; Heide *et al.*, 2001; Merrill *et al.*, 1996).

With regard to pedagogical benefits, teachers feel that the use of computers will help teach learners independence and responsibility, a finding that is also demonstrated in the literature (Baillie *et al.*, 2000; Christensen *et al.*, 1998; Lelouche, 1998). As is supported in the literature, teachers agree that lessons will become more interactive (Baillie *et al.*, 2000; Christensen *et al.*, 1998; Forsyth, 2001), while learners will be able to access information easily beyond the school walls, which is validated in the literature review (Baillie *et al.*, 2000; Lelouche, 1998; MacArthur *et al.*, 2003; Wiley, 2001).

However, 78% of teachers indicate that computers would not be used often enough if CAL systems are implemented, a finding that is supported in the literature (Johnson, 2003; Loschert, 2003). The first concern is demonstrated regarding the availability of computers. There is strong agreement amongst the surveyed teachers, at 87%, that there is currently a low availability of computers in South African schools, as is demonstrated in the literature (Asmal, 2000), yet attitudes are mixed whether the implementation of more computers would increase teacher usage at 49% consensus, a statement the literature also claims as unproven (Balajthy, 2000). Secondly, at 70%, a majority of teachers indicate that they prefer traditional methods of teaching to CAL. Thirdly, at 91% agreement, teachers demonstrate that in general they are keen for the implementation of CAL but feel that they need training, as concerns are shown that teachers have lower levels of computer literacy and demonstrate higher levels of anxiety when using computers. Teachers also feel that recent trainees tend to be more receptive to computers. A majority of teachers therefore agree that they would need to dedicate extra time to participating in ongoing training, as reflected in the literature (Brown *et al.*, 1996; Cousins *et al.*, 1993; Johnson, 2003).

2.2. What are teachers' perceived benefits of computers in education?

Teachers value the improved access to information and better learning resources that CAL systems provide that allows for quicker collection, assimilation and analysis of information, as is supported in the literature (Baillie *et al.*, 2000; Lelouche, 1998; Valdez *et al.,* 2004; Wiley, 2001).

Secondly, teachers appreciate that CAL systems help learners develop job related and practical skills that assist learners in finding work opportunities after school (Baillie *et al.*, 2000; Heide *et al.*, 2001).

Thirdly, teachers agree that CAL systems provide learners with fun and positive learning experiences that maintain learner interest, as is supported in the literature (Christensen *et al.*, 1998; Forsyth, 2001; Lelouche, 1998; Owen *et al.*, 1998). Lastly, teachers value the benefits of CAL that allow learners to work at their own pace a function of learner centred learning principles (Christensen *et al.*, 1998; Eom *et al.*, 2000; Wiley *et al.*, 2001).

2.3. What are teachers' perceived disadvantages of computers in education?

Teachers feel the biggest disadvantage of CAL systems is that computer resources are costly to implement and to maintain. Literature indicates that a consequence of CAL implementation is a rise in intuition fees, faulty or outdated equipment and insufficient technical support (Baillie *et al.*, 2000; Brabazon, 2000; Heide *et al.*, 2001; Richard, 2003) that creates concern whether the level of investment required is justifiable (Draper *et al.*, 2002; Mayer, 2000). Currently, however, mostly as a result of budget constraints (Johnson, 2003; Loschert, 2003), limited computer resources are available to teachers in schools, providing limited opportunities of use for CAL purposes.

Secondly, teachers indicate that CAL systems only suit computer literate learners and leave learners with lower levels of computer literacy at a disadvantage. The literature supports that learners with greater levels of computer abilities tend to perform better on CAL systems (Desai, 2000).

Thirdly, teachers demonstrate that CAL systems are not suited to all learning styles. The literature supports this finding by indicating that learners who need higher degrees of structure and guidance (Boles *et al.*, 1999; Brabazon, 2000) or have lower levels of meta-cognitive information processing abilities (Bussey *et al.*, 1997; Forsyth, 2001) tend to perform at lower levels when using CAL systems.

3. The needs and priorities for CAL implementation in South African schools

3.1. What are the factors preventing the implementation of CAL in South African Schools?

As a whole, teachers agree most strongly that a lack of funds is a barrier to CAL implementation in South African schools. Literature indicates that schools are often under-funded for sufficient technology implementation in schools (Schofield, 1995).

At lower levels of agreement, teachers also indicate that the implementation of CAL systems in South African schools is a lower priority function with regard to schools' needs and resources. As indicated in the literature, Maslow's hierarchy of needs, as placed in the educational context, requires that all infrastructural needs of administration and adequate physical and human resources be met before technology related learning systems are implemented, as technology may not have the desired positive effect on learners if their learning environments are under resourced (Johnson, 2003).

The findings also indicate that having too few staff members and trained computer staff, inadequate classrooms, space limitations, theft and security issues also remain challenges to CAL implementation. These findings support previous research studies performed in South African schools (NCETDE, 1998).

3.2. What are priority needs in schools for the Implementation of CAL systems?

Teachers demonstrate a general need across various items for CAL implementation. However, as is supported in the literature, teachers indicate that providing more individual attention to learners (Alessi *et al.*, 2001; Hitchcock, 2000) and receiving greater access to information and resources (Baillie *et al.*, 2000; Lelouche, 1998; Wiley, 2001) are the biggest priorities for CAL implementation.

Also validated in the literature, teachers indicate a general need for better record keeping processes (Johnson, 2003; Pieters, 2001), interacting and sharing resources with other schools (Lai, 1996; Owen *et al.*, 1998; Schrum *et al.*, 1997; Valdez *et al.,* 2004) and the need for ongoing training for CAL implementation (Schofield, 1995).

From a developmental perspective, teachers overwhelmingly indicate that the widespread implementation of CAL systems should not occur before all schools' basic needs are fulfilled. Literature also indicates that a discrepancy exists between the aspiration for technology in schools and the vision that all schools have the fulfilment of basic infrastructural needs (Johnson, 2003; Richard, 2003). Maslow's hierarchy of needs applied in the educational context requires that all adequate infrastructural needs are met in schools before technology related learning systems are implemented to ensure the success and sustainability of CAL systems in schools (Johnson, 2003).

4. The structure and layout for CAL implementation in South African schools

4.1. What is the optimal grade for CAL implementation in South African schools?

At 46%, the majority of teachers agree that the optimum grade for CAL implementation at schools is Grade One. On average however, the optimal grade for CAL implementation in schools is Grade Three.

4.2. What is the optimal structure for CAL implementation in South African schools?

Teachers indicate that the most ideal structure for CAL implementation is that each learner and teacher has access to their own computer. At more realistic levels, teachers indicate that allocating one computer for every five learners would be sufficient.

Teachers indicate, however, that they would prefer there not to be computers in classrooms. This finding is supported in the literature that indicates that unless classroom settings are physically or structurally changed, the integration of computers into classroom settings often proves unsuccessful (Ortega *et al.*, 2001). However, literature indicates that when computers are situated outside of the classroom setting, there is a lesser chance of computers being integrated into the educational process (Bitter *et al.*, 1993). Also, having computers outside of the classroom context does not allow the active and exploratory learning styles proposed by CAL theories to emerge in school systems where learners become passive respondents in limited and rigid computer access opportunities (Addison *et al.*, 1997).

4.3. What is the software most relevant for CAL implementation in South African schools?

The findings indicate that the use of Drill and Testing software, CD-Rom based software, Spreadsheet software, the Internet, Design software, Word Processors, Presentation software, Programming software and Simulation software are the software relevant for general CAL implementation in South African schools. More specifically, teachers indicate that Drill and Testing software, CD-Rom based software, Spreadsheet software, Internet use and Design software are the software that are relevant for use in the Grade 10 Mathematics learning area.

Teachers indicate that Drill and Practice and Testing software are the most suitable for general CAL implementation and use. Previous studies in South African schools also report that drill and practice applications feature most prominently in educational computing at schools, particularly in the Mathematics and Language learning areas (NCETDE, 1998). The use of Drill and Practice and Testing software is shown in the literature to help learners to exercise material that has been taught, in an electronic and automated environment until required skills have been refined or committed to memory, while freeing up time for teachers to dedicate to other tasks (Bitter *et al.*, 1993; Brown, 1997; Hughes, 1998; Ortega *et al.*, 2001).

However, teachers demonstrate low levels of capability and experience in using Drill and Practice and Testing software, demonstrating a need for training and opportunity for integration into schools. On the other the other hand, teachers demonstrate higher levels of capability, general work experience and perceptions of suitability for the use of spreadsheet software, word processing software and CD-Rom based software, yet demonstrate low incidents of use for teaching Grade 10 Mathematics. This again demonstrates an opportunity for integration, as teachers would require less intensive training in using software, as opposed to Drill and Practice and Testing software, but would need to be trained in how the CAL systems are integrated into the curriculum regardless.

5. The levels of CAL most suited to the implementation of CAL in South African schools

5.1. What levels of CAL are most suited for CAL implementation in general?

Teachers agree that computers can be used for information collection purposes, allowing learners to search, collect and analyse information off the Internet. This is supported in the literature (French *et al.*, 1999; Heide *et al.*, Loschert, 2003).

Teachers agree that computers can be used for word processing purposes, allowing learners to compile, prepare and type up homework assignments, as is indicated in the literature (Bitter *et al.*, 1993; Heide *et al.*, 2001).

Teachers support that computers can effectively be used for demonstration purposes, allowing teachers to demonstrate and work examples for learners. The literature indicates that demonstration is a function of CAL delivery software, such as presentation software (Heide *et al.*, 2001; Mayer, 2000).

Finally, teachers agree that CAL systems could allow learners to perform instructional exercises and examples, a function of CAL delivery software (Heide *et al.*, 2001; Merrill *et al.*, 1996) and drill and practise software (Bitter *et al.*, 1993; Brown, 1997; Heide *et al.*, 2001; Hughes, 1998; Ortega *et al.*, 2001).

5.2. What levels of CAL are most suited to the delivery of the Grade 10 Mathematics curriculum?

Teachers indicate a general propensity to CAL Level Three, a CAL scenario where teachers use computers to prepare and teach lessons, while learners perform exercises on computers under teacher supervision. However, teachers indicate that currently, CAL Level Two is more realistically suited to the Grade 10 Mathematics curriculum. The CAL level two scenario is where teachers prepare and teach lessons in the traditional method, but learners perform exercises on computers under teacher supervision. Teachers demonstrate greater aversion to CAL Level Five, where learners learn independently off computer tutorial software and other media, while performing unsupervised exercises on computer.

The results suggest that to a lesser extent teachers would personally prefer to have a greater degree of technological freedom and access to materials in creating and developing teaching material, an instructional strategy that is characteristic of a Constructivist teaching orientation (Semple, 2000). However, the results suggest that teachers would prefer learners to have less freedom in using technological media in the instructional process, using the computer only to perform supervised exercises; a process characteristic of the Behavioural Learning theory (Boyle, 1997; Kotze *et al.*, 1996). The results therefore, suggest that teachers prefer a technological instructional context that allows lower levels of learner control (Brown, 1997; Overbaugh, 1994; Yang, 1993).

6. The levels of CAL that teachers foresee as being implemented in the future

6.1. What levels of CAL do teachers perceive to be common in South African schools in five years' time?

At 36%, the majority of teachers indicate that CAL Level Two is the expected level of CAL to be common in South African schools in five years' time. The CAL Level Two scenario is where teachers prepare and teach lessons in the traditional method, but learners perform exercises on computers under teacher supervision. There is therefore a match between the level of CAL that teachers feel is most suited to the Grade 10 Mathematics curriculum, and the level of CAL that teachers expect to find in schools in five years' time.

5.3 CONCLUSIONS ABOUT THE RESEARCH PROBLEM

The research problem under study is:

What are teachers' attitudes toward the implementation and integration of CAL systems in South African schools?

In response to the research problem, the following conclusions are provided.

In general, teachers feel very positive about the use of computers in schools and specifically for teaching purposes. Teachers indicate that they believe the use of computers in education is inevitable and agree that the use of computers in education will provide value in the educational context. These findings support the claims in the literature that teachers generally feel positive about the use of educational technologies and the value that the use of computers provides to schools (MacArthur *et al.*, 2003; NCETDE, 1998; Valdez *et al.,* 2004).

Teachers demonstrate high levels of access to computers and fairly capable computer abilities, yet demonstrate low levels of awareness of available computer facilities, as well as low levels of computer use. The findings therefore support the literature that indicates that implementing CAL into the school system, may have less to do with the implementation of computers in schools than the integration of computers into the school curriculum (DOE, 2003c) as well as the need for intensive training in using and adapting CAL systems (Brown *et al.*, 1996; Cousins *et al.*, 1993; Johnson, 2003). This provides some validity to statements in the literature that the implementation of computers absent from the school curricula may leave computers underutilized or unused (NCETDE, 1998).

However, teachers show that they have a preference for traditional teaching methods to CAL instructional methods, demonstrating a specific preference for traditional chalk and whiteboard media. The findings suggest that teachers do not value computers for their instructional purposes, but rather value the use of CAL systems for their:

- administration and management capabilities
- information collection and storage capacities
- use as tools to prepare lessons and create homework assignments and educational material through software such as word processors
- use as demonstration tools for teachers do demonstrate information and material to learners
- use as tools for learners to perform instructional exercises and examples
- abilities to motivate learners and provide learners with positive learning experiences
- tendency to provide learners with job related practical computer skills.

School computer use activities are therefore geared toward practical educational related activities as opposed to instructional activities. The findings also suggest that the use of computers to teach is not a priority of education related computer use. The findings therefore validate the literature that indicates that despite the modern advancements, a variety of both traditional and modern media are best suited to various educational activities (Desai, 2000; Loschert, 2003).

With regard to the preferred structure of CAL systems in schools, teachers indicate that learners should be exposed to CAL systems early in the school career, commencing from Grade One to Grade Three. At the ideal, each teacher and learner should have access to their own computers, while the allocation of one computer for every five learners in schools is viewed as acceptable. However, teachers feel that computers should not be in classrooms.

With regard to CAL instruction, teachers demonstrate a preference for a teaching scenario where teachers use computers to prepare and teach lessons, but learners perform exercises on computers under teacher supervision. Teachers demonstrate greater aversion to a teaching situation where learners learn independently off computer tutorial software and other media, while performing unsupervised exercises on computer. In the instructional situation, therefore, teachers would prefer to have a greater degree of technological freedom and access to materials in creating and developing teaching material, an instructional strategy that is characteristic of a Constructivist teaching orientation (Semple, 2000). However, teachers would prefer learners to have less freedom in using technological media in the instructional process, using the computer only to perform supervised drill and practise exercises, a level of computer use characteristic of the Behavioural learning theory (Boyle, 1997; Kotze *et al.*, 1996). More realistically, due to low levels of computer availability and computer literacy, teachers expect the common level of instructional CAL in schools in five years' time to be at a level where teachers prepare and teach lessons in the traditional method, but learners perform exercises on computers under teacher supervision.

Teachers therefore indicate that Drill and Practice and Testing software are the most suitable for general CAL implementation and use. Previous studies in South African schools also report that Drill and Practice applications feature most prominently in educational computing at schools, particularly in the Mathematics and Language learning areas (NCETDE, 1998). Teachers however demonstrate low levels of ability and experience in using Drill and Practise and Testing software.

Teachers prefer less involved CAL systems as computer resources are costly to implement and maintain, CAL systems suit computer literate learners, leaving learners with lower levels of computer literacy at a disadvantage, and CAL systems are not suited to all learning styles. From a developmental perspective in the context of South Africa, teachers overwhelmingly indicate that the widespread implementation of CAL systems should not occur before all schools have their basic needs of water, sanitation, electricity and human resources fulfilled.

5.4 IMPLICATIONS FOR POLICY AND PRACTISE

The e-Education policy sets out a plan for the implementation of CAL systems into schools in a multiyear format of action, consisting of three major phases of integration from year 2004 to 2013 (DOE, 2003c). In Phase one, where the aim is to enhance system-wide and institutional readiness to use ICTs for learning, teaching and administration in schools (year 2004 to 2007), the plan intends for the establishment of an education and training system that supports the integration of ICTs into education practice. Though the findings of the research study indicate that teachers in general are positive regarding the use of computers in schools, they indicate very specific feelings regarding the extent that computers should be integrated into the educational and instructional process. The e-Education policy does not stipulate and define the specific guidelines and structures of a CAL presence in schools, but intends over the three phase period to ensure that ICTs have been fully integrated into the educational processes at all schools.

It is recommended that specific definitions and structures of CAL practice are created and stipulated in research and policy documents regarding CAL implementation and integration, to demonstrate and clarify the various facets and characteristics of CAL systems that fall under the broad umbrella of ICTs. It is then recommended that studies be conducted to determine the suitability and relevance of various facets of CAL to the South African educational system. This becomes vital as though a large number of research studies have been carried out to determine what factors contribute to good teaching practise in the traditional teaching setting, little research has been done to determine whether or how the use of computers in educational settings helps to improve the quality of education delivered compared to its traditional alternatives (Baillie *et al.*, 2000; Hitchcock, 2000; Housego *et al.*, 2000; Robinson *et al.*, 2003; Valdez *et al.,* 2004). Schools therefore tend to implement educational technology practises before investigating whether and how the technology will be used to its full capacity in the context of South African schools, or what the human and educational impact would be on learners and teachers (Hobson *et al.*, 1998; Hugo, 2002; McCabe *et al.*, 2003). Research, therefore, should be conducted to further validate and expand the findings of this research study, that indicate that a variety and combination of both traditional and modern media are best suited to various educational activities (Desai, 2000; Loschert, 2003). Finally, it is recommended that teacher training programmes focus on the actionable integration and adaptation of CAL systems to school and national curricula (DOE, 2003c) over and above the training of basic computer literacy (Brown *et al.*, 1996; Cousins *et al.*, 1993; Johnson, 2003).

5.5 FURTHER RESEARCH

As an immediate response to this research study, it is firstly recommended that the research be expanded across a greater geographical scope, as literature indicates that significant urban and rural differences exist in the patterns of use of computer technologies as well as levels of developed physical infrastructure (Hall, 1998). It is then recommended that research of the same nature be performed on the same sample of learners, namely Grade 10 Mathematics learners in the context of this study, to create a wholistic understanding and plot the interplay between teachers' and learners' attitudes.

At the various variable breakdowns, the following suggestions are made for further research based on insightful trends demonstrated in the findings:

- *An exploration of the correlation between the attitudes toward, and usage patterns of, educational media across Demographic groups* - this topic is relevant as in the findings, 50% of teachers in the Black demographic group indicate that the use of computers is the most effective teaching medium, the highest rating among the demographic groups, yet indicate the lowest rate of ever having used computers at 69%

- *An exploration of the computer usage patterns of Female and Male teachers* - the literature suggests that traditionally males tend to have a higher propensity toward the use of computers and technologies (Schofield, 1995), but the research findings, however, demonstrate propensities for computers at various levels between male and female teachers (see section 4.3.1.2.1.2.2)

- *A comparative study of the work related use of computers at home and at school amongst teachers* – the findings demonstrate that 72% of the teachers surveyed use computers at home for work activities, and tend to spend longer periods using computers at home than at school (see section 4.3.1.2.1.3.1), and therefore could demonstrate various differences in work related computer use

- *A study of the preferences of educational media at across age groups* – the findings indicate that older teachers have a higher inclination for using traditional chalk and whiteboard teaching media (see section 4.3.1.1.2.4), suggesting a difference in educational media preference across age groups

- *An exploration of the various levels and content of training received by teachers across various groups* – aiming to understand the levels of CAL training received by teachers, to direct training programmes to specific needs

- *An investigation into the priority funding allocations for computer and CAL implementation and integration into schools* - as the findings indicate that the costs to implement and maintain CAL systems are the biggest disadvantages to the use of CAL systems (see section 4.3.1.5.2.1), a study to identify which CAL systems should be considered priority in schools and the levels of budget worthy of dedication to the implementation procedure

- *An exploration into the levels of anxiety experienced by teachers toward the use of CAL systems in schools* – the findings indicate that 49% of the teachers surveyed feel that teachers fear computers (see section 4.3.1.3.2.1), that therefore provides a challenge to the integration of CAL systems into schools

- *A study into the optimal structure of CAL systems in schools* – the findings indicate that teachers have stronger preferences for individual computer allocations for teachers and learners, while not having computers in classrooms (see section 4.3.4.1), that requires further exploration, elaboration and specific detail

- *An investigation into teachers' opinions regarding the implementation of CAL with regard to the developmental priorities for South African schools* – the findings indicate that teachers feel that widespread implementation of CAL systems should not occur in South African schools before all schools have their basic needs fulfilled (see section 4.3.2.2.2.1), which requires more detailed exploration.

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APPENDICES

APPENDIX A. DATA COLLECTION QUESTIONNAIRE

THESIS TOPIC: An Investigation into the Attitudes of Teachers in Port Elizabeth to the Implementation of Computer Assisted Learning

STUDENT: Paul Harvey

RESEARCH SUPERVISOR: Professor Peter Cunningham (University of Port Elizabeth)

INSTRUCTIONS:

- You need to answer the questions by either placing a tick "√" in the answer blocks, or writing some numbers as your answers.
- Please note, some questions you may have to skip if the questionnaire prompts you to do so. Please be aware of this as you go along.
- Pages are printed on both sides!
- Please start at item B.1.

A – QUESTIONNAIRE DETAILS – *FOR OFFICE USE ONLY*

A.1 SAMPLE CODE: [ ]

A.2 INTERVIEWEE NAME [ ]

A.3 NAME OF SCHOOL [ ]

A.4 FIELDWORK CODES

B – INTERVIEWEE DETAILS

PLEASE TICK THE APPROPRIATE BLOCK IN EACH ITEM BELOW:

B.1 DATE OF COMPLETION

		2003

B.2 WHAT IS YOUR PREFERRED TITLE? (Optional):

Miss 1	Ms 2	Mrs 3	Mr 4	Dr 5

B.3 PLEASE INDICATE YOUR GENDER:

Female 1	Male 2

B.4 YOUR DEMOGRAPHIC GROUP ACCORDING TO THE RSA CENSUS:

Black 1	Coloured 2	Indian 3	White 4	Other (please specify)…………………… 5

B.5 WHAT IS YOUR AGE GROUP?

21 – 30 (1)	31 – 40 (2)	41 – 50 (3)	51 – 60 (4)	Over 60 (5)

B.6 WHICH LEVEL DO YOU TEACH?

Higher grade 1	Standard grade 2	Both higher and standard grades 3

B.7 IN WHICH LANGUAGE MEDIUM DO YOU TEACH? YOU MAY CIRCLE MORE THAN ONE.

Afrikaans 1	English 2	Xhosa 3	Other (please specify)………………………..... 4

B.8 HOW MANY YEARS HAVE YOU BEEN TEACHING?

B.9 WHAT IS YOUR HIGHEST QUALIFICATION?

1	Grade 12 certificate	
2	Tertiary level certificate	
3	Tertiary level diploma	
4	Tertiary level degree	
5	Honours degree	
6	Masters degree	
7	Doctor's degree	
8	Other (Please specify):………………………………………	

B.10 DO YOU HOLD ANY OF THE FOLLOWING POSITIONS AT YOUR SCHOOL?

Subject head 1	Grade head 2	All of the above 3	None of the above 4

C – COMPUTER ACCESS AND USE

C.1.1 HAVE YOU USED A COMPUTER?

Yes 1	No 2

C.1.2 IF YES, PLEASE RATE YOUR ABILITY IN USING THE FOLLOWING COMPUTER APPLICATIONS. PLEASE MARK YOUR ANSWER WITH A TICK "√", AND ONLY GIVE ONE ANSWER PER LINE:

		Very Poor	Fairly Poor	Fairly capable	Very Capable
1	Word processors e.g. MS word				
2	Spreadsheet programmes e.g. MS excel				
3	Presentation software e.g. Powerpoint				
4	Publishing software e.g. MS publisher				
5	Databases / data storage programmes e.g. MS access				
6	Design / drawing programmes e.g. Cad programmes				
7	Computer programming software e.g. Visual basic, c++				
8	Web site design software				
9	Use of the internet e.g. Internet explorer				
10	CD - rom information software e.g. CD - rom encyclopedias				
11	E-mail e.g. Outlook express				
12	Administrative software				
13	Drill and practice / computer testing software				
14	Simulation software e.g. Sim series				
15	Computer games				

C.2.1 IS THERE A COMPUTER THAT TEACHERS CAN USE AT SCHOOL?

Yes 1	No 2

IF YES PLEASE CONTINUE, IF NO PLEASE MOVE ONTO ITEM C.3.1

C.2.2 ON AVERAGE HOW MANY HOURS A WEEK DO YOU MAKE USE OF COMPUTERS AT SCHOOL?

0 - 5 hours (1)	6 - 10 hours (2)	11 - 15 hours (3)	16 - 20 hours (4)	More than 20 hours (5)

C.2.3 IN YOUR OPINION, DO ALL TEACHERS MAKE USE OF THESE FACILITIES?

Yes 1	No 2

C.2.4 IN YOUR OPINION, WHAT IS THE GENERAL COMPUTER ABILITY OF TEACHERS AT YOUR SCHOOL:

Very Poor 1	Fairly Poor 2	Fairly capable 3	Very Capable 4

C.2.5 IN YOUR OPINION, WHAT TASKS DO TEACHERS USE COMPUTERS FOR AT YOUR SCHOOL? YOU MAY SELECT MORE THAN ONE:

1	Used for school administration and management	
2	Used for lesson preparation	
3	Used to teach computer science as a subject	
4	Used as a teaching tool to teach any subject	
5	Used for gathering information on the internet or on CD-Roms	
6	Used for testing	
7	Used for communicating via e-mail	
8	Other. Please specify: …………………………………………………	

C.3.1 DO YOU HAVE A PERSONAL COMPUTER AT HOME?

Yes 1	No 2

IF YES PLEASE CONTINUE, IF NO PLEASE MOVE ONTO ITEM C.4.1

C.3.2 ON AVERAGE HOW MANY HOURS A WEEK DO YOU MAKE USE OF THE COMPUTER AT HOME?

0 - 5 hours (1)	6 - 10 hours (2)	11 - 15 hours (3)	16 - 20 hours (4)	More than 20 hours (5)

C.3.3 DO YOU USE THE COMPUTER FOR ANY WORK RELATED ACTIVITIES?

Yes 1	No 2

C.4.1 AS A TEACHER, HOW OFTEN DO YOU USE THE FOLLOWING MEDIA?

		Frequently	Seldom	Never
1	Chalk / white boards			
2	Computers			
3	Overhead projectors			
4	Radios / tape / CD players			
5	Slide projectors			
6	TVs			
7	Video machines			

C.4.2 WHICH ONE OF THE MEDIA LISTED ABOVE IN "C.4.1" HAVE YOU USED THE MOST? PLEASE WRITE THE NUMBER ONLY:

C.4.3 WHICH ONE OF THE MEDIA LISTED IN "C.4.1" DO YOU BELIEVE TO BE THE MOST EFFECTIVE TEACHING TOOL? PLEASE WRITE THE NUMBER ONLY:

C.5 IN YOUR OPINION WHAT PERCENTAGE OF SCHOOLS IN PORT ELIZABETH HAVE COMPUTERS AVAILABLE FOR TEACHERS TO USE? (THERE IS NO WRONG ANSWER!)

0% - 20% (1)	21% - 40% (2)	41% - 60% (3)	61% - 80% (4)	81% - 100% (5)

C.6 TO WHAT EXTENT DO YOU AGREE WITH THE FOLLOWING AS REASONS WHY SCHOOLS DO NOT HAVE COMPUTERS?

		Strongly agree	Agree	Disagree	Strongly disagree
1	Because they do not need them				
2	Inadequate classrooms				
3	Lack of funds				
4	No space to keep computers				
5	No trained computer staff				
6	No electricity				
7	No telephone lines				
8	Not enough staff				
9	They need them but are not seen as a priority				
10	Because of theft and security reasons				

C.7 PLEASE INDICATE TO WHAT EXTENT YOU AGREE WITH THE FOLLOWING STATEMENTS:

		Strongly agree	Agree	Disagree	Strongly disagree
1	Teachers choose not to use computers because they believe it will take them too long to learn how to use them.				
2	Most teachers are scared of using computers.				
3	Teachers generally make an effort to use the computer as much as they can regardless of how computer literate they are.				
4	Teachers trained more recently tend to be more open to using computers than teachers trained longer ago.				
5	Providing more computers to schools will not guarantee that more teachers will use computers.				
6	Most teachers prefer traditional methods to computers in their daily working.				
7	Teachers use computers less in schools because the equipment is not functioning correctly or is outdated.				
8	Teachers want to use computers but feel that they require some training before they can do so.				
9	Teachers want to use computers but do not because there are not computers available in their schools.				
10	Less than half of teachers would make use of computers if they were made available in all schools.				

D – COMPUTER INFORMATION

D.1.1 EARLIER, IN ITEM "C.4.1" YOU TOLD US ABOUT YOURSELF, BUT NOW PLEASE THINK ABOUT TEACHERS IN GENERAL. HOW OFTEN DO TEACHERS YOU USE THE FOLLOWING MEDIA?

		Frequently	Seldom	Never
1	Chalk / white boards			
2	Computers			
3	Overhead projectors			
4	Radios / tape / CD players			
5	Slide projectors			
6	TVs			
7	Video machines			

D.1.2 WHICH OF THE ITEMS LISTED ABOVE IN "D.1.1" DO YOU THINK TEACHERS USE THE MOST? PLEASE WRITE THE NUMBER ONLY:

D.2 IN YOUR OPINION, AT WHICH GRADE SHOULD COMPUTERS BE INTRODUCED INTO THE MATHEMATICS CURRICULUM?

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

D.3 TO WHAT EXTENT DO YOU AGREE WITH THE USEFULNESS OF THE FOLLOWING IN THE TEACHING SITUATION?

		Strongly agree	Agree	Disagree	Strongly disagree
1	Teachers can use the computer to demonstrate examples of the taught work.				
2	Each learner can do practice examples on computers under a teacher's supervision.				
3	Teachers can perform a usual teaching lesson with the use of a computer.				
4	Learners can learn a lesson entirely off a computerized tutorial under the supervision of a teacher.				
5	Learners can learn a lesson off a computerized tutorial under their own supervision.				
6	Learners can use the computer to type up assignments and to complete other hand-ins.				
7	Learners can use the computer to search for information on the internet or on CD-rom information resources.				
8	Teachers and learners can use the computer to communicate via e-mail regarding homework assignments or general class related messages.				
9	Teachers can use the computer to mark and assess learners' work.				
10	Each learner can be tested and assessed on computer based testing programmes.				

D.4 TO WHAT EXTENT WOULD YOU BE SATISFIED WITH THE FOLLOWING SCENARIOS REGARDING COMPUTERS IN SCHOOLS?

		Strongly Satisfied	Somewhat Satisfied	Somewhat Dissatisfied	Strongly Dissatisfied
1	Each classroom has one computer for all learners and the class teacher to share.				
2	Each classroom has one computer for teachers to use and one computer for all learners to use.				
3	Each classroom has one computer allocated for every five learners in the classroom.				
4	Each classroom has one computer available for all learners to use, and the teacher uses computers in the staff room.				
5	There are no computers in the classrooms, but a separate computer room where all classes use computers.				
6	There is only computer access for learners who do computer science as a subject, in a separate computer room.				
7	There are computers in classrooms for only teachers to use.				
8	Each teacher has her/his own computer to use.				
9	Each learner has her/his own computer to use.				

D.5 TO WHAT EXTENT DO YOU AGREE WITH THE FOLLOWING REGARDING COMPUTERS IN CLASSROOMS?

	Computers in classrooms will:	Strongly agree	Agree	Disagree	Strongly disagree
1	teach learners responsibility				
2	help learners and teachers improve their computer skills				
3	allow learners to have more time to use the computers in school time				
4	allow lessons to be more interactive				
5	take up too much space				
6	mean that computers are damaged often				
7	still not provide enough time for all learners to use the computer individually				
8	not be used often				
9	fall prey to theft				
10	be used to their full capacity				

D.6.1 TO WHAT EXTENT DO YOU AGREE WITH THE FOLLOWING AS BEING PRIORITIES IN CURRENT TEACHING PRACTISES?

		Strongly agree	Agree	Disagree	Strongly disagree
1	Having better assignment management and less assignments lost				
2	Having better communication and passing of messages between teachers and learners				
3	Having better communication and passing of messages between teachers and teachers				
4	Having better record keeping processes				
5	Having access to more information and teaching resources				
6	Interacting and sharing resources with teachers from other schools				
7	Having less time spent marking and administrating				
8	Having less time spent preparing tests				
9	Having more accurate marking and assessment processes				
10	Giving more individual attention given to learners				
11	Having ongoing training provided at the time and place that best suits each teacher				

D.6.2 IF YOU LOOK AT THE LIST IN QUESTION "D.6.1", PLEASE TELL US WHICH ITEMS YOU FEEL TO BE THE FIRST, SECOND AND THIRD IN ORDER OF PRIORITY REGARDING CURRENT TEACHING PRACTISES. PLEASE WRITE THE NUMBERS ONLY:

1	First Priority	
2	Second Priority	
3	Third Priority	

D.7.1 IN YOUR OPINION, HOW SUITABLE ARE THE FOLLOWING COMPUTER APPLICATIONS TO ASSIST TEACHING MATHEMATICS AT A GRADE 10 LEVEL?

		Very Unsuitable	Somewhat Unsuitable	Somewhat Suitable	Very Suitable
1	Word processors e.g. MS word				
2	Spreadsheet programmes e.g. MS excel				
3	Presentation software e.g. Powerpoint				
4	Publishing software e.g. MS publisher				
5	Databases / data storage programmes e.g. MS access				
6	Design / drawing programmes e.g. Cad programmes				
7	Computer programming software e.g. Visual basic, c++				
8	Web site design software				
9	Use of the internet e.g. Internet explorer				
10	CD rom information software e.g. CD - rom encyclopaedias				
11	E-mail e.g. Outlook express				
12	Administrative software				
13	Drill and practice / computer testing software				
14	Simulation software e.g. Sim series				
15	Computer games				

D.7.2 OF THE LIST IN QUESTION "D.7.1", WHICH COMPUTER APPLICATION DO YOU FEEL TO BE THE MOST IMPORTANT TO ASSIST TEACHING MATHEMATICS AT A GRADE 10 LEVEL? PLEASE WRITE THE NUMBER ONLY:

D.7.3 IN YOUR OPINION, HOW CAPABLE ARE GRADE 10 LEARNERS OF USING THE COMPUTER APPLICATION YOU CHOSE TO BE THE MOST IMPORTANT IN ITEM "D.7.2"?

Very Poor 1	Fairly Poor 2	Fairly capable 3	Very Capable 4

D.8 HAVE YOU EVER USED A COMPUTER IN ANY CAPACITY FOR WORK RELATED ACTIVITIES IN YOUR TEACHING CAREER?

Yes 1	No 2

IF YES, MOVE ONTO THE FOLLOWING ITEM, IF NOT PLEASE MOVE ONTO ITEM E.1.1

D.9.1 FOR WHAT TASKS HAVE YOU USED COMPUTERS IN YOUR TEACHING CAREER? YOU MAY SELECT MORE THAN ONE:

1	Used for school administration and management	
2	Used for lesson preparation	
3	Used to teach computer science as a subject	
4	Used as a teaching tool to teach any subject	
5	Used for gathering information on the internet or on CD-Roms	
6	Used for testing / assessment	
7	Used for communicating via e-mail	
8	Used for programming	
10	Other. Please specify…………………………………………..	

D.9.2 IF YOU SELECTED MORE THAN ONE, WHICH SINGLE TASK HAS FEATURED THE MOST IN YOUR COMPUTER USE? PLEASE WRITE THE NUMBER ONLY:

D.10 PLEASE INDICATE WHICH OF THE FOLLOWING COMPUTER APPLICATIONS YOU HAVE USED IN WORK RELATED ACTIVITIES:

1	Word processors e.g. MS word	
2	Spreadsheet programmes e.g. MS excel	
3	Presentation software e.g. Powerpoint	
4	Publishing software e.g. MS publisher	
5	Databases / data storage programmes e.g. MS access	
6	Design / drawing programmes e.g. Cad programmes	
7	Computer programming software e.g. Visual basic, c++	
8	Web site design software	
9	Use of the internet e.g. Internet explorer	
10	CD rom information software e.g. CD - rom encyclopaedias	
11	E-mail e.g. Outlook express	
12	Administrative software	
13	Drill and practice / computer testing software	
14	Simulation software e.g. Sim series	
15	Computer games	
16	Other. Please specify:…………………………………………….	

D.11.1 HAVE YOU EVER USED A COMPUTER IN ANY CAPACITY FOR TEACHING GRADE 10 MATHEMATICS?

Yes 1	No 2

IF YES, MOVE ONTO THE FOLLOWING ITEM, IF NOT PLEASE MOVE ONTO ITEM E.1.1

D.11.2 I NOW WANT YOU TO THINK SPECIFICALLY OF TEACHING GRADE 10 MATHEMATICS. PLEASE INDICATE WHICH OF THE FOLLOWING COMPUTER APPLICATIONS YOU HAVE USED SPECIFICALLY RELATED TO TEACHING GRADE 10 MATHEMATICS:

1	Word processors e.g. MS word	
2	Spreadsheet programmes e.g. MS excel	
3	Presentation software e.g. Powerpoint	
4	Publishing software e.g. MS publisher	
5	Databases / data storage programmes e.g. MS access	
6	Design / drawing programmes e.g. Cad programmes	
7	Computer programming software e.g. Visual basic, c++	
8	Web site design software	
9	Use of the internet e.g. Internet explorer	
10	CD rom information software e.g. CD - rom encyclopaedias	
11	E-mail e.g. Outlook express	
12	Administrative software	
13	Drill and practice / computer testing software	
14	Simulation software e.g. Sim series	
15	Computer games	
16	Other (Please specify):…………………………………………….	

D.11.3 IF YOU SELECTED MORE THAN ONE ITEM IN QUESTION "D.11.2", WHICH COMPUTER APPLICATION HAVE YOU USED THE MOST? PLEASE WRITE THE NUMBER ONLY:

E - ATTITUDES

E.1.1 HOW DO YOU FEEL ABOUT THE GENERAL USE OF COMPUTERS IN EVERYDAY LIFE?

Very negative 1	Negative 2	Positive 3	Very positive 4

E.1.2 HOW DO YOU FEEL ABOUT THE USE OF COMPUTERS FOR GENERAL WORK RELATED ACTIVITIES, SUCH AS ADMINISTRATION AND LESSON PREPARATION?

Very negative 1	Negative 2	Positive 3	Very positive 4

E.1.3 HOW DO YOU FEEL ABOUT USE OF COMPUTERS SPECIFICALLY AS TEACHING TOOLS IN SCHOOLS?

Very negative 1	Negative 2	Positive 3	Very positive 4

E.2 TO WHAT EXTENT DO YOU AGREE WITH THE FOLLOWING STATEMENTS REGARDING COMPUTERS IN EDUCATION?

		Strongly agree	Agree	Disagree	Strongly disagree
1	Computers provide learners with better job opportunities.				
2	Computers in education are inevitable.				
3	There is no value in implementing computers in education.				
4	Computers will eventually replace teachers.				
5	Computers help learners to be independent.				
6	Computers help save time in preparation and administrative tasks.				
7	Implementing computers means extra hours in ongoing training.				
8	Computers will give teachers a heavier workload.				
9	Money for computers should be spent on other resources.				
10	Teachers aren't computer literate enough to use computers effectively.				
11	Computers provide access to information beyond the school walls.				
12	Computers provide teachers with more skills.				
13	Computers help make work look professional.				
14	Implementing computers will change the curriculum.				
15	Implementing computers as teaching tools will be a smooth transition from the traditional teaching methods currently used.				

E.3.1 PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE WITH THE RELEVANCE OF THE FOLLOWING BENEFITS OF COMPUTER ASSISTED LEARNING?

	Computer Assisted Learning:	Strongly agree	Agree	Disagree	Strongly disagree
1	allows learners to work at their own pace				
2	allows more interactive learning				
3	allows the use of visual presentations and graphics				
4	encourages communication between students				
5	improves learner motivation				
6	provides better access to information				
7	provides extra learning resources				
8	provides learners with job-related skills				
9	provides more individual attention to learners				
10	provides practical experience to learners				
11	helps improve writing and word processing skills				
12	allows the learner to be more productive				
13	allows the quicker collection and interpretation of data				
14	allows learners to be more self-directive and independent in their learning				
15	provides learners with a fun experience of learning				
16	holds the interest of the learner longer than traditional lessons				
17	accelerates the learner's learning rate				
18	can free up a teacher's time to spend more time interacting with learners				

E.3.2 OF THE ITEMS ABOVE IN “E.3.1”, WHICH ONE DO YOU FEEL MOST STRONGLY ABOUT? PLEASE WRITE NUMBER ONLY:

E.4.1 PLEASE INDICATE THE EXTENT TO WHICH YOU AGREE WITH THE RELEVANCE OF THE FOLLOWING DISADVANTAGES OF COMPUTER ASSISTED LEARNING?

		Strongly agree	Agree	Disagree	Strongly disagree
1	Favours learners who are more computer literate				
2	Favours boys over girls as boys traditionally tend to be more computer literate				
3	Limits the interaction between learner and teacher				
4	Creates distractions that prevent learners from sticking to the educational task				
5	Is time consuming				
6	Is expensive to implement and maintain				
7	Is attractive on the surface but not as pedagogically sound as traditional teaching methods				
8	Computer technology changes quickly and will create disruptions in the curriculum and routine of teaching.				
9	May disadvantage learners who need the structure and linear direction of traditional teaching methods				
10	Causes compromises in the curriculum				
11	Creates too much focus on the teaching tool, and too little focus on the lesson content				
12	Computers cannot be available whenever each learner requires using it				
13	The computer and its operation dictate the lesson, and not the lesson content				
14	A computer has a limited range of activities compared to regular education				
15	A computer does not suit all learners' learning styles.				
16	Computer assisted learning results in downsizing of teaching staff as computers take over more tasks				
17	Creates social pressure for schools to be socially "with it"				
18	Creates unpredictable technical interruptions				

E.4.2 OF THE ITEMS ABOVE, WHICH ONE DO YOU FEEL MOST STRONGLY ABOUT? PLEASE WRITE NUMBER ONLY: [ ]

E.5 HAVE YOU HAD ANY TRAINING ON USING COMPUTER SOFTWARE OR APPLICATIONS?

Yes 1	No 2

E.6 REGARDING SOUTH AFRICA, DO YOU AGREE WITH THE FOLLOWING STATEMENT?

Computers are important enough to be implemented in all South African schools before all schools have electricity, water and other basic needs.

Yes 1	No 2

F - COMPUTER ASSISTED LEARNING AND THE MATHEMATICS CURRICULUM.

F.1 BELOW WE HAVE MADE A LIST OF ITEMS THAT FORM PART OF THE GRADE 10 MATHEMATICS CURRICULUM. SET OUT ACROSS THE HEADINGS OF THE TABLE THERE ARE FIVE DIFFERENT TEACHING SCENARIOS. THESE SCENARIOS DIFFER IN THE AMOUNT OF INVOLVEMENT THE COMPUTER HAS IN THE TEACHING PROCESS. IN SCENE 1 THE COMPUTER IS NOT VERY INVOLVED IN THE TEACHING PROCESS, WHILE IN SCENE 5 THE COMPUTER IS VERY INVOLVED. IN YOUR OPINION, WHICH SCENARIO WOULD BEST SUIT THE INSTRUCTION OF EACH ITEM OF THE CURRICULUM? ONLY ANSWER ONCE PER LINE, AND INDICATE YOUR ANSWER BY PLACING A TICK "√" IN THE APPROPRIATE BLOCK. PLEASE TAKE SOME TIME TO CAREFULLY READ THROUGH THE SCENARIOS BEFORE ANSWERING ANY ITEMS.

	SCENARIO 1 After a traditionally taught lesson, the teacher uses the computer to demonstrate parts of the lesson while learners watch. The learners do exercises and assessments in the traditional way.	SCENARIO 2 After a traditionally taught lesson, the learners use computers to do exercises, which are supervised by the teacher.	SCENARIO 3 The teacher prepares and teaches a lesson on computer. After the lesson learners use computers to do exercises, which are supervised by the teacher.	SCENARIO 4 The teacher does not prepare a lesson, but rather uses a computer programme that has tutorials and lessons on it. Each learner follows the lesson on her or his own computer, which the teacher facilitates. The Learners do supervised exercises on the computer.	SCENARIO 5 The teacher does not prepare a lesson, but rather uses a computer programme that has tutorials and lessons on it. Each learner follows the lesson on her or his own computer, but the teacher does not facilitate the lesson. The learners follow the computer program independently and facilitate their own learning. Learners search for information in information resources such as CD-Roms or the internet. The Learners supervise their own exercises, which they do on computer.
1 - Products					
2 - Factors					
3 - Algebraic fractions					
4 - Quadrilaterals					
5 - Trigonometry					
6 - Linear equations & inequalities					
7 - The linear function					
8 - Simultaneous equations					
9 - Quadratic functions					
10 - Circle & hyperbola					
11 - Functions E.g. Domain and range.					
12 - Intercept theorems					
13 - Exponents					
14 - Circle geometry					
15 - Trigonometric graphs					
16 - Trigonometry					
17 - Revision for examinations					

F.2 IN GENERAL WHICH OF THE SCENARIOS IN "F.1" DO YOU THINK WOULD **BEST** SUIT INSTRUCTION OF THE GRADE 10 MATHEMATICS CURRICULUM?

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5

F.3 IN GENERAL WHICH OF THE SCENARIOS IN "F.1" DO YOU THINK WOULD **LEAST** SUIT INSTRUCTION OF THE GRADE 10 MATHEMATICS CURRICULUM?

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5

F.4 IN YOUR OPINION, WHICH OF THE SCENARIOS IN "F.1" DO YOU THINK WILL BE THE COMMON TEACHING METHOD IN SCHOOLS IN 5 YEARS TIME?

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	No change from now (6)

Appendix B. Letter to School Principals

6 November 2003

Dear ______________________________

I am currently undertaking a research study to fulfil the requirements for the Masters Degree in Sociology at the University of Port Elizabeth. The research topic I have chosen is:

AN INVESTIGATION INTO THE ATTITUDES OF TEACHERS IN PORT ELIZABETH TO THE IMPLEMENTATION OF COMPUTER ASSISTED LEARNING

A document released by the Departments of Education and Communications titled "Strategy for Information and Communication Technology in Education" in 2001lays out a plan for implementing Information Technology into South African schools. Some of the outcomes planned for this strategy are:

- All schools will have at least one Internet-linked computer for administration and support purposes.
- Schools will have access to Internet-linked computing facilities for learner and educator use.
- At the end of the Foundation Phase, all learners will have used computers in the acquisition and enhancement of their numeracy and language skills.
- Learners and educators will have basic competence in the use of word processing, spreadsheet, flat database, e-mail, and web browser applications.
- Learners and educators will have used a host of user-machine interfaces, including keyboards, touch pads and other devices.
- The Department of Education, in collaboration with the Department of Communications and other role players, will ensure that all schools, teacher centres and district offices are 'wired'.

My study aims to provide valuable and scientific input regarding decision-making and the further development of Educational Policy in this regard. My goal is to supply information that will influence policy in a way that benefits teachers and the school system as a whole.

I am now moving into the second phase of my research, which is the data collection phase. My chosen sample group is Grade 10 Mathematics Teachers, each of whom will be provided with questionnaires to complete. The information collected will not in any way reflect the opinions of the school where the teacher is employed, but rather the individual views of each teacher. Also, the identity of both teacher and school will remain strictly confidential throughout the research.

I thank you for your help and support. I will be more than happy to provide you with a summary of my findings at the end of the study. Please e-mail this request to paulh@frontline.co.za.

Yours sincerely,

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MR PAUL HARVEY
Contact Number: 082 475 4857

APPENDIX C. LETTER OF CONSENT

November 2003

Dear ________________________________

My name is Paul Harvey. I am registered at the University of Port Elizabeth and am currently completing my Masters degree in Sociology. As part of our curriculum, students are required to complete a research thesis on a topic of their choice.

The topic I have chosen is:

AN INVESTIGATION INTO THE ATTITUDES OF TEACHERS IN PORT ELIZABETH TO THE IMPLEMENTATION OF COMPUTER ASSISTED LEARNING

My study aims to provide valuable information for the creation of Educational Policy, as well as to present scientific input into all areas of decision-making regarding the implementation of computers in the educational system. By providing information from you, the teacher involved in the education system, I trust that my goals can be achieved in this regard, and hope that a voice from teachers will influence policy in a way that benefits teachers and the school system as a whole.

I appreciate and value your professional input, and therefore ask you to please be involved in my research study. Your involvement in the study would require that you fill in the attached questionnaire.

Your responses and identity will be kept strictly confidential and will not be discussed or shared with any personnel at your school, or parties involved in the research process and dissemination of results. Please sign below your name at the bottom of the page, and then complete the attached questionnaire. Arrangements will be made to receive the completed questionnaires from you.

If you have any queries pertaining to my study, please feel free to contact my supervisor, Professor Peter Cunningham, at the University of Port Elizabeth on (041) 5042350 during office hours.

Thank you for your time and your support.

Yours sincerely,

____

MR PAUL HARVEY
Contact number: 082 475 4857 / 041 373 7616

…………………………………………………………………………………………..

I agree to be a part of the abovementioned study, and understand that my details and answers will be kept confidential.

Name: ________________________ Date: __________________

Signed: ________________________