# EQUIPPING FOUNDATION-PHASE LEARNERS FOR SUCCESSFUL COMPUTER-ASSISTED INSTRUCTION

by

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# SUMMARY

Computers are excellent tools and assistants in foundation-phase classrooms. Computer-assisted instruction (CAI) influences the way teachers teach, as well as the way learners learn with regard to the curriculum. The responsibility for providing foundation phase-learners with educationally appropriate computer experiences in literacy, numeracy and life skills rests with the educators because the learners' progress in learning depends on the skills, attitudes and ingenuity of the educators, and the software they select for the learners. Educators should have the vision, the knowledge and the experience to introduce and apply CAI to benefit every learner in the didactic situation.

Educators' general lack of knowledge and skills in this area has necessitated the compilation of didactic guidelines. The guidelines emerged from the literature that was consulted for this study. These guidelines should assist educators in providing successful CAI for learners.

Key terms

Computers in education; computer-assisted instruction; CAI and foundation phase; CAI and teaching; CAI and learning; CAI and literacy; CAI and numeracy; CAI and life skills; guidelines for CAI; curriculum and CAI

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# CHAPTER 1:  INTRODUCTION

## 1.1  Motivation for the study

Practical problems experienced by educators and learners with using computers as tools and assistants at some local schools resulted in this research into how to prepare foundation-phase learners for successful computer-assisted instruction (CAI).  Personal teaching experience at four different schools during the previous eight years revealed the following regarding the application of computers in these schools:

- one school had no computers at all
- one school had a computer laboratory, reserved for use by learners of the subject Computer Science
- the third (a private school) had computers available for each learner in the senior phase, and every educator was professionally trained to use CAI with the selected programs that the learners followed, resulting in personal enthusiasm
- the fourth had quite a number of (networked) computers packed together in one classroom for security' sake, but not a single teacher used them for teaching purposes

A comparison of the last two situations in particular caused personal concern which lead to the investigation of the situation and resulted in this research.

Computers are available to a large extent, in many homes and schools and they have become an established part of society.  They are, however, not yet an integrated part of the South African education system.  Educational institutions have to provide for the current didactic needs of their learners, and this includes the use of technology.  McCain (1996:123) states in this regard that the lack of technological leadership will waste money and opportunities in assimilating technology into schools.  Modern educational systems thus have to take the initiative and provide learners with the opportunity to develop technological skills as part of their didactic development.  In Britain and the USA all primary classrooms in schools have, on average,

access to at least one computer and 86% of British primary schools had access to the Internet at that stage (Haugland & Wright 1997:1; Schwartz & Beichner 1999:15). The challenge to make use of CAI in education, in general, is thus clear.

The South African educational system cannot afford to ignore the importance that the education systems in countries in the rest of the world attach to CAI, and should follow suit in order to remain significant in the skills that they offer learners in the technocratic era. However, it does not seem likely that computers will soon be supplied to government schools out of the national budget. According to Mr V. Naidoo, Director of the Centre for Educational Technology and Distance Education of the Department of Education, in a personal conversation on 29 May 2000, a specific policy for equipping schools with computers does not yet exist in the South African context. Private organisations and companies like South African World Links for Development (WorLD), aim to establish computers at each school, and to train educators in using and managing computers. To attain this is a tall order in the light of research undertaken by SchoolNet, which showed that in March 1998 only 1.8 % of South African schools had had some form of Internet connection (*SchoolNet SA Report* 1998:8). However, the gautengonline-project, a combined initiative of the Gauteng Provincial Government and the Provincial Educational Department, intends to provide free e-mail and Internet access for all learners in provincial schools in Gauteng by 2006 (*Sunday Times*, 17 March 2002). This is the first attempt of its kind in Africa, and a praiseworthy effort.

Computers used as assistants and tools in teaching and learning influence the way educators teach as well as the way learners learn. The integration of CAI with the curriculum could improve the exploitation of the school-related qualities of computers by educators and learners alike. Absolute rules for the optimal use of computers in classrooms do not exist, although various recommendations and suggestions are found in the literature on CAI in the foundation phase. This lack of guidelines results in the current situation regarding computers in schools, as Newby, Stepich, Lehman and Russell (2000:61) note:

"Teachers and schools are still struggling to find the best ways to make use of these wonderful tools."

It also seems that the computers that are available in the schools are seldom fully utilised. Guidelines for CAI could provide educators with more details about the practical implementation of computers for use in the classrooms. Such guidelines could also enlighten the technological needs of foundation-phase learners, and put their eagerness for using computers to didactic advantage. The lack of didactic guidelines can be seen as an important inhibiting factor for preventing the optimal use of CAI in foundation-phase classrooms in the present situation. This state of affairs provided additional motivation for this study.

## 1.2  The problem

Computers are not freely available for use as tools and assistants at local schools, educators are not adequately equipped and they thus experience a lack of information to introduce CAI and computer-related skills to the learners, and curricula in the General Education and Training band do not really supply didactically founded guidelines for teachers to deal with CAI either. The following is therefore common in foundation-phase classrooms

- there is a lack of technological equipment
- educators are reluctant to initiate CAI due to a lack of didactic guidelines
- computers in classrooms are rarely used to their full potential
- learners lack basic computer skills
- learners lack basic typing skills.

Educators should initiate didactic activities in the classrooms which link up with the curriculum. Teacher confidence with computers should result in CAI, and should include appropriate guidance for the young learners on the use of computers as tools. The children should then be in a position to use computer hardware and software in the classroom, in order to become better

learners. However, in general, educators suffer from a lack of technological skills, and computers are not yet adequately dispensed and available for use in South African schools. Schwartz and Beichner (1999:10) state in this regard that very few schools had computers at the stage when American curriculum planners and educational leaders began to talk about the importance of using computers in schools. The situation has changed since then. The situation regarding computers in schools in South Africa could conceivably improve in a similar fashion. It is thus essential to compile practical guidelines for educators, in preparation for the possibility that, in future, computers will become more freely available in schools. This will enable educators to better equip foundation-phase learners for successful CAI.

## 1.2.1 Analysis of the problem

The proliferation of computers in the adult world and the fact that education involves the transfer of knowledge, skills and values to learners with a view to adulthood, imply that computers should be used as tools and assistants in teaching and learning. The Department of Education (1997a:21) says in this regard that learners should not access knowledge through books alone, but also through other available means. The computer has become one of these "other available means" and its value as a tool and an assistant in schools should thus be exploited. Educators are therefore urged to introduce learners to the use of modern technology in the classrooms in order for learners to compete in societies where computers are fast becoming commonplace.

In the past computers might have had a marginal effect on activities in classrooms because of problems such as a lack of computer-related skills and facilities. Such problems inhibited didactic experiences with computers. However, more recent developments in information infrastructure and availability stress the urgent challenge for their successful application by educators and learners alike. To give structure to the provision of successful CAI to foundation-phase learners and to ensure the improvement of the didactic situation, it has

become necessary to give educators practical guidelines which will help them apply CAI in this school phase.

It follows from the didactic triangle (see figure 1.1) that learners, educators and the learning matter should be distinct and active partners in the learning situation. It is thus necessary to consider the educators as well as the learners and their abilities, skills, attitudes and needs, in terms of the learning programmes and the curriculum for the foundation-phase, to establish the effect of CAI on teaching and learning (see figure 1.2).

Figure 1.1: The fundamental didactic structure

Learning matter

Educator                                                    Learner
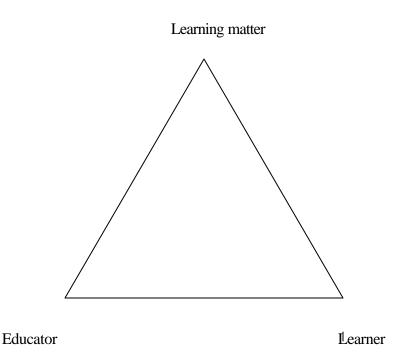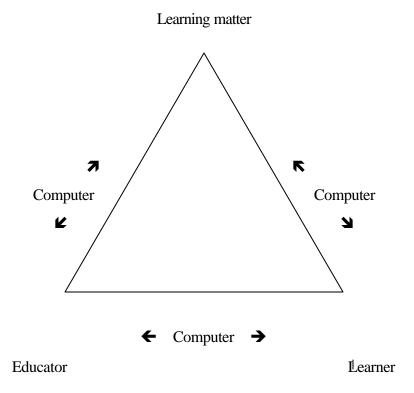
Figure 1.2: The influence of the computer

Learning matter

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                    Learning matter

                         /\
                        /  \
                       /    \
                      /      \
                   ↗ /        \ ↖
                    /          \
          Computer /            \ Computer
                ↙ /              \ ↘
                 /                \
                /_____  \
```

←   Computer   →

Educator                                    Learner

1.2.1.1  The computer and the learning matter

When computers are used in the classroom to present the learning matter, they provide the learners with the opportunity to be actively involved with the content of the learning programmes.  However, as is the case with all teaching and learning aids, it is vital that both the educators and the learners are able to use the computer to support the transfer and handling of the learning matter.  Schwartz and Beichner (1999:9) found that initially computers were used in schools almost solely to enhance traditional education through applications like drill-and-practice, word processors and electronic workbooks.  They go on to say that the wider application of computers to the learning matter, even to the extent of generating higher-order reasoning skills, has the potential to change some imperfect conditions in schools.  It is therefore

necessary to use learning matter in an integrated way to enhance the themes that are being attended to, especially in foundation-phase classes.

Once educators and learners are familiar with the qualities of computers, they can be used as tools in schools to support learning and promote the organisation and tidy presentation of the work of the learners (Newby et al 2000:18). McCain (1996:124) says in the same vein that the versatility of the computer as a production and presentation tool could enhance modern education, for it has the power and attributes to increase the effectiveness and appeal of learning experiences when applied creatively. A computer is just a machine (Schwartz & Beichner 1999:10), but can provide learners with fun while learning and can thus be used in foundation-phase classrooms to cultivate a positive attitude toward learning. Computers can be instrumental in improving the transfer of the learning matter if they are properly used as tools and assistants in schools. Didactic guidelines for the practical implementation of CAI could assist educators in supporting foundation-phase learners and ensuring successful CAI in the classrooms.

1.2.1.2  The computer and the educator

Educators hold the key to CAI. Educators can use computers in the classroom to expand the learning experiences of learners. This entails changes in the teaching styles of the educators. Educators should be open-minded and willing to try out new techniques to introduce the learning matter to the learners, rather than being rigid in their ways. Educators should accept the technological challenges, even though they might feel old methods are secure and comforting to cling to, and that they are not adequately equipped to introduce new technology to the learners (McCain 1996:101).

Purchasing, installing and maintaining technological equipment and training and re-training educators are expensive and laborious. McCain (1996:102) states that investments in computers, networks and facilities are valuable only to the extent that the educators accept the

technology and capitalise on its capabilities. Technology is shrinking the world into a global society, built on a knowledge-based economy, and educators have to educate the population to think creatively, productively and prolifically (Jenkins 1990:113). Learners who receive an increasing proportion of their lessons from educators using presentation software, and who produce electronic presentations of their own, can undergo important changes in the way they think and learn (Schwartz & Beichner 1999:79). Newby et al (2000:6) allege that it might once have been sufficient to learn rote responses in given working environments, but the real world today demands that individuals use high-order reasoning skills to solve complex problems. Educators should thus experiment with computers and improve their own skills in accordance with their new needs. This should enable them to integrate CAI into the curriculum and to combine teaching methods in classrooms to complement the learning matter. The ways in which educators use modern technology are as varied as the educators are themselves (Schwartz & Beichner 1999:1). A positive and daring educator attitude can be regarded as the first step towards successful teaching with CAI in foundation-phase classrooms.

Unfortunately, educators and educational role-players are sometimes reported as being wary of computers as another folly, because other previously boosted "great technological hits" in teaching turned out to be "dodgery", as Koschmann (1996:3) noted:

> "Before computers, a number of other forms of technology - film, radio, and television - had been introduced into the classroom with varying degrees of success."

However, as more is learned about technology and learning and more effective appliances are being developed to support and enhance CAI the greater the likelihood that educators will fully exploit modern technology, like computers, to improve their teaching.

1.2.1.3  The computer and the learner

Foundation-phase learners have to experience success in the classroom to encourage independent and life-long learning.  The Department of Education (1997b:12) states the following about learning in the foundation-phase:

> "A great emphasis is put on creating conditions that lead to success.  All learners will succeed .... not all learners will succeed at the same time.  Instead, learners will be able to develop at their own pace.  Learners will know what they are learning and why. They will be encouraged to take responsibility for their learning."

Parents should be involved in CAI to ensure that they share in the learners' success, as personal computers are becoming an integral part of life and will influence the lives of their children in future.  Computers are available in homes and the community, in places like banks, shops and schools.  Using computers in the classroom influences the self-actualisation of the learners, for they develop the confidence to use these tools in real life situations as well.  If learners use computers as tools and assistants in foundation-phase classrooms, and CAI becomes part of the curriculum, successful and individualised learning could follow.

Learners' skills in using the technology will improve when they start using computers independently.  Casey (1997:68) states that it is natural for young children to sit down in front of technological devices of any kind, including computers, and go ahead and use them as tools without any fear at all.  He continues that it would be a wasted opportunity if schools did not capitalise on the attraction youngsters feel for computers.  Learners enjoy pretending that they are adults.  Using computers at their level can transfer this pretence to the classroom and emphasise the way in which they experience success.  Haugland and Wright (1997:114) write in the same vein:

"As technology becomes easier to use and as early childhood software proliferates, young children's use of technology proliferates. Therefore, early childhood educators have a responsibility to critically examine the impact of technology on children and be prepared to use technology to benefit children."

Learners thus need to practise computer-related skills appropriate to their level, to enable them to cope with the challenges that the new technology poses. The best entry point for using computers to learn as part of technological education is with young children, for their positive experience of the joy of learning could be supported and sustained through the proper application of the technology (Jenkins 1990:113). The foundation-phase is thus seen as the ideal stage to introduce CAI to learners.

Curriculum 2005 intends to open the way for successful learning for all South Africans, according to Bengu (Department of Education1997b:1):

"Essentially, the new curriculum will effect a shift from one which has been content-based to one which is based on outcomes. This aims at equipping all learners with the knowledge, competencies and orientations needed for success after they leave school or have completed their training."

Using computers in classrooms can assist the learners to be better prepared for their lives as future citizens, for their adult lives will include more, and more specialised, use of technological equipment and components.

Computers are used quite extensively as tools and assistants in schools in developed countries. Teaching and learning in local schools could also benefit if CAI were to become a partner in South African schools. Using CAI can generate successful and individualised learning. It therefore becomes the professional duty of educators to include computer literacy, at least, in the curricula, especially in the foundation-phase. The total effect that computers are likely to

have on the development of the way children learn still needs to be fully established, but computers can be used to diversify and personalise learning and allow self-pacing, to suit the learning rate and abilities of the individual learner, according to Schwartz and Beichner (1999:79). They also note that since these tools are so new, researchers have really only begun to imagine how they might affect students' learning and thinking. However, learners enjoy the new challenges that computers are able to generate, and educators should assist individual learners to experience as much success as possible with CAI in the classroom.

The guidelines according to which educators can equip foundation-phase learners for successful CAI, were derived from the chapters on computers (Chapter 2), and educators (Chapter 3) and learners and CAI (Chapter4), and will indicate how teaching and learning in the foundation phase should be approached using computers as tools and assistants.

## 1.2.2 Statement of the problem

In the light of the previous discussion, the problem statement is:

Computers have become increasingly available in society, but they are not yet used extensively as tools and assistants in foundation-phase classrooms. This is mainly due to a lack of information and didactically founded guidelines for educators to apply in order to equip learners for successful CAI.

## 1.3 Aim of the study

This study aims to extract didactic information from the literature and then state this information in the form of guidelines for the effective use of computers as tools and assistants to the benefit of teaching and learning in foundation-phase classrooms.

## 1.4  Defining the terms

The title of the study indicates that it deals with computers as tools and assistants, and the ways in which educators could prepare learners in foundation-phase classrooms for successful CAI. The aim of the study emphasises the need for guidelines in this regard.  To avoid possibly confusing terminology, the terms *foundation-phase learners, computer-assisted instruction, successful education* and *didactic guidelines*, are explained from the point of view of this study.

### 1.4.1  Foundation-phase learners

Learners up to nine or ten years of age and in (the equivalent of) grade 3, are known as foundation-phase learners.  The Department of Education (1997:31) states that:

> "Early Childhood Development (ECD) applies to the process by which children from birth to at least nine years grow and thrive physically, mentally, emotionally, spiritually, morally and socially.  Part of the ECD, the foundation-phase (grades 1-3), forms the first part of the General Educational and Training band of the NQF."

Foundation-phase learners thus include all learners who have just started school, up to and including those who have, or should have, progressed to the third academic year.  These learners form the point of departure for successful CAI, as in agreement with Jenkins (1990:113), who says the population has to be educated to think creatively, productively, and prolifically in the information age through fostering a positive predisposition toward learning. This education should include the technological and begin with the young child in the foundation phase.

## 1.4.2  Computer-assisted Instruction (CAI)

Schwartz and Beichner (1999:79) describe CAI as designed to supplement existing forms of education rather than to replace them.  This view is supported in this study.  Computer-assisted Instruction (CAI) thus implies that the computer is used in the didactic situation to support the educator in teaching as well as the learner in learning.  Computers in the classroom motivate both the educators and the learners to aim at optimal achievement.  The educator controls the learning activities and the computer is one of the instructional media serving the purposes of education.  CAI offers liberation in the classroom because it is a support as well as a tool which educators and learners can use in classroom-related activities.  CAI thus means that computers are used as tools and assistants in classrooms to extend and contribute to what is already being offered by the curriculum and the educator.

According to Koschmann (1996:5), it is important to note that in the early literature the term "CAI" was used as a generic term to include all uses of the computer in education.  This tendency might be confusing to some researchers.  Furthermore, other terms that are not synonymous with CAI are also found in the literature.  The meanings of some of these, like computer-based instruction (CBI), computer-based education (CBE) and computer-managed instruction (CMI) will be discussed in chapter 2.  The explanations should shed some light on the different interpretations of the phenomenon of using computers in the classrooms.

## 1.4.3  Successful learning

Success in learning is motivational for all learners.  Haugland and Wright (1997:1) claim that children learn best through experiences that positively support their development:

" For young children's optimal growth they should be assured of early childhood experiences that maximise their development. Experiences that widen their vision, opening their eyes to the wonders of learning and the joys of discovery…."

The Department of Education (1997b:12) states in this regard that it is important to create conditions that lead to success. All learners will succeed, but not necessarily at the same time. Success is achieved when a learner can prove mastery of a skill. Computers in the classroom make such early school success possible (Casey 1997:1). Educators need to assist individual learners in all their attempts to learn and succeed in the classroom. Learners that experience success in early learning should develop the desire and confidence to proceed to life-long learning.

In this study, successful learning includes the motivational aspects of success, and implies that every learner should experience some positive feelings about the attempted activities in the didactic situation, in order to cultivate a desire in the learner to "try again" or find more information. The ease with which certain didactic activities are completed on computers can assist all individual learners to experience some success while learning through CAI.

## 1.4.4 Didactic guidelines

Guidelines imply rules according to which people need to act in order to reach a destination. Haugland and Wright (1997:4) claim that educators need to know how to select computer experiences and how to guide young children once the software is in the classroom. Guidelines could assist the educators with implementing CAI in the foundation phase.

Educators steer teaching and learning according to the principals found in the curriculum. The South African curriculum does not include many aspects of CAI in the foundation phase. Computers are also not commonly found in these classrooms. However, educators who have access to computers in classrooms need didactic guidelines to assist them in making effective

use of CAI in teaching and learning.  Didactic guidelines refer to educationally sound principles that educators could follow to reach certain goals in literacy, numeracy and life skills as learning programmes in the foundation phase.

## 1.4.5  Programmes/Programs

According to the Department of Education (1997b:13, 32) the term *programme* refers to a learning programme, or a set of learning and teaching activities,  which comprises of units of learning materials combined with a methodology, and ways of assessing learner achievements, based on national guidelines, by which learners can achieve agreed-upon learning outcomes, such as the curriculum for CAI.  On the other hand, the term *program*, refers to computer programs or software.

## 1.5  Demarcation of the field of study

Computers currently have many uses over a wide spectrum in life.  These uses of computers are not relevant to this study, since it is exclusively concerned with the application of computers as tools and assistants in the educational sphere.  This study concentrates specifically on how computers and the relevant software and applications can be effectively applied to enhance teaching and learning in foundation-phase classrooms.  The aim is therefore to formulate practical guidelines from a didactic perspective which could assist educators in the use of CAI in teaching and learning in the foundation phase.

## 1.6  Outline of the study

A substantial literature study of previous research on educators and learners, especially learners in the foundation phase of various developed countries, using computers in primary schools, has been undertaken in accordance with the title and aims of this study.  The motivation for

undertaking this study is explained in this chapter.  The problem is stated and the terms are defined, while an outline of the study is also provided.

Chapter 2 enlarges on the term CAI and other related terms, as well as the didactically applicable features of the computer as a modern technological tool.  The computer and its qualities, especially its applicability in teaching and learning, as well as aspects like software, multimedia and the Internet, are examined.  Special reference is made to the role of CAI in the didactic situation related to the foundation phase.

Educators of the foundation-phase learner play a vital role in implementing CAI in the classroom.  Their skills, abilities and attitudes towards the learners and their learning, as well as towards the computer and the application of CAI, are examined and described in chapter three.  The curriculum and its extension to include CAI as well as didactic aims regarding the use of computers in the foundation phase are also considered.

Chapter 4 deals with learners in the foundation-phase.  Attention is given to their didactic needs and abilities in the educational situation.  The relationship between foundation-phase learners and their educator and the learning areas, literacy, numeracy and life skills, as well as the computer, forms an integral part of this chapter.

Practical guidelines that resulted from the literature consulted and that could assist educators to successfully implement CAI in foundation-phase classrooms are provided in chapter 5.  Attention is also given to the practical implementation of CAI in literacy, numeracy and life skills in the foundation phase.

The summary follows in chapter 6 which also provides the findings and  recommendations based on the literature about the computer, the educator and the learner.  These could assist educators to equip foundation-phase learners for successful CAI.

# CHAPTER 2:  THE COMPUTER AND EDUCATION

## 2.1  Computer-assisted Instruction (CAI)

Computers are powerful modern technological tools.  When the computer becomes a partner in the didactic situation, it influences teaching, learning and the learning matter.  The purpose of this study is to assist educators to adequately equip foundation-phase learners to be successful at Computer-assisted Instruction (CAI).  The term CAI, as well as the capabilities and qualities of computers and software, will be scrutinised to demonstrate the potential of these versatile technological tools for educators and learners in foundation-phase classrooms.

### 2.1.1  Terms related to CAI

The two major lines of thought among researchers regarding the use of computers in classrooms are that the computer can either *replace* or *assist* the educator.  Papert (1980:5) explains the manifestation of this phenomenon as follows:

> "In many schools today, …. (CAI)…. means making the computer teach the child. One might say that the computer is being used to program the child.  In my vision, the child programs the computer and, in doing so, both acquires a sense of mastery over a piece of the most modern and powerful technology and establishes an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building."

The learner using CAI could thus be viewed either as an active partner, in control of learning - the view supported by this study - or as a passive subject and mere receiver of information. The didactic propensity of the authors in this field is revealed in the terminology, among other

things, that they prefer to use when discussing the phenomenon of learners using computers in the classroom.

The various related terms and acronyms found in the literature on the phenomenon of children using computers for learning need to be clarified. For example, the abbreviation, CAI is used both for Computer-assisted Instruction and Computer-aided Instruction. Simonson and Thompson (1990:122) explain that, in general, the term Computer-assisted Instruction (CAI) refers to all educational software, and it usually means a programmed learning approach in which a student follows step-by-step instructions on a computer to achieve specific educational objectives. Papert (1992:41) states in the same vein that the term Computer-aided Instruction (CAI) should be used to indicate the fully assimilated use of computer technology, including the administering the exercises traditionally given by a educator using a blackboard, a textbook or worksheets. CAI thus implies that computers supply learners with information.

Differences between the views of authors become apparent when they explain exactly how the information should be delivered to the learners. Steinberg (1991:2) asserts that "aided" in Computer-aided Instruction refers to interactive, individualised and guided computer-presented instruction. Sewell (1990:52) uses "computer-aided" as well, but differentiates between "instruction" and "learning". He says CAI (Computer-aided Instruction) tends to incorporate approaches which emphasise the role of a computer program in teaching or which direct the learner in a given subject area, while CAL (Computer-aided Learning) reflects a shift of emphasis towards the active role of the student in the learning process. Simonson and Thompson (1990:122) consider the use of Computer-based Learning (CBL) and Computer-based Instruction (CBI) but prefer to use the term "learning" to "instruction". To them "learning" is a general term which naturally encompasses situations in which the computer is used as an educational tool without delivering information or instructing the student. CBL describes all student-learning related to the computer and it is used as an umbrella term for all educational computer uses. Simonson and Thompson stipulate that although the term Computer-based Instruction (CBI) is frequently used, the term *instruction* might be seen as

indicative of the educational uses of the computer only, because the computer delivers information to learners, omitting the use of the machine as a tool.  Bright (1987:176) differentiates between Computer-managed Instruction (CMI) and Computer-assisted Instruction (CAI):

> "The primary difference between CMI and CAI is that in CAI the computer administers instruction to a student, and in CMI the computer determines what the instruction is going to be.  That instruction may be administered through CAI, print materials, film, tutoring, or any of many other formats."

Some authors, like Newby, Stepich, Lehman and Russell (2000:262) accept the term CAI, but state that its meaning could be extended by adding the term "intelligent'" to it, resulting in Intelligent Computer-assisted Instruction (ICAI):

> "In education, the concept of the expert system led to the development of intelligent tutoring systems, sometimes called intelligent computer-assisted instruction (ICAI). They embody the expertise of a tutor within a particular content domain."

Kahn and Yip (1996:175) came to a similar conclusion about the expertise of the computer in the classroom.  They, however, prefer "learning" to "instruction" and see an expert module, containing all the domain knowledge or subject matter that can be run as a simulation of the problem solving processes to reason about given problems, as being at the heart of Intelligent Computer-assisted Learning (ICAL).

## 2.1.2 Conclusion

Different terms are used to name the concepts regarding computer use in the classroom, due to the personal preferences of individuals in this field of study. However, the following general trends in usage are apparent in the literature

- the term *instruction* refers to the educational uses of the computer when it is used to deliver information to students. Instruction includes approaches that emphasise the role of programs, but not the uses of the computer as a tool
- l*earning* is mostly used to denote the opposite of instruction. It refers to the didactical aspect, and stresses the active role of the learner in learning. Learning is more than just delivering materials to learners, or instructing them
- the terms *assisted/based/mediated/managed/aided* are often used at random, although the users normally state fair reasons to give substance to their preferences. *Assisted* or *aided* refers to the mediation of the instruction to learners using different formats. When using the terms *managed, based* or *mediated* the authors usually refer to the computer and its programs as if they determine all aspects of instruction from the planning to the assessment of related activities.

The term "Computer-assisted Instruction (CAI)" will be used in this study. In this context the embracing term implies learning, as it is manifested in schools, assisted or supported by computer technology. It refers to the supplementary role of the computer in the didactic situation, such as providing various types of learning matter through applications and software, and augmenting and improving teaching and learning. The computer is capable of handling instruction, while supporting individualisation and interactivity, but the educator determines the amount and quality of tutoring provided and the learner chooses how, and how much of the application to use. The educator remains the responsible person in the classroom and provides opportunities for learning to occur, through the use of the computer as a partner, a tool and an assistant in the didactic situation. The term *Computer-assisted Instruction (CAI)* explains the

exact role of the computer as a tool and assistant in classrooms, and it will be used in this sense throughout this study.

## 2.2  The computer as a tool in education

Computers are powerful tools that can be networked or used as single units to initiate, facilitate and consolidate teaching and learning in the foundation phase.  Haugland and Wright (1997:1) state in this regard that:

> "Computers may be an influential tool to enhance young children's potential, facilitating the learning process. Children's learning environments should be designed based upon sound developmental theory.  These should reflect the unique nature of children."

Casey (1997:130) describes computers as a new kind of writing machine for authors, a new kind of brush for painters and a new kind of instrument for musicians.  He says education is about how to make things better, in other words to create respect for learning and to make knowledge applicable, both inside and outside schools.  The main pre-condition for using computers as assistants and tools to enhance teaching and learning in classrooms, is that the users should have the necessary skills to make proper use of them in every possible learning situation.  Hills and Hooper (1994:129) say that the converging of computing with communication resulted in the term *information technology* (IT).  IT describes the use of computers and related equipment to produce, manipulate, store, print, receive and transfer information, by using pictures, text, sound, video and other data in electronic form.  They further state that IT creates the space and time for learning and the acquisition of skills by increasing the efficiency of transferring information and knowledge.  It can also enhance the effectiveness of education by enlarging the learning repertoire of the learners since it can use images, real-life and virtual illustrations and sounds.  The computer is a relatively common phenomenon in the world today, and has the qualities to become indispensable as a teaching and learning tool in modern didactic situations.

Both educators and learners should exploit the school-related attributes of computers to help improve education from as early as the foundation phase. Lawler (1997:13, 44) says modern schools are under increasing pressure to replace the teacher-centred instruction of the industrial age with the learner-centred ideas of the communication age, because the information age signifies the challenge of preparing learners for the vast amounts of information they will encounter in the coming years. Computers make valuable tools and assistants in teaching and learning in the hands of modern educators and learners, also in foundation-phase classrooms. But to achieve this, the basic skills, including computer literacy, to exploit the technology, must be in place.

## 2.2.1  Computers

The word "computer" refers to an electronic machine that processes information according to sets of instructions. The performing capabilities and functions of computers are defined, enabled and constrained by the hardware and software that comprise a particular system, and the needs and skills of the operator. A computer is a programmable multi-tool able to connect people throughout the world. Computers can help with various teaching and learning tasks and can offer relief in various fields, because, instead of having separate tools for separate tasks like writing, drawing, filing and calculating, the computer is one tool which can perform all these tasks. In the past educators planned and implemented instruction, using available tools like typewriters, pencil and paper, lesson planning books and calculators to obtain better results in teaching (Newby et al 2000:40, 41). The computer is a relatively new tool with the ability to assist teaching and learning when educators make use of CAI.

## 2.2.2  Networking

Computers can be used as stand-alone units, or they could be networked to assist educators to manage information in the classroom. A network is a communication system linking computers

and devices together, enabling individuals to share hardware, software and information, while each computer can still operate independently. It boils down to a combination of wires, equipment and software that interconnects all the electronic equipment in a school or centre, as well as people and information, even in remote places. Networking is a positive development in software applications in schools, where groups of learners can be taught simultaneously using the same learning matter. Networks allow educators to share resources and access many software programs without having to load or unload disks. Networking saves money and decreases the workloads of educators in the classroom and should be used more often in classroom computing (Casey 1997:115; Haugland & Wright 1997:158; McCain 1996:44, 46). The networking of computers gives educators freedom to diversify. This is especially needed in foundation-phase classrooms where a large volume of group work is normally done, and the individual needs of the learners and the educators still remain a priority.

## 2.2.3 Computers and education

Computers make excellent tools in foundation-phase classrooms. Casey (1997:104) says that the issue is not whether computers can be used effectively in schools, but rather how effectively can they be used by learners and educators. Skinner (1986:16) also realised the value of computers in schools:

> "With the help of teaching machines and instructional programs, .... (t)eachers will have more time to get to know students and to serve as councillors. They will have more to show for their work, .…education will be more efficient, it will probably cost less than it does now."

The issues of individual attention, productivity, efficiency, time and cost are crucial in education, and should thus be addressed when computers are used as one of the resources in the classroom.

A computer is only one of the tools of modern times and technology. Bigum (1986:176) regards a computer as just another tool, like a calculator or pencil or a slide ruler, which learners should use as a tool for writing, storing and manipulating information. Armstrong (1995:72) states the following about the new possibilities that are created through computers as tools in instruction:

"In the past we have treated information as a scarce resource that educators deliver to students. In the world of universal access to telecomputers, information is an abundant resource that learners can access on their own in response to questions raised by educators. Learners in future will become nomads in cyberspace, unfurling their magic carpets of the mind as they sail across the infosphere....."

Learners can now access vast amounts of available information relatively easy using relevant skills to open up new horizons in instruction.

Casey (1997:62) lists characteristics and advantages of computers as instructional tools and assistants in the classroom

- computers are motivating and fun. They make things happen
- computers with good software can be highly interactive as opposed to books, tapes, films, radio or television. The user controls what happens
- computers are non-judgemental and they have infinite patience
- computers with hypermedia can explain concepts in a more interesting, visual or animated manner
- computers can simulate situations which are too complex, dangerous or costly to do in the classroom. Chemical reactions, ecosystems, space travel, and the like can safely be explored
- children can create reports and research for their peers by using hyper-studio and other authoring systems. Real-world learning occurs in problem solving and the creation of these materials.

- Through telecommunication, computers bring the resources of the world into the classroom and allow students in one classroom to communicate with others anywhere in the world.

These characteristics reveal the versatility of computers and this study will focus on them to elicit how CAI can support teaching and learning, especially in the foundation phase.

The unique features of technology demand new ideas in teaching and learning practices for they affect cognition, intelligence, thinking patterns, abilities of problem solving, even learner-involvement and participation in classroom activities. Knight and Knight (1995:148) link learning directly to the tools used in schools:

> "The key components of intelligence are the ability to deal with abstractions, the ability to solve problems, and the ability to learn. Papert advises that educators see the computer as one sees any other educational object. Computers are the tools that technology has provided for use in classrooms. In not keeping up with the computer technology, education is failing to keep pace with the changes taking place in society as a whole."

Jenkins (1990:115, 116) is also positive about the effect of computers on learning, and says more information on thinking patterns and learning as a skill might become known in the future through new frameworks within which to explore the various domains of thinking. Young children learn by using their senses. The computer is ideal for this type of learning. Multimedia technology stimulates the active involvement of young children and involvement enhances learning. Other authors also commented on this aspect. Peck and Hughes (1997:114) recorded the observation of an educator after using CAI for some time in a grade one class. She reported the following about her learners:

> "I'm really amazed at the growth I see - and the thinking patterns. They're just beginning to sort things out differently. They're able to look at things from different angles, and it has to be the computer."

Bonk and King (1998:380) claim that integrating CAI into the didactic situation could empower educators to transcend their notions of school and what it means to be a student and an educator, rather than just adding a new innovation to existing systems. How well computers are implemented as tools of instruction and learning in foundation-phase classrooms, will eventually determine the real value they have for users. Computers fascinate people, and learners are often wholly attracted to these technological appliances. Papert (1992:1) ascribes the enchantment of children with computers to the versatility of the machines:

> "Across the world children have entered a passionate and enduring love affair with the computer. The greatest amount of time is devoted to playing games.... They use computers to write, to draw, to communicate, to obtain information. Some use them as a means to establish social ties while others use them to isolate themselves. In many cases their zeal has such force that it brings the word *addiction* to the minds of concerned parents."

Familiarity with using computers as instructional tools should be cultivated in the early years, to enable learners to gain self-confidence as operators as well as independence in their learning (Moursund 1997:1l). CAI provides a variety of opportunities through which learners can make use of available information, but educators need to combine tool and skill in accordance with the curriculum to ensure successful CAI. This means that computers can assist educators to prepare learners for the unique challenges of the future which go beyond school situations. The skills and attitudes of educators and learners will determine to what extent this is achieved.

## 2.2.4  Computer literacy

Computer literacy refers to the skills that a user needs to use a computer and which he or she accumulates over time. Ambron (1990:262) says learners should be fairly well acquainted with the different qualities of computers to ensure their optimal utilisation in schools, in order to meet their learning objectives. They go on to say that learners should acquire the ability to use computers as tools, similar to typewriters or calculators, to process or manipulate data on disk or on a keyboard, and to present information neatly and unambiguously. Computer literacy should not be confused with computer programming. Programming is a separate, specialised skill and should not be taught to all the learners. It currently assumes its correct place in schools, as part of Computer Science, which is an additional and voluntary subject (Rodda et al 1991:2, 24). Computer literacy material should introduce learners to the computer and how it works, along with ways to use it as a tool for learning.

Towards the end of the 1980s, most instructional computing experts in the USA had abandoned the archaic idea of computer literacy as a separate field of study that necessitates a unique course at primary school level. It was agreed that computer literacy should rather be integrated into the curriculum, to develop naturally, like numeracy or life skills. Computer literacy should be applicable to the entire realm of learning within the context of regular classes, where educators have to ensure that learners acquire the skills to use the computer, to manage the content that they need to master (Newby et al 2000:252). Better computer literacy improves learners' skills on the computer, resulting in more effective CAI, also in foundation-phase classrooms.

Rumsey (1988:30) lists computer literacy aims as that they should

- acquaint learners with the nature of computer systems and associated terminology
- familiarise students with the range of computer equipment and enable them to use specified terms with confidence (objectives include using a keyboard, performing simple tasks, loading pre-written programmes and using these to save information)

- develop practical appreciation of the nature of computer programs and the way they operate

- acquaint students with a range of uses of computer technology in industry, commerce and other fields

- familiarise students with current trends in information technology and the social implications of its widespread use

- increase learners' ability to benefit from education and training based on or allied to computer-assisted learning.

Computer literate learners should thus have an understanding of computers and their uses, both in the classroom and elsewhere, and should be able to independently turn a computer on, type, edit, save, print, use disks and relevant components, and shut it down.

## 2.3   Software and computers in schools

*Software* is the term used to describe the programs or sets of instructions that activate the computer and its devices to perform.  The software unlocks and directs the capabilities of the hardware or physical components of a computer system.   According to Newby et al (2000:272):

> "The software is what makes the hardware work.  Software, within the limitations set by the capabilities of the hardware, determines what the computer can do. Applications software includes programs designed to perform specific functions for the user, from processing text to doing calculations.  It includes the common computer tools as well as all educational software.  It is through the applications software that most of the real work gets done."

Software has to be selected with care to ensure that it is relevant, appropriate and exactly what is needed at that moment. Both educator and learner can use the different computer applications and relevant software for various tasks. This supports the role of the computer as an educational tool and assistant and enhances the didactic situation when carefully selected and appropriately used.

Software packages include tool software that is used when educators aim to achieve learning goals related to the development of cognitive skills. CAI includes making use of drill-and-practice, simulations, tutorials, instructional games and problem solving when using the computer as an educator; or word processing, databases, graphics (photographs, clip art, charts, graphs), spreadsheets, presentation software and desktop publishing when it acts as an assistant or productivity tool (Newby et al 2000:187). This study will show how applications, such as word processing, databases, spreadsheets, games and multimedia can offer foundation-phase learners a wide variety of activities and skills when using CAI in the classroom.

## 2.3.1   Word processing

Word processors are writing-tools. They are conceded to be the most widely used of all computer tools for personal productivity, for they are able to eliminate many difficulties associated with editing, and can produce mechanically correct printed versions of written work. They allow users to enter, edit, revise, format, store, retrieve and print text, while most of them make it possible to include graphic and tabular materials with the text. Word processed text can be stored on disks to be retrieved, revised and reused at later stages (Newby et al 2000:44). Word processors support the learning of writing skills in schools and should thus form an integral part of CAI in classrooms.

Once one has even a very limited familiarity with the keyboard layout, which young children acquire rapidly, the production of text becomes simple and fast, freeing learners to concentrate on the content rather than on the form or letter formation of their products (Sewell 1990:173). Bradsher (1990:325) says word processing programs can compactly store written work and

enable even young children to produce "writing" that looks neat and inviting to the reader. The writers can concentrate on composing, knowing that they may easily revise and edit their work later, resulting on average in both longer documents and better-quality writing. Word processing does not guarantee instant success, and lessons can suffer from the same poor teaching methods as the more traditional paper and pencil, textbook, writing, reading curriculum (Casey 1997:77, 88). Word processors can help foster the writing process by making the creating and editing of materials easy, ensuring that the final product looks professional.

## 2.3.2 Databases

Newby et al (2000:53) compare a database to a collection of information, similar to a recipe file or a telephone directory, although they describe them as more flexible to access and easier to manipulate. Databases can provide large volumes of information, like an entire encyclopaedia on CD-Rom, or they could be small and basic, compiled by educators, to suit the specific needs of learners in certain situations. Database software provides educators and learners with the capability of creating, editing and manipulating vast or minute collections of information and searching for it will assist learners to develop problem solving and higher-order thinking skills (Schwartz & Beichner 1999:91, 93). Modern database software is designed to allow the user to easily record, organise, store, access, retrieve and analyse all kinds of data, enabling them to search for specific data and quickly sort records (Newby et al 2000:175). Computer databases can provide learners with the opportunity to interact with material within the constraints of their individual differences. Databases can also provide opportunities for growth and development of learner-cognition through the techniques of information retrieval and synthesis. Educators have a facilitating role during the process of information handling (Chambers 1999:161). Well-planned and properly structured databases allow foundation-phase learners access to the specific information that they need.

## 2.3.3 Spreadsheets

Newby et al (2000:55) state that electronic spreadsheets are general-purpose calculating tools in which rows and columns of numbers can be totalled. They derive from the paper sheets once used by accountants. Spreadsheets support disk storage and retrieval as well as printing, and can be used by both educators and learners for setting up and maintaining financial records and budgets. Spreadsheet programs like Excel, allow learners to concentrate on real-world mathematical problems without becoming bogged down in the calculations. Learners can creatively display data through charting, but they need to understand that such results are only as good as the data and formulas entered into them (Newby et al 2000:177). Using spreadsheets enables learners to handle numerical relationships at an early age, to achieve thinking processes that will be useful in problem solving activities and to promote higher order thinking skills (Griffin & Bash 1995:9). Spreadsheets could thus be helpful in assisting learners in numeracy-related skills when wanting to organise numeric data, even in foundation-phase classrooms.

## 2.3.4 Games and simulation software

Computers are not merely for manipulating numbers on spreadsheets, or letters in a word processor; they can also be used to access, manipulate and display information in many forms by means of games and simulations to the benefit of learners in foundation-phase classrooms. Young children learn primarily through play. Wasserman (1985:332) claims that making learning "fun" gained new impetus with the development of educational software. She goes on to say that game playing is one of the most effective methods for introducing computers to new users and thousands of applicable games exist. Foundation-phase learners do not need any prodding to put their fingers on the keys of the console. They enjoy computers for the games they offer, rather than for the stimulating and self-enriching teaching aids that they are. Learners are enchanted by the attractive, compelling, imaginative programs, in which they experience control over the machine as well as full power over their learning. Games and simulations add to the attraction of the computer because they are fun to use. Skills like reading, problem

solving and keyboard competence have been found to improve when this initial interest starts to expand (Simonson & Thompson 1990:10).

2.3.4.1  Games

Computer games yield various features that could be exploited through developmentally appropriate software.  Educators can use well-matched games in teaching, and expect learning as a result (Bright 1987:54; Liang & Johnson 1999:57).  Griffin and Bash (1995:81) support this opinion by saying:

> "For many children, the computer is seen as a games machine, and their interest is in beating their hi-score on the latest game.  As parents we should be encouraging our children to use computers for a variety of activities which promote learning.  As teachers, we should be embracing this technology, recognizing its weaknesses and strengths and exploiting its potential. In the busy homes and classrooms of today this is not always easy.  But, if we don't accept this challenge, who will?"

Learning by playing games is one of the reasons children are so attracted to computers.  Lawler (1997:17) says the following about learning and the types of games that motivate learners to learn:

> "We need to ask what learning consists of in kids and in grownups.  What kinds of games can we play which will make it attractive ....to learn something?"

Various authors identify different attributes of computers and software that could foster use in teaching and learning in the foundation phase.  Sewell (1990:15) calls them mystery and magical properties while Liang and Johnson (1999:57) mention imagination, creativity, challenge and curiosity.  Following rules to attain goals, competing against oneself, others, or against an objective standard, are seen as motivating, especially for tedious and repetitive content, also, variety, including fantasy, competition, cooperation, challenge, recognition, rules of play, an end goal and reward are regarded as advantageous (Newby et al 2000:94, 169).  Wegerif and

Scrimshaw (1997:65) say games require children to read text on the screen and decide on the action before moving on to the appropriate page; Griffin and Bash (1995:106) add that games provide delight, mental challenge, participation, and a problem solving environment where players can observe, question, hypothesise and test. Liang and Johnson (1999:57) state that playful software might include the kinds of play that is typically exhibited by young children, including investigative play, functional play, games-with-rules, pretending or dramatic play, and constructive play. Educators should use computers to encourage and help children to play and learn through developmentally appropriate activities and materials. Sewell (1990:88) states in this regard that:

> "It is apparent that computers and electronic games have strong motivational appeal to many. .... (The) power (of computers) derives from what can be achieved by using them - in other words, by the nature of the activities they promote."

Although some games are imperfect and unsuitable for use in foundation-phase classrooms, games as such could nonetheless influence and even change the atmosphere and expectations surrounding children's computing experiences.

## 2.3.4.2 Simulations

The use of simulations gives learners the freedom to make near-realistic choices on an appropriate scale, without the threat of finality which would accompany such decisions in real life. Simulations are really advanced games that include programs in which some features of real-world situations are abstracted to form a model of that same situation. Simulations allow learners to make decisions, enter them into the computer and receive feedback on the outcomes, giving the users the power and ability to manipulate various aspects of an incomplete model that contains the essential elements of that which is simulated, to realistically simplify reality (Knight & Knight 1995:144; Schwartz & Beichner 1999:19). Software which allows users to think and solve problems is thus regarded as simulations.

The ability to simulate complex situations such as chemical reactions, eco-systems and demographic or economic changes is a powerful reason for using computers in education. Training pilots, doctors, chemical engineers, or training in any profession or activity where a mistake in the real world could be very costly, is best served by learning on a computer which simulates the real-life situations. Simulating real events often makes it possible to train learners to think laterally across traditional subject boundaries (Stonier & Conlin 1985:23). The use of simulations in CAI can allow realistic practice in classrooms without the risk involved in real-life situations. Abstract ideas can be made visible to the human eye, thus allowing the exploration of otherwise inaccessible situations by teaching hidden processes such as word formation, plant growth, colour blending, graphing, play development, architecture, the immune system, gravity, motion, and other cause-and-effect relationships not easily observed with traditional aids. They also assist the logical thinking processes of learners through activities that force them to plan ahead in order to experience success (Haugland & Wright 1997:53; Sewell 1990:38). Simulations facilitate the manipulation of material and equipment, encourage discovering and promote social interaction, allowing the development of cognitive, affective and interpersonal skills. Simulations can provide stimuli for group discussions geared towards formulating goals, determining strategies and learning to trust others. Simulations include elements of chance which make them quite realistic and allow students to interact differently with them on different occasions (Newby et al 2000:95). However, Bright (1987:61) argues that they might be too complicated for foundation-phase learners:

> "Given the students' level of sophistication at dealing with content in the primary grades, there will be relatively few opportunities to use simulations. Most simulations require, at a minimum, fairly good reading skills as a critical part of the interaction, and young children may not have sufficient skills to engage in this kind of interaction. Too, the cognitive level of primary-grade children may be too low to allow them to interpret relationships among variables accurately. A few simulations, however, especially in the area of simple 'economics' might be appropriate - for example, running a store or a

small business. After all, 'playing store' has always been a popular activity in these grades."

Simulations offer realistic possibilities for using computers in the didactic situation. Some simulations might be advanced, but educators could use several qualities of this type of software at different levels as part of CAI, to enhance the thinking processes and motivation of learners in foundation-phase classrooms.

## 2.3.5  Selecting appropriate software for use in schools

Software programs have to be selected with care to ensure that they are totally applicable to the didactic situation at that moment. To learn implies that a learner is critically involved with the learning content. Learners engage in positive play with computers when given developmentally appropriate activities and materials and when a match is achieved between challenges from the micro-world and the abilities and interests of the players. Learners thus become active partners in their developing maturity, "playing at computers", while positive outcomes like creativity and critical thinking could be established as well (Liang & Johnson 1999:56; Haugland & Wright 1997:89). Appropriate software challenges learners to compete with themselves and improve their skills, working at their own pace and spending time on individual learning needs at CAI.

Incorporating the variables that can enhance the appeal of the computer into educational software can result in significant learning gains. A computer drill-and-practice program is just more motivating than similar paper-and-pencil exercises (Newby et al 2000:166). The computer industry tends to integrate entertainment and non-entertainment systems because there is both a school and a home market for educational software. The term *edutainment* was consequently developed to describe software that has a combined educational and entertainment focus. Current edutainment software is not only fun to use, but also provides a variety of learning experiences (Griffin & Bash 1995:82; Haugland & Wright 1997:156).

School and home can thus truly support one another when educators and parents cooperate to share the educational responsibilities relating to the learners.

Open-ended and developmentally appropriate software that seeks to emphasise learner control, problem solving, creativity and information management, can enhance curricula. Such software allows new fields to be explored, as well as retrieving and sorting of information. This will help children to carry out research and will emphasise the joy of learning, inspiring learners to focus on learning objectives, rather than to concentrate on extrinsic motivators (Haugland & Wright 1997:47, 156; Sewell 1990:30; Simonson & Thompson 1990:389). Haugland and Wright (1997:13) are explicit in this regard:

> "Children's high motivation is not just the response to a new, novel media. It continues even when children are having difficulty getting the program to do what they want. Four characteristics of microworlds and simulations which maximize their potential to intrinsically motivate children to learn are: challenge, curiosity, control and fantasy."

The software determines what learners can achieve in CAI, and should thus be selected carefully and responsibly, particularly when it will be used by foundation-phase learners. These young learners need to experience the freedom to choose and control activities, and save and print their efforts to benefit more from learning with computers.

2.3.5.1    Control

Learners need to experience control of the technology and software they are using in order to progress and build their confidence with CAI. Haugland and Wright (1997:35) state in this regard that:

> "Children have to control the program, making decisions and solving problems through trial and error, to make the software do what they want."

They go on to say that learners should be able to decide on the direction and flow of the activities when software has child control. Software should install easily and run quickly throughout motions, avoiding long pauses, for learners can become confused when software runs too slowly. Learners become active participants in CAI when they can change objects and situations, enabling them to examine variants, initiate new activities, decide on the sequence of events and set the speed for exploring programs, according to their own pace. Child control thus ensures that learners explore the world through discovery by using the available software.

2.3.5.2    Save and print

The ability of computers to save and print documents saves time and ensures continuity in teaching and learning, especially in the foundation phase. These features give learners the opportunity to obtain a hard copy of the work done, which they could easily use to compare their efforts, reflect on their activities and make changes to enhance their learning. They may be interrupted during their computer experiences, for it may be time for lunch or to go home. Printing and saving ensure that they know they can stop and re-visit the software where they left it, if desired. These functions are important for educators and parents, for they provide accurate records of individual computer experiences that could be used for assessment (Haugland & Wright 1997:50). Continuity is of major importance in learning, especially in the foundation phase. While educators might forget the exact progress of a learner in a specific area, the computer can be used to keep track of all the learner activities and the progress of each individual. Saving and printing their work ensures that learners might return to the exact spot where they previously stopped working.

2.3.5.3    Choice

Educators should provide a variety of programs to allow the learner an appropriate choice in learning activities. Educational software, like all applicable learning matter, needs to progress from easy to complex, to teach the new skills and knowledge when the learners are ready to learn them. Learners start stretching programs and their applicability to meet their needs when they develop self-confidence, resulting in creativity and original thinking. This is a meaningful and exciting stage in learner-progress, because the learners can start to combine features of programs, work with friends on complex projects or elaborate on school projects, using selected multiple resources. However, when learners become self-confident, parents or educators normally decide to move on to a new program without giving them a choice, often forfeiting such valuable experiences (Haugland & Wright 1997:50). Games and play provide choice in abundance, and can support individual learning experiences when making use of CAI in foundation-phase classes.

## 2.3.6 Multimedia

Newby et al (2000:101) describe multimedia as communication through the integration of various media into a single delivery system under computer control. It may weave together text, graphics (slides or other visuals from the Internet or books), animation, video and audio from videodiscs or CD's, as well as virtual reality. They continue that a multimedia system looks like a computer system, but with additional pieces of equipment connected to it via cables. Interactive multimedia exchange both inputs and outputs with users, involving them, and allowing them to choose what they want to see, read and/or hear next, while passive multimedia implies that the user presses the "start" button and watches a prepared presentation unfurl, like watching a television program. Interactive images enable the quick changing of perspectives and discovering of new relationships, connections and patterns (Paine 1994:99).

Multimedia gives a new dimension to information and its distribution, for it provides an excellent avenue for the motivation, exploration and instruction of all learners in a multi-sensory, diverse sphere (Ward 1994:26). Multimedia is useful when wanting to connect to people and resources

throughout the world, including libraries, databanks, museums and resource forums. It disseminates information effectively and quickly, which is significant in schools where that which is important today, might be irrelevant next week (Grabe & Grabe 1996:212).

Creativity benefits from the freedom that multimedia applications offer, for educators and learners can create their own multimedia software in accordance with their needs. Semper (1990:55) states in this regard that:

> "The right piece of an image at the right time can have a profound impact. People should be encouraged to create their own material. In such a case, much of the educational potential and aesthetic quality would be found in the *freedom* of the actual creation process."

Jenkins (1990:121) adds that multimedia can become a technology-based medium for thinking, learning and communication:

> "Multimedia can create both the context and content for learning. Children create transformations through play, imagination, observation, and movement. Multimedia technology offers limitless opportunities for young children...."

Multimedia translates as "many formats", by which definition, a child's story illustrated with drawings, a series of slides with musical accompaniment compiled by an educator, or software that allows the creation of projects using multiple formats, are regarded as multimedia (Ward 1994:27). Also, electronic encyclopaedias contain components of multimedia that bring information to life through sounds, narration, pictures and animations that can be printed or transferred to diskettes. Multimedia can be used in foundation-phase classrooms for activities like storytelling, creating animation, managing databases, doing presentations, sorting and gathering information and developing art projects. This implies that both professional,

commercially prepared multimedia packages and a simple story-strip, created by a 5-year old, cite as multimedia and can be used effectively in foundation-phase classrooms to enhance teaching and learning (Griffin & Bash 1995:65; Haugland & Wright 1997:15,158). Multimedia, including hypermedia and the Internet, simplifies teaching, for learners could be working independently or in groups, while the educator is busy at other activities.

2.3.6.1     Hypermedia

Ward (1994:5) describes hypermedia as the use of text, graphics, video or sound hyperlinks. Hypermedia systems can help to solve the problem of the tremendous storage capacity of optical media, when one wants to follow some logical path through material, without calling all items into view, one by one. Hypermedia allows multimedia to be used in non-linear fashion, where units of information, such as individual words, segments of text and audio, video clips, pictures and animations are interconnected in multiple ways. Individuals working in a hypermedia environment control the flow in which individual items are experienced, by choosing and directing the software and hardware to present the next unit of information (Grabe & Grabe 1996:213, 286;).

The World Wide Web (WWW) consists of a worldwide collection of electronic documents that have built-in hyperlinks to other documents. The WWW has thus made hypermedia the norm and common denominator of the computing world. Consequently, many schools teach learners how to use and create multimedia, and thus preparing them for future study and work (Newby et al 2000:183). Hypermedia tasks allow students to anchor what they have learnt in more realistic experiences, for it offers more variety than traditional materials in schools. Individuals can follow the lead of other authors by using hypermedia applications, known as "stacks" and "stack-ware", or they can author their own pathways through material. Designing material involves a complex set of processes through which the authors become involved in the construction of personal knowledge. Authors can now structure a product for a purpose, to enable learning to focus on the accumulation of information, instead of the application thereof

(Grabe & Grabe 1996:242, 371).  The variety offered by hypermedia assists learners in thinking about their efforts, evaluating their own work and deciding on the best product.  It can thus promote the learning activities of all students.

Hypermedia offers many possibilities in teaching and learning, especially in foundation-phase classrooms.  When the computer takes the role of the learner, the student has to "teach" it through a programming language or hypermedia authoring tool like **HyperStudio,** which requires organisation and problem solving skills from the students (Newby et al 2000:187).  Hypermedia information consisting entirely of text is called **hypertext.**  It simplifies connecting to other files by clicking on a word on the screen.  Hypertext will improve learning because it focuses on relationships between ideas rather than on isolated facts (Sewell 1990:218).  According to Semper (1990:53) **HyperCard** can control and present sounds, images, text and graphics in a dynamic or static manner.  HyperCard teaches children to program, make tools for their own use, and have fun.  Interactive hypermedia can be seen as the most complex of the multimedia formats.  New hypermedia authoring tools and environments are often especially designed for elementary school learners, changing the role of educators from dispenser to facilitator (Grabe & Grabe 1996:217, 362).  Hypermedia might be somewhat advanced for foundation-phase learners, but progressive educators can use this medium to offer their learners useful learning experiences.

2.3.6.2     The Internet

The Internet comprises a network of computers, linked by the telecommunications network and it is one of the latest applications to revolutionise communication.  It supports communication forms such as electronic mail (e-mail), discussion groups, databases, library catalogues, file transfer, telephone- and video-conferencing, gopher and WWW sites and community computing networks, thus interconnecting people and providing resources the world over (Newby et al 2000:57, 261).  The Internet provides masses of information on various topics that could be beneficial to educators and learners in foundation-phase classrooms as well.

According to Liang and Johnson (1999:58) online services provide access to up-to-date information, text, graphics and multimedia, on virtually every imaginable subject, on a scale that was not possible before, thus breaking down the barrier of classroom walls and bringing new opportunities and challenges to both educators and learners, to keep up with changes in society. The roles of educators are redefined - they are urged to become organisers of interactive learning experiences by setting up more independent learning opportunities. The learners have to be able to conduct real research and experiments, test hypotheses, contribute to databases, access the world's resources of information on limitless topics, converse with experts and share knowledge with students, worldwide (Armstrong 1995:12). This freedom demands greater responsibility from both educators and learners.

The Internet is a phenomenon that has become a part of the lives of learners through the common availability of computers in modern societies. It has become a powerful learning tool, but like all learning tools, it has to be used properly both inside and out of the classroom. The Internet is an application intended for public use with all types of information available to every user. Learners need to use it under supervision and with clear objectives in mind to ensure success when learning (Newby et al 2000:208). Schools have the responsibility to effectively assist learners in properly managing modern technology and its various applications. Careless and unstructured "surfing" on the Internet could instantly turn opportunity into chaos!

## 2.4 School-related attributes of computers

Computers have various features that relate perfectly to didactic situations. They can, for instance, help to simplify classroom activities when used as an assistant, a tutor and a demonstrator in the classroom. Computers can help the educator to manage the classroom situation and demonstrate learning matter to create an inclusive learning environment where every learner can feel capable and worthy (Bonk & King 1998:371). Learners experience joy and independence when they use the computer as a tool to create and learn content and solve problems. This versatility, to enable educators as well as learners, coupled with its interactivity and the power to store, access and manipulate vast amounts of information in virtually no time, might explain why so much attention is currently given to computers in education (Newby et al 2000:18). Using computers in schools can help turn teaching and learning into enjoyable experiences for all concerned.

Learners enjoy using computers, and educators should take advantage of this by making the most of computers in the didactic situation. Griffin and Bash (1995:69) say in this regard:

> "The young have no fear of technology, they have been brought up in a technological environment. Yet it is us adults (who fear technology) who have the exciting and often frightening task of using this advanced technology within our teaching."

Using computers with suitable software in the classrooms empower learners to initiate questions, debate and reflect, and help educators to guide, model, question and scaffold learning activities. However, it is necessary for the educators to plan the didactic situation carefully and to have proper control to realise successful CAI in classrooms.

## 2.4.1  The computer and teaching

Schools bring education to societies.  They must keep up with changes in the societies with regards to what and how they teach.  Computers should be used as tools in modern classrooms to assist educators to teach more effectively, for schools today cannot have a future without technology (Casey 1997:121).  Educators should attempt to reach every individual learner through instruction, tutoring, assessing, advising and motivation.  This is hard to accomplish, for the educator's efficiency in transmitting information is, for example, poor compared to demonstrations delivered by computers (Hills & Hooper 1994:137).  However, modern technological tools, like computers in the classroom could support educators in this regard.  The effective use of CAI offers educators assistance and relief in foundation-phase classrooms, especially when they are used as tutors and for demonstrations.

### 2.4.1.1   The computer as tutor

Teaching implies tutoring.  A tutor presents content, poses questions or problems, requests responses, analyses, supplies appropriate feedback and provides practice until learners demonstrate a pre-determined level of competency.  Computers become tutors when they are used to present information dynamically, highlight text to capture attention or depict processes through animated graphics.  A computer can quickly deliver a complex menu of responses to various learner inputs.  It can assess learning when remedial work or advancement is built into programs to meet the needs of individual learners, and tutorials can automatically maintain records to inform the educator of learner progress.  Tutors teach basic skills, like reading and arithmetic, although they may be used to teach higher-level skills as well - a tall order for one educator often teaching large and heterogenic classes (Newby et al 2000:96, 97).

Younger learners are still very dependent on the physical nearness of a human teacher acting as a substitute parent, but they enjoy the challenge, variety and fun that the technological tutor can offer them in the didactic situation.  Critics state that computer-based education is not uniformly

successful for all uses or at all levels. They maintain that human tutors teach when they listen to a learner describing a problem. Human teachers can provide supportive comments, gestures, like a smile, a nod or ask informative questions. They are also aware of the social network in which learning takes place - the influence of parents, peers and educators, as well as the role of the individual's own expectations and self-perceptions in the course of learning, while computers are not (Sewell 1990:206; Simonson & Thompson 1990:40). However, when computers act as tutors, they can relieve educators from some time-consuming responsibilities, including demonstrations, to attend to these other more humane aspects of teaching.

## 2.4.1.2   The computer as demonstrator

Children in modern societies have become dependent on a visual learning environment. Educators could make effective use of computers as demonstrators when they include audio and video to transmit learning matter and show learners how to do a task by providing an organised perspective of lesson content. Learners can view lifelike examples of a skill or procedure from a computer demonstration. Ordinary verbal explanations are made more concrete through the illustration of ideas, principles and concepts. A demonstration done on computer can present instruction that includes variety through the changing, adapting and combining of media and methods to result in better learner-attention. The computer can help to evaluate learner responses, provide feedback and determine appropriate follow-up activities, thus requiring interaction from learners. Learners can participate actively in demonstrations as well, by counter-demonstrating what was learnt, and at their own pace – this effectively assists individualisation (Newby et al 2000:97; Schwartz & Beichner 1999:78, 79). The educator is essential in the classroom, but computers can be used as tools and assistants to maintain learner-interest and to enhance individual learning through well-planned activities.

## 2.4.2  The computer and learning

Modern educators have to find ways to make learning fun and less stressful in order to build a world of thinking citizens (Schank & Cleary 1995:1).  Guided computer usage in the classroom offers a solution, for it benefits teaching and learning and ensures that fun remains a part of the learning process, but not unconditionally so.  Gillings and Griffiths (1989:21) advise educators to select programs with care:

> "This is the key pointer towards using computers in primary schools - the programs used should be simple to use, relevant and useful."

Learning implies acquiring certain skills and computers can provide young children with a meaningful, concrete learning environment where this could be accomplished.  Positive attitudes combined with suitable software can result in effective CAI and better learning in every classroom.  Phillips (1988:249) adds that:

> "The computer can provide rich environments for problem solving, and investigation, it is a powerful visual aid, and it can remove many of the less important cognitive loads from the teacher and learners.  However, its depth of understanding is limited; it is poor at many activities which teachers can do better, such as managing a discussion, encouraging strategic thinking, regulating the pace and offering appropriate levels of guidance.  We believe that teachers should teach with computers; neither the computer, nor the teacher, is as effective working alone."

In the same vein, Liang and Johnson (1999:61) warn that computer proficiency does not always imply cognitive development.  The educator has a vital role to fulfil, to ensure that effective learning results from learning activities when the computer is used as tool and assistant, especially in foundation-phase classrooms.

Educators can promote effective learning by using computers in tandem with developmentally appropriate computer software - also for foundation-phase learners. Computers can assist learners at all levels and in most learning areas, especially through the infinite patience and fun they offer. Computers support interactivity and can assist children to develop their critical and logical thinking, as well as problem solving and classification skills. Computers can also help to teach individual learners what they are ready to learn, at their own pace, through drill-and-practice, discovery, cooperative learning, discussion and reflection (Haugland & Wright 1997:42). Guided computer usage from as early as the foundation phase, could thus result in more effective teaching and learning at all levels and for all learners.

2.4.2.1   Problem solving

Problem solving is a natural way of learning that develops from an early age. It allows learners to use previously mastered content and skills to resolve current problems. Expert problem solvers relate new information to prior knowledge. They are primed for using their knowledge to carefully solve problems. Novices have less coherent knowledge to work with, for they have not found relationships between concepts and do not see the patterns and principles defining the domain. Novices tend to spend more time on attempting solutions that are not well thought out (Dahlberg 1990:13; Lawler 1997:190). Information technology in schools empowers learners to address real-world problems and produce useful results.

Computers can assist learners in problem solving activities in a variety of ways. Taylor and McDougall (1986:4) regard computers as dumb, patient, and rigid, making good tutees to be taught by learners, and causing the latter to gain insight in their own learning. Learners enjoy taking on the role of an educator. When the computer functions as learner, the roles of computer and student are reversed and the objective is for the student to "teach" the computer to perform some task. The learner must understand a problem or content and has to be able to communicate this to the computer in a way that the computer will "understand". Learners thus

have to learn the content they want to teach, as well as how to present that content. This requires logical thinking, organisation and problem solving skills. Students can clearly see the implications of their individual decisions. As a result, many experts believe this to be one of the most valuable ways to use a computer in education (Newby et al 2000:179). Independent problem solving activities that invite learners to be observant and inquisitive, and compare and evaluate aspects of the truths that they discovered, result in autonomous, purposeful and successful learning.

Bringing the learners' natural learning abilities into the school environment can increase literacy and learning. Linking abilities to learning content can make learning functional, and create a school environment that encourages lifelong learning (Dahlberg 1990:17). Nanny (1990:88) says computers can provide learners with similar problems in a multitude of ways in game-like fashion. This feature helps to keep learners interested in the learning matter while they are learning. CAI-based problem solving programs focus on building specific skills such as spatial ability and logic. Problem solving skills include that learners sift through information, seek relevant relationships and find coherent ways to represent conclusions. Learners must define the problem (state a hypotheses), examine data and generate solutions to arrive at a higher level of understanding of the content (Newby et al 2000:93). Computers provide learners with practice in different problems over a short period of time. This helps them to practise and better their problem solving skills in an active way. All learners can thus experience success at all levels, resulting in better learning from an early age.

2.4.2.2   Drill-and-practice

Drill-and-practice will help learners to increase their fluency in a newly acquired skill, or to refresh an existing skill through a series of exercises. Drill-and-practice should include corrective feedback to remedy errors that learners might make along the way. Drill-and-practice can be beneficial when learners need to memorise and readily recall information (Newby et al 2000:96). Rodda et al (1991:2) state that the computer has all the questions and

knows the correct answers in the drill-and-practice mode. Learners usually proceed to the next level when mastery of the previous level has been achieved, thus working at their own pace. This mode has an important role to play in education, but creativity could be stifled when the computer dominates and controls the learning progress and when excessive repetition occurs. A computer drill-and-practice program could, however, be more motivating than similar paper-and-pencil exercises, for it makes use of popular elements like game and challenge (Newby et al 2000:166). If software is carefully selected, computers can be great tools for use with drill-and-practice in foundation-phase classrooms.

Liang and Johnson (1999:56) urge educators to resist using computers primarily as electronic workbooks and for meaningless drill-and-practice, but to use them to encourage and to help youngsters to play and to learn through a systematic approach. Teachers should thus guard against the "push-and-see" attitude, whereby children can begin anywhere in a computer program, make changes and reach a goal through a process of elimination, without mental effort to reach an end state. They should require a moderate level of difficulty and effort from the learners to change plans in micro-worlds, and thus achieve a balance between playful fluidity and strategic planning as an outcome of learning. Haugland and Wright (1997:6) report that researchers lack unity on the issue of CAI in foundation-phase classrooms where much inculcation is done:

> ".... (T)here has been considerable debate regarding the potential dangers and benefits of computers in early childhood classrooms. Opponents believe computers should not be placed in early childhood classrooms. They fear computers .... will rob children of their childhood.
> Pencils and paper alone cannot rob children of childhood. Yet, a multitude of worksheets surely can. In a similar way, if computers are used for extended periods with drill-and-practice software, and children are pressured to succeed, computers can rob children of their childhood."

Foundation-phase learners need a lot of repetition to promote learning. Developmentally appropriate drill-and-practice software could be used to effectively enhance such skills in learners in new and interesting ways.

## 2.4.2.3 Discovery

Discovery incorporates much of the cognitive theory, for it allows learning to result from trial and error, with minimal help from the educatorr. Computer databases offer a valuable stimulus for engaging children in inquiry learning that requires them to observe, question, classify, compare and hypothesise. Learners can experience control and success in this mode and thus learn more effectively (Knight & Knight 1995:144; Newby et al 2000:93). Computers make discovery possible and this is an important technique for it enables and encourages students to "find answers" and discover the facts themselves. To discover things can build learner-confidence.

## 2.4.2.4 Cooperative learning

Van der Horst and McDonald (1997:127) state that cooperative learning comes about when learners work together in a group small enough that everyone can participate on a collaborative task that has been clearly defined, and without the educator's direct immediate supervision. Heterogeneous groups of learners often use computers when working together toward a common academic goal or task. This type of cooperative learning enhances social skills as well, for learners have to depend on one another to reach the goal (Newby et al 2000:92). Learners learn easily from other learners because they share interests and have similar skills and abilities at this level.

## 2.4.2.5 Discussion

Discussion is a dynamic method that encourages classroom rapport. Learners talk, share information and work towards a solution or consensus through verbal discourse, especially with relation to CAI matters. Discussion teaches content as well as processes, such as group dynamics, interpersonal skills and oral communication (Newby et al 2000:95). Computers provide ample opportunities for constructive and learning-related discussions to take place when learners formulate heir own opinions in the classroom.

2.4.2.6 Reflection

Reflection is a skill learners should acquire so that they can fully understand their experiences and learn from their mistakes as well as their triumphs. Self-reflection, monitoring, motivation, and the use of feedback are skills the expert learner needs. Every individual must learn them through use and exercise (Newby et al 2000:265). Reflection is also seen as a process of taking stock, thinking quietly, catching up with oneself, mulling over events or making sense of personal experiences. It is unique to each person, cannot be directly observed, and thus tends to be overlooked or neglected very easily (Van der Horst & McDonald 1997:89). Computers offer learners ample opportunity for reflection, through their interactivity. Learners sometimes work on a computer in a one-on-one relation and have to think about the why and how of their activities in CAI.

2.4.2.7 Interactivity

Interactivity is sometimes regarded as computers' chief advantage. Computers can present a variety of problems and require individual responses, thus demanding the learner's active involvement and response as a result of learning. The computer provides immediate feedback. It can inform the learner if an answer is right or wrong, and give a reason. The educator or learner can set the levels of difficulty of a program, or it may adjust automatically, based on the learner's performance (Newby et al 2000:101). Sewell (1990:5) says the following about computers in classrooms:

".... (T)he computer undoubtedly has the capacity to be used individually.... Perhaps the most frequently reported advantage is that computers are potentially interactive and as a result of this interactivity they can promote more active learning amongst students of all ages and all abilities. .... (S)tudents will have the equivalent of their own individual tutor who will be aware of their educational history,.... and who will provide material best suited to individual needs. Computers have the ability to individualise the learning act by competently supporting the learning activity of each pupil. The child doesn't become bored with waiting for the teacher's attention and consent to continue with the next task."

Interactivity thus motivates learners to progress at their own pace in systems that were originally designed to cater for large groups.

Skinner (1986:15) observed that traditional schools use "classic forms of teaching" and learning is still a passive process. He came to the conclusion that:

"Only rarely can behaviour be immediately reinforced, and a student cannot move on at once to new material. Hence teachers must resort to punishment (and) admit we have failed to solve a central problem in education. What is taught to a large group cannot be precisely what each student is ready just at that moment to learn."

Interactivity could benefit all aspects of learning, because the individual learner is truly constructive on a level that complements and supports his or her personal level of development. Educators should make proper use of what computers can offer to benefit the teaching and learning activities in their classrooms.

2.4.3  Different views about computers in schools

Computers are fairly new phenomena in the didactic situation.  Both positive and negative aspects about their use in schools are thus continuously reported, especially in literature on CAI. These two extreme views on modern schools are reported by Newby et al (2000:264):

"Critics charge that despite investments of huge sums of money, computers have not delivered the expected educational improvements.  Perhaps computers will simply fade into a minor role in the classroom, as did instructional television.  Education and schooling will continue unaffected.  (*This is one extreme position.)*

.... (A)ccording to Lewis Perelman schools are no longer needed, and, to make matters worse, they are getting in the way of truly necessary changes.  Changes may be so dramatic that they completely alter what we think of as education and schooling today. (*This is another extreme position.)*

They then offer their view, as "a more moderate course", envisioning a future enabled by information technology between these two extremes, where both educators and learners embrace and integrate instructional technology, to improve teaching and learning in the Information Age (Newby et al 2000:265).  Computers are seen as tools to truly improve modern education and bring these viewpoints closer together.

Negative viewpoints about CAI are usually based on the inadequacies of computers in the classroom.  For instance, Ross and Schulz (1999:10) report an opinion by Gregorc (1985) that computers are "inanimate objects lacking empathy".  Lawler (1997:79) reports that people are saying:

"Computers have not improved education.... (and)
Computer experiences are inferior to real ones."

Computers are sometimes deemed to be too abstract. Computers have also been criticised as being "low-level" and not consistent with a view of learning as knowledge construction. Drill-and-practice programs are seen as little more than electronic worksheets, tutorials are regarded as mere electronic page-turners and many early programs are made off as adaptations of older instructional forms such as paper-and-pencil worksheets (Light & Littleton 1999:1; Newby et al 2000:170). Similarly, Wegerif and Scrimshaw (1997:1) claim there remain uncertainty and debate among educators and educationalists about how best to use computers in the classroom, for surveys often report they are underused in schools.

A more moderate view states that some of these aspects are changing, for newer software releases tend to make better use of the computer (Newby et al 2000:170). Schwartz and Beichner (1999:23) recommend with regards to negative attributes, that computers should not be used in isolation. According to them there are real reasons to be excited about the possibilities that technology can offer educators. Technology cannot solve all the problems that schools face, but it can change the way things are done. Sometimes those changes are beneficial, and sometimes they are not. In the same vein, Wootton (1986:293) reasons that computers can play a vital role in the educational development of students, but that they are just another teaching resource and their use in the classroom should be justified. Newby et al (2000:262) continue that many positive experts foresee a future in which small, powerful computers will become standard school equipment for every learner, completely replacing textbooks, paper and pencils. Jonassen (1996:4) voices the opinion that students are not controlled by technology, but that they can enhance the capabilities of the computer, while the computer enhances their thinking and learning. How and how well computers will be used will depend on how well educators and learners can manage the technology, especially in foundation-phase classrooms.

## 2.4.4  Conditions for success in using computers in the foundation phase

Computers make good assistants in foundation-phase classrooms. Royle (1989:173) says children can achieve exciting results on computers, developing their knowledge and skills gradually and at their own pace, by using a small proportion of the facilities that are available. Learners need basic skills to benefit from hands-on use of computers. Recommendations found in the literature (Casey 1997:43; Campbell & Hanlon 1990:261; Haugland & Wright 1997:68; Moursund 1997:80; Rodda et al 1991:23) include

- proper preparation and support of learners are necessary
- foundation-phase learners can be introduced to basic retrieval skills
- learners need to be able to use the keyboard and mouse to feel comfortable and in control of what happens on the screen
- they need to be able to turn the computer on and shut it down properly
- they need to be able to handle disks
- they need to be able to open, save and close files
- proper typing skills are not absolutely necessary, but hunting for and pecking at the keys seems to have been a main reason for the underutilization of equipment
- very young children are capable of using the keyboard in a proper way
- good computer-related skills assist the building of self-confidence in learners.

Educators should apply different approaches at various levels to find the best strategies for implementing CAI into each classroom, to accommodate individual differences in both teaching and learning styles. CAI, like all teaching aids, could result in positive as well as negative outcomes, depending on how well computers are used in the classrooms. Educators need to plan well and ensure computers are used effectively, for them to be of educational significance. The last word on CAI has not been spoken and the debate is not yet over, but it seems that the

debate resulted in improvements being made to programs to make CAI more acceptable and easier to use in foundation-phase classrooms.

## 2.5    Summary

Computers are versatile technological tools that can enhance educators' teaching and learners' learning in foundation-phase classrooms. When CAI becomes a teaching partner, education can be improved if developmentally appropriate software is used in tandem with good skills. Learners regard using computers as fun, a treat, feeling grown-up or special, resulting in positive attitudes toward learning that can benefit their learning and development. However, inadequate resources like computers and supporting facilities might negatively influence extensive use of CAI in the classroom.

CAI implies that the computer fulfils a supplementary role in the classroom, providing various types of learning matter through applications and software, handling aspects like instruction, individualisation and interactivity. The computer as tutor can bring success to every learner in every class, assisting them to perform better in both cognitive and skill-related activities. Computers present content, pose questions or problems, request responses, analyse, supply appropriate feedback and provide practice until learners reach a pre-determined level of competency. Computers can save time and provide variation when used as tools and assistants in classrooms. CAI provides learning opportunities and offers the learners joy and independence through activities like drill-and-practice exercises, cooperative learning, discovery and problem solving. Implementing CAI into classrooms can effectively accommodate individual learner-differences, for it teaches the individual learners what they are ready to learn, and at their own pace - also in the foundation phase. The educator determines the amount and quality of tutoring provided by computers.

Educators have the responsibility to integrate CAI with the curriculum through suitable learning activities in the classroom, but they remain in control of the class. Educators thus have to be well-trained, with good computer-related skills, to ensure that CAI is successfully integrated into foundation-phase classrooms.

# CHAPTER 3: TEACHING AND THE COMPUTER

## 3.1  Teaching foundation-phase learners in schools

The educator is regarded as one of the pillars of the didactic triangle which represents the three main elements of education.  The educator directs events in the classroom and accepts responsibility for the learners and their interaction with the learning matter.  A curriculum provides the educator with guidelines on the learning areas in order to promote and consolidate teaching and learning in the classroom.  This also applies to the foundation phase where formal education is normally initiated.  The role of the curriculum thus needs to be considered alongside that of the educator, where classroom management and parental assistance are concerned, especially in terms of the influence of computers on teaching.  This will help to set up guidelines for equipping foundation-phase learners for successful CAI.

The school forms an integral part of all societies because it brings education to the learners.  Education has evolved into a basic human right for every member of each society, irrespective of class or creed.  As a result, the number of learners has grown and educators have to cope with vast numbers of learners in classrooms, while remaining under pressure to provide instruction that meets the specific needs of individual learners.  The diversity of learners due to different learning styles, differences in background and experience, varied home and life settings, as well as the availability of new technology, complicates modern education even further (Newby, Stepich, Lehman and Russell 2000:2).  The advantages of individual or small-group tuition have been recognised in the educational approaches associated with the Ancient Greeks (Sewell 1990:4).  Schools should, ideally, thus only need to cater for small numbers of learners, but teaching limited numbers of learners is not viable in schools as we know them today.

Educators should ensure that schools adapt and change as society changes, to efficiently accommodate the real educational needs and to be relevant to that specific society.  The shift

from the industrial to the information age represents a major shift in all spheres of society, which necessitates the redesigning of traditional notions of schooling, to enable children to excel in modern living and working environments (Bonk & King 1998:365). Lewis (1999:142) says that:

> "Information is no longer structured only in a simple, linear, logical fashion; it is becoming fragmented, multi-channelled and simultaneous. Education must help the learner make sense of this new information age."

The school of the information age is committed to providing mass education, but it needs to effectively accommodate the learning needs of individual learners to be relevant in terms of its mission. Using computers to teach can assist educators and learners because it brings technology to didactic situations. CAI can ensure the survival of the school and its relevance as an institution of teaching and learning in modern societies.

Criticism of schools will prevail, but researchers like Bradsher (1990:323) say that using computers as tools in schools from a young age could have a positive influence on the cognitive abilities of learners:

> "If only we can put this marvellous tool into the hands of children while they are still young, the thinking goes, we can preserve their innate curiosity and imagination from the crushing influence of formal schooling."

She goes on to say that educational computing could liberate everyone involved in schools, for computing can encompass the relationship between information technology and cognitive development.

Education can be successful if educators adapt to modern demands and become facilitators and managers of classrooms and computers. CAI has the potential to enable learners to master

information, enhance their cognition and become more independent in learning if the technology is appropriately applied and effectively managed in schools.

## 3.1.1  The educator

Educators and schools became almost synonymous once public schools became general institutions of education, bringing the services of private tutors to more than one student at a time.  Educators serve in roles which vary from administrator to surrogate parent.  The most important role, however, is that of "instructional expert" which entails having to plan, facilitate and evaluate all instructional activities, thus influencing what learners experience and learn in the classroom (Newby et al 2000:2; Skinner 1986:12).  Educators thus have to actively support the living and learning of learners, present learning matter and manage the classroom situation.

The advent of public schools caused educators to adopt integrated qualities to fit in with what schools demanded of them.  Modern educators need to revise their role in the didactic situation due to the availability of technology and the demand for individualisation.  Educators have to manage classroom activities effectively, deliver high-quality instruction, facilitate student thinking and evaluate learning.  They should seek to help students in achieving their personal goals and use learner interest as an integral part of all educational processes.  Educators, however, often define their role as a combination of the transfer of knowledge and classroom management, instead of defining it according to an understanding of how students learn, and enabling them to do so (Lewis 1999:147; Sewell 1990:191).  Educators have to take control and effectively introduce CAI into classrooms through good planning and organisation.   Evans-Andris (1996:114) voices an opinion that is possibly in the minds of several parents and administrators:

> ".... (I)t's nice to know that someone who is qualified can give the students the proper direction and instruction that will help them make the best use of the computer."

Educators need to be suitably qualified to control and improve the didactic situation through effective CAI in every classroom. Blanchard (1999:2) advises on teaching and the use of computers by stating that:

> "Teachers concerned with literacy instruction and achievement cannot afford to slink around the edges of these new ideas and practices, uncertain of their roles. Educators who do not possess the knowledge or training to use technology effective and to turn aside its chirpy theatrical claims, will be dependent on those who, by luck, leisure, or labor, have commanded it."

It is the educator's responsibility to introduce and facilitate CAI properly and to integrate the use of computers into the curriculum to ensure optimal learning opportunities for every learner, especially in foundation-phase classes.

## 3.1.2 The educator as facilitator

Facilitating learning is a major task of the modern-day educator. The traditional practice of rote-learning by learners has to be replaced by individualised exploration and the discovery of information in modern foundation-phase classrooms. The educator has to plan, set up, manage and evaluate the teaching and learning activities to benefit the total development of every individual in the classroom. Casey (1997:79) compares traditional views with current views on the roles of educators and learners in learning:

> "The old teaching paradigm implies that learning only happens when the teacher puts information into children's heads. The new paradigm implies that children can construct and learn .... when they are in control. The new paradigm does not imply that the teacher is unnecessary .... a knowledgeable teacher who acts as a guide, facilitator, or fellow learner is essential."

Educators no longer present pre-discovered knowledge, but rather facilitate learning when they advise learners on modern approaches which could result in effective learning.

In modern teaching the focus shifts from the transmission of knowledge to the creation thereof. Educators guide learners to discover and develop basic life skills, such as active inquiry and reflection, in order to analyse and synthesise information, solve problems and successfully construct new knowledge through creative participation and understanding. Progressive educators facilitate learning by selecting and implementing suitable learning matter and by motivating learners to improve their personal skills and abilities through the use of different materials and tools, such as computers. Educators observe and evaluate learner's progress and provide them with relevant feedback in this regard. They thus monitor and guide rather than dominate and direct learning activities (Bonk & King 1998:370; Newby et al 2000:146; Van der Horst & Mc Donald 1997:231). According to Armstrong (1995:12) the educator, as facilitator, should help students

- to formulate interesting questions and identifies study areas
- to locate information resources relevant to topics
- to evaluate the quality, relevance, meaning and application of such information.

Educators who facilitate could therefore be regarded as important in assisting learners to become independent in their learning. Outcomes Based Education (OBE) requires of educators to be facilitators who focus on the outcomes of education and plan educational activities with that in mind, rather than merely teaching information. Effective management and strategic planning need to be present in classrooms for positive results to occur in all teaching and learning (Department of Education 1997b:28; Van der Horst & McDonald 1997:15). Educators who create an atmosphere for smooth and purposeful learning through their motivation, enthusiasm and positive feedback, allow the learners to feel good rather than inhibited about participating in the learning activities, and help them to understand where they

are eventually heading with their learning and why. Skinner (1986:14) says the following about teaching:

> "We learn when what we do has reinforcing consequences. To teach is to arrange such consequences. ....(E)ducation is preparation., .... preparing is not the same as living. Students and teachers tend to move too quickly (from preparing) to the 'living' stage."

Facilitating aims at getting all the learners more involved in the success of their learning. Successful facilitating implies that educators have to constantly assist and support individual learners to develop their cognition at their own level and pace.

3.1.2.1  Teaching individuals in schools

Accommodating student differences is one of the fundamental problems with which educators have to cope. Educators who implement CAI in foundation-phase classrooms are in a better position to ensure that each individual learner participates actively in learning. Casey (1997:126) stresses the importance of catering for individual needs in instruction and says educators must concentrate on creating an environment of learning in which each individual child can grow at his or her own rate. In order to do this educators need support, power and tools to make individual decisions about how to facilitate the writing and reading growth of each learner. Computers as assistants and tools in the classroom can provide the educator with the necessary support and power to cater for the learners' needs. Koschmann (1996:7) states in this regard:

> "Since one-on-one tutoring is commonly considered as the gold standard against which other methods of instruction are measured (Bloom 1984), the new paradigm is founded on the proposition that education could be globally improved by providing every student with a personal (albeit machine-based) tutor."

A personal educator allocated to each student is unaffordable, but according to Knight and Knight (1995:147) computers can provide one-on-one instruction in classrooms. CAI can accommodate individual differences in intelligence, interests and background and can eliminate the problem of pacing, for the programs usually contain content which varies in the levels of difficulty. CAI can present individuals with interesting tasks and offer them the opportunity to explore and to recover without embarrassment if the efforts proved to be a failure (Schank & Cleary 1995:43, 72). CAI subsequently offers educators and learners more freedom because this instruction caters for their individual needs in didactic situations.

Haugland and Wright (1997:68) voice the opinion that better educators have always managed to combine respect for the past with realistic aims for the future. Modern technology provides educators with more opportunities to find materials that match the interests and abilities of children and their varying learning styles. A major use of the computer as a tool in teaching and learning should be to promote cognitive activity for every individual (Newby et al 2000:2). Ross and Schulz (1999:6) comment on CAI and the developing learner by saying that findings generally indicate that while CAI has tremendous potential to individualise, a number of learner characteristics such as motivation, learning styles, and background knowledge may affect the quality and effectiveness of a CAI instructional session. Although the computer has the potential to serve the educational objectives of individuals in classrooms educators have to remain cautious when using the computer as a learning tool. Educators need to rethink preparation, learning activities and assessment involving CAI to establish what works and what needs to be improved to present successful individualised education, and higher levels of cognition, especially in the foundation phase.

3.1.2.2  Development of learner cognition

Facilitating learning means that an educator extends the goal of education to engage learners in learning.  Understanding results from thinking and using, not from memorising.  Using computers as tools in schools can enable learners to acquire more knowledge and cognitive skills than was previously possible (Jonassen 1996:259).  Säljö (1989:144) alleges that the purposeful and effective use of the correct tool is imperative to expand learner cognition:

> "It has been assumed that computers and modern information technology will revolutionise human learning and create what is sometimes referred to as a learning society.  The learning is not only inside the person, but in his or her ability to use a particular set of tools in productive ways and for particular purposes."

Educators need to ensure that learners have the right tools available at the correct time to enable them to engage in effective learning and to support the development of their cognition.

Computers can be used to access information, interpret and organise personal knowledge and to acquire the problem solving skills necessary for and relevant to learning and living in the information age.  We can assume that what learners learn in one situation, will improve their performance in another.  Educators should select computer programs that can be used as cognitive or mindtools to improve learners' thinking skills.  Such mindtools will soon function as intellectual partners of the learner and help him or her to engage in critical thinking and higher-order learning.  The various learning activities provided by computers can extend cognition, for they require learners to think in meaningful ways (Grabe &  Grabe 1996:56, 70;  Jonassen 1996:3, 9; Simonson & Thompson 1990:389).  Learners need to develop insight into the task requirements and their personal capabilities.  Educators have to ensure that learners gain competence in planning, evaluating and regulating academic behaviour, in order to learn and think more effectively.

Higher cognition is often linked to better problem solving abilities. Primary education, following a good technology curriculum, could help learners to develop problem solving skills in a practical way resembling everyday life. Educators should help learners to think about problems or unmet needs while supporting their efforts to design solutions (Bickart & Pierrel 1999:20). Peck and Hughes (1997:114) describe computers as "tools of the intellect". They observed how computer-using first graders thought differently. These learners were making inferences, analysing and synthesising information, which resulted in altered thinking patterns and language usage. They state further that children learn first-hand about processes and materials when they invent, for inventing introduces them to step-by-step problem solving by

- identifying the problem
- proposing solutions and
- considering constraints; and then
- creating and
- evaluating the product.

CAI allows learners to learn by discovering facts independently through practical and purposeful activities that endorse cognitive development and autonomous learning. Lewis (1999:142) therefore states that:

"Constructive learning stresses active, outcome-orientated and self-regulated learning, where meaning is negotiated and multiple perspectives are encouraged. The flexible and interactive characteristics of multimedia and telematics are enormously supportive of this."

Educators also facilitate cognition by creating opportunities for learners to discover facts while learning. Bradsher (1990:323) wants educators to foster independence and allow learners to "discover" aspects of the learning matter for themselves, but reminds them that inquiry-based

learning does not just happen - it demands a lot of planning and subtle structuring by the educator. Newby et al (2000:147) advise educators to also encourage active discovery as part of learning:

> "Make sure students understand that 'one right answer' may not exist. .... (T)hey may need examples on how to observe, compare, and evaluate phenomena. Constantly encourage and reward students for being inquisitive, and for trying new approaches."

Educators should embrace the challenges computers can offer learners, and should assist them to successfully develop different skills and activities, using this tool in the classroom.

3.1.2.3 Success as motive

Learners need to experience success while learning in order for them to gain confidence and develop a desire to take up other learning-related challenges. Educators facilitating learning should ensure that each learner experiences some form of success, especially in foundation-phase classrooms. A learning culture can then be cultivated. The current South African education policy emphasises the need for successful learning by individual learners. According to the Department of Education (1997b:12):

> "A great emphasis is put on creating conditions that lead to success. Time will no longer control the learning process. This means that not all learners will succeed at the same time. Different aspects of the learners' abilities, such as their creativity and critical thinking will also be assessed. Learners will know what they are learning and why."

The mastery of applicable life skills like creativity, logic, critical thinking and analysis results in successful learning. The skills should include expertise in the technological field as well. The Department of Education (1997b:21) states in this regard that:

"Outcomes-based education is a flexible, empowerment-orientated approach to learning. It aims at equipping learners with the knowledge, competence and orientations needed for success after they leave schools or have completed their training. Success in school is of limited benefit unless the learners are equipped to transfer that success to life in a complex, challenging, high-tech future."

In teaching, modern educators need to keep in mind that each individual learner is capable of achieving success. The educator as facilitator and computer expert needs to create a positive atmosphere that enhances various aspects of learning, especially for individuals in foundation-phase classrooms.

## 3.1.3 The educator as computer manager

This study supports the opinion of Birch (1995:49) that, to effectively assist foundation-phase learners in their efforts at CAI, educators need to be conversant in the areas of the technical, the curricular and the pedagogical. Lewis (1999:142) claims that the embedding of modern technology in the workplace affects the work and attitudes of educators, who consequently experience a constant demand for better qualifications and knowledge of newer and faster technology, due to the drive for competitiveness. Educators must be able to advise learners to use technological applications in pursuit of the necessary learning skills to cope with the expansion of and increasing demands in higher education. Educators have to be familiar with modern technology and what it can offer to help learners in this regard (Evans-Andris 1996:5). This also applies to educators of learners in the foundation phase where the first steps towards technological excellence are taken.

According to Haugland and Wright (1997:70) new levels of learner competence will emerge as each educator becomes a comfortable and competent user of computers. As information technology continues to proliferate, educators have to use every opportunity to teach learners to

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learn in as many ways possible.  Learning about computing implies that the computer is used to do things that are useful, meaningful and intellectually engaging (Jonassen 1996:9).  However, educators often fail to spend enough time and effort to familiarise themselves with computers, or to ponder on the capabilities of these machines in specific didactic situations.  Simonson and Thompson (1990:100) say in this regard:

> "As Papert suggests, discovering the appropriate uses of the computer in education has been a problem for educators.  Few deny the enormous educational potential of this machine, which can handle data with amazing speed and accuracy and is beginning to stimulate human thought and behaviour, but agree that we have yet to begin to tap the possibilities for utilizing the technology."

When efficiently applied, computers make excellent tools and assistants in classrooms that can benefit both educators and learners in terms of time and effort.

Using CAI as a means of supplementing classroom instruction has escalated in recent years, especially for educators faced with large classes and heavy work loads.  Wasserman (1985:332) believes that, if computers are conceived as a means of liberating educators, the latter may be freed to concentrate on more demanding professional functions that make their teaching more significant and effective.  Educator skills and attitudes, as well as initial and in-service training, influence how well they implement and manage the computer as an assistant and a tool in teaching and learning in foundation-phase classrooms.

3.1.3.1  Computer skills and educators' attitudes

Educators often regard computers as essential learning tools, like books, pencils and paper, but they are sometimes disillusioned with CAI, when their expectations are bigger than their integrating efforts.  Implementing computers as tools in classrooms requires educators to have sufficient educational and technical knowledge.  The lack of expertise among educators

regarding the applicability and teaching qualities of computers caused researchers like Rumsey (1988:37) to warn that:

".... (T)o know a subject well enough to teach it, an educator must know how computers are used in the field."

Educators have to be eager, willing to learn, and excited about sharing modern innovations and new ideas in order to apply CAI successfully. Enthusiasm usually grows once educators start using different applications and programs, which could then help them to implement their own ideas using new resources. Educators should select software based on curricular goals and the needs of the learners, and should develop creative and engaging projects to integrate computer activities with normal instruction. Educators need to rethink old practices, build new skills and ensure that balanced curricula make their way into the classroom. By applying the technology as part of their teaching methods they can expand the learning experiences of their learners. Using computers in classrooms results in individualised instruction and enhances teaching, for it creates new opportunities for learning and the assessment and evaluation of learner skills (Evans-Andris 1996:90, 101, 148). Educators either like or dislike modern technology. It does seem that those who dislike it are prepared to give CAI the benefit of the doubt, provided that schools have sufficient and effective support-systems in place.

The fact that technology has not successfully been integrated in all classrooms could probably be attributed to aspects like a lack of proper teacher training, insufficient support by school administrators and inadequate funding. Casey (1997:112) says successful results with CAI have been achieved where the desire for integrating technology in the classroom originated with the educators, while administrators shared in their interest. Administrative indifference normally creates a lack of assistance in managing, operating and maintaining computing equipment. Educators need to focus on teaching-related activities when using computers as tools. CAI can therefore not run smoothly in classrooms where educators are burdened with these additional

administrative responsibilities (Druin 1998:16; Evans-Andris 1996:19). Principals who involve educators in planning the technology curriculum and give them the time and opportunities to familiarise themselves with new equipment, ensure that CAI can be fully integrated through developmentally appropriate activities in the early grades (Bickart & Pierrel 1999:22). Educators tend to feel insecure in the classroom when they have to use methods and equipment that they are not quite familiar with. Hardy (1998:132) reports in this regard that educators have raised concerns about how to effectively integrate computers into the curriculum. They are hesitant to experiment with new and complicated technological appliances. Paine (1994:7) states that:

> "Technology will only be fully exploited when the role of the teacher fully exploits the technology. In an already overcrowded curriculum, in an already overcrowded day, we expect teachers to climb an enormously steep learning curve. In many ways we should wonder at the fact that so many have made the effort rather than lament that so many have not."

The possibility that computers in schools might be mere whims or short-term crazes, like other previously introduced "new ideas", can furthermore cause confusion or indifference among educators. McCombs and Whisler (1997:17) found that:

> "Educators themselves are often resistant to change. There always seems to be a new bandwagon, one that 'comes in with a bang and goes out with a whimper'. Rather than evaluate the educational impact of each bandwagon, many educators hope it will go away, as have so many others before it."

Educators who feel insecure are reluctant to try out new ideas in their teaching. They tend to use computers as an extra aid, not directly linked to core learning and often avoid using them (Bickart & Pierrel 1999:20). Educators do not always overtly embrace or resist computer implementation in classrooms, but often consider it to be an under-valued activity, peripheral to

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their task.  They create and participate in strategies that distance them from computers, and keep the amount of time they spend on computer-related activities to a minimum (Evans-Andris 1996:147).  It is reported that

- one teacher said that it feels good to know how to use computers, but it does not make better teachers, it just makes the teaching more fun for the kids.  "I really don't think the means justify the ends.  My computer skills got better, but not my teaching skills" (Evans-Andris 1996:95)
- another teacher voiced her concerns that "Computers interfere with the human element of teaching.  Teaching should be a humanistic profession, not a mechanised one" (Evans-Andris 1996:99)
- "I am always afraid of what might go wrong" is a common comment (Birch 1995:45).

Technical confidence gives educators a sense of autonomy in their work at classroom level, while proper curriculum organisation and classroom management enable them to provide appropriate learning experiences.  Griffin and Bash (1995:2) agree that modern technology is often threatening and too demanding on the time and energies of some educators.  This is further exacerbated by the fact that

- educators lack sufficient training in the use of the computer
- the computer never seems to work when it is needed most
- users need a lot of time and effort to acquaint themselves with new software
- computer technology is continually changing, and consequently staff have to spend time and effort in understanding new computers and new software
- there is just not enough time in a day for a educator to do everything he or she would like to do.

However, educators should not allow feelings of inadequacy to thwart their enthusiasm. Casey (1997:95) provides good advice to all novice educators:

> "My advice to educators just getting started? Jump on in - you will never know it all, you will never have all or enough of the right equipment, time will always be short - but you, your students, and your school will benefit by opening the door and letting the world in. After all, the 'World is at our Fingertips'."

3.1.3.2 Training of educators

Although advanced technology has become an integral part of classrooms, Griffin and Bash (1995:14) report that many educators in schools lack technological confidence and remain at best indifferent to computers in the classroom and at worst completely computer-phobic. Educators will, however, find it increasingly difficult to avoid using computers and related technology in education (Hardy 1998:132). The real problem for educators is to know what to do with a computer once they know how to start it. Educators must therefore be fully competent in using the computer before they will be able to encourage their learners to use it as a tool for managing data base systems or word processing (Grabe & Grabe 1996:348). Purposeful and efficient computer-related training will ensure that CAI is properly introduced and managed in modern foundation-phase classrooms, for educators who lack proper skills are just not aware of what can be done (Hardy 1998:119). Modern educators thus have to be better trained than before with a basic understanding of how technological tools can be integrated and effectively used in the classroom - to coach, consult, advise, offer suggestions, and nudge learners along as they broaden their knowledge (Casey 1997:79). Haugland and Wright (1997:17) state in this regard that:

> "The potential for computers to enrich young children's lives appears to be as great as our vision. Whether this potential will be realized depends on the wisdom and

experience of teachers. Without training it is very difficult for teachers to obtain the necessary expertise to successfully integrate computers into their curriculum. Only when teachers feel comfortable with the technology will computers play a significant role in early childhood classrooms."

The paradigm-change in education thus results in an urgent need for renewal in teacher training that will focus on technology, for the successful implementation of computers in schools depends heavily on investments in staff development which makes provision for individual skill levels, needs and personal interests.

Authorities should consider the teaching of educational telecommunications to both pre-service and in-service educators, since pre-service educators in particular are expected to complete their preparation as fully knowledgeable members of the information age, with skills in using telecommunication technologies for professional development and incorporation into curricular instruction (Schrum & Berenfeld 1997:87). A new generation of young and computer confident primary school educators, with proper initial training and relevant skills, could be instrumental in giving CAI the necessary momentum to make a difference in modern education. Casey states that curricula for the training of new educators need to lead them on the way to technological supremacy and enable them to cope with modern educational demands. He explains how CAI affects teaching (Casey 1997:44):

"We now switch from a teaching situation, where the educator decides which actions to take, to a real learning situation where the children explore, exchange ideas and build their own knowledge by interactions with the computer and with the environment. Teachers should accept the fact that their role is changed. New types of teacher training are needed, based on the fact that the educational world is changing, and changing fast."

Individual educators should take responsibility for acquiring technological skills. Newby et al (2000:259) state that educators should read journals, attend conferences and workshops and take courses to update their knowledge of CAI in order to be in a position to comfortably and successfully pass expertise on to the learners. Practical training in the latest computer-related knowledge and experience through group sessions or peer tutoring in schools can also be an effective means of dispersing information to educators. In-service training programmes should incorporate experienced local computer experts and educators to provide hands-on experience, follow-up support and feedback to colleagues. Training should be conducted in a non-threatening environment and at convenient times for the educators, while presenting information in step with opportunities for practising and mastering relevant technology. Earlier computer training for educators was often unproductive, for it focused mostly on technical aspects rather than on the curricular value of computing (Casey 1997:79). Investing in time and money, by both individuals and institutions, could result in capable and confident educators, making the best of CAI in the didactic situation.

There is more to successful CAI in the classroom than just good training. Institutions have to provide the necessary infrastructure to encourage the use of computers in schools. Ward (1994:47) identifies the need for technological equipment in classrooms as another important aspect in the quest for the continual development of staff and utilisation of CAI:

> "The increasing ability of technology will mean little unless schools of education provide effective training and unless teachers have access to ongoing opportunities for staff development. Telephones, computers, and modems should be standard equipment in every classroom to make it easier for teachers to work together and to take advantage of the innumerable databases, networks, and software available. The intelligent use of technology is indispensable for creating a true, collaborative world of learning."

Individuals and authorities could support one another to ensure that CAI takes its rightful place, also in foundation-phase classrooms.

3.1.3.3 Teaching and computers in schools

Educators plan and initiate learning activities by deciding on the skills learners need, and how to best assist them in gaining these. Sound lesson planning, individual learner support and objective assessment should be the priority of every educator who wants to improve education. McCombs and Whisler (1997:86) also stress the value embedded in good personal relations in the classroom:

> "Schooling is more than good programming and pedagogy. The best curriculum or lesson in the world will have no effect in the hands of educators who do not believe in, respect, and relate to their students. The very foundation of any learning experience resides in the nature of teacher-student relationship and the quality of the classroom climate."

Learners normally trust their educators and assess their own scholastic and social progress against the reaction and assistance they get from their educators. Educators should therefore be interested in and enthusiastic about their subject matter and teaching in general, they should organise teaching materials and information and give clear explanations. Good educators have been found to give quality feedback, to be available and helpful and have concern for their learners and their learning and to encourage learners to express their own opinions (McCombs & Whisler 1997:29).

Foundation-phase learners spend most of the school day with a single class-teacher. These learners have to master scores of basic literacy, numeracy, and life skills, and learn to take more responsibility for their own learning as they progress through school. The educator also has to prepare learners for the "new" type of education which starts in grade four when they will be challenged by greater independence in their working and learning, and which will involve computers. Learners become increasingly independent and empowered when educators

manage to bring new learning environments within their reach by making activities cognitively accessible and removing irrelevant obstacles from the learner's path (Grabe & Grabe 1996:45; Sewell 1990:19). Educators really empower foundation-phase learners when they manage to introduce technology into their learning activities, for using technology fosters independence and prepares the learners for the more advanced teaching that will follow in the next school phase. Haugland and Wright (1997:68) stress the role of educators as classroom managers and supporters of learners in the technological age:

> "One role the teacher chose to play was as a *facilitator* who scaffolded the children when they needed support and posed additional questions to further their thinking. His second role was that of a *curriculum designer* who prepared the environment with stimulating materials and challenging activities. In this role he tried to match the skills and concepts promoted by various pieces of software with the learning styles of individual children and the overall themes and projects of the whole class. His third role was as an *observer* who carefully noted the learning that occurred for beginner and advanced users. All these roles .... are indeed parallel to the job each teacher does daily in relation to selecting literature, math manipulatives or any other learning tool experience."

Primarily, teachers should be teaching. The increasing amount of technology available in schools has opened a window for innovation, competition and change in educational systems (Moursund 1997:53). Computers are versatile. They can assist educators in presenting instruction, providing instructional activities, to quiz or require other interaction from learners, to evaluate responses, provide feedback and determine appropriate follow-up activities in classrooms. Computers are interactive for they require active responses and involvement from the learners (Newby et al 2000:164). Educators should exploit this phenomenon. According to Sewell (1990:2), thinking about CAI does not only mean thinking about computers: it means thinking about education as well. Educators should invest time and energy in developing their own skills

in CAI and gaining positive results in teaching and learning in foundation-phase classrooms. If educators could satisfactory answer the question "Why should I use a computer in my classroom?", computers would begin to play a significant part in teaching and learning. Griffin and Bash (1995:13) are positive about the application of CAI in primary schools and say:

> "Children have taken the information technology in their stride. Added to that, the computer is as much a part of the internal architecture of the primary school classroom as the blackboard and the reading corner."

Learning through CAI would then be a normal development of education for foundation-phase learners. However, the abilities of learners to manipulate computers are of the utmost importance in this regard. Educators need to be on the alert in this regard and select computer programs that are relevant, useful and simple to use.

Computer technology is changing and challenging the roles and attitudes of educators in teaching and learning. Independent learning is becoming a vital skill, but putting a child alone in a room with a computer will not result in effective education. Educators have a crucial role in CAI, for they explain things so learners can understand while computers merely give messages, and you can't ask them why (Firkin 1986:50). The educator should have sufficient computer experience and managerial skills to lead the way for learners to make optimal use of CAI in the foundation-phase. The attitudes, expectations, experience and skills of educators in conjunction with curricular goals will determine how well CAI will be facilitated and managed in foundation-phase classrooms.

## 3.2 The curriculum

The curriculum is at the heart of the education and training system, for it includes and integrates all aspects of teaching and learning. A curriculum is everything planned by educators to help

develop the learner, including physical resources, work programmes, assessment criteria and extra-mural programmes. It is relevant and flexible because its base is the needs of a community. The overall goal of the curriculum is to provide each learner with opportunities to develop into an active, responsible, fulfilled citizen with a balanced personality and life skills (Department of Education 1997a:1, 4, 13; 1997b:10). Van Brummelen (1990:9) says about curricula:

> "I think of a curriculum as a dynamic series of planned learning experiences that continually is changed and adapted as it is used in the classroom."

Curricula should initiate change in the role and functions of schools to accommodate the needs of every learner as a developing person and a responsible adult. Curricula also need to keep up with major changes in societies to enable schools to remain relevant. Modern curricula should also initiate the use of computers in learning in schools at a level appropriate to learner-development.

Liang and Johnson (1999:59) carry the view of Dewey (1897) who at the turn of the previous century wanted educators to keep up with technological changes. They maintain that Dewey did not at that stage want the curriculum to be technology-driven, but wanted educators to subsume technology within overarching curricular and programme goals. They further state that if these observations were valid then, they should also be relevant in this millennium. This confirms the views of Heppell (1994:30) who says:

> "Recognising changes in children and taking advantage of them in curriculum change is an essential task for education. Formal education structures will need a swift response if opportunity is not to be wasted. Educators are fundamental to all this. They are skilled at observing their students' capability and at progressing it. They are creative and imaginative but the curriculum must give them the space and opportunity to explore the new potential for learning that technology offers. Structures like external assessment and

curriculum frameworks must allow them the freedom to continue to be good teachers in the face of changing technology and changing students."

The compilation of curricula involves the development of various aspects of teaching and learning, such as the learning programmes, learning materials and lesson preparation. It is not a simplistic affair. The broad aims of a curriculum should be to develop skills and afford learners the opportunity to gain experience. Examples and instructions contained in the curriculum should be derived from the world that the learners know, in order to provide them with extended knowledge. Curricula need to be scientific, cultural-based programmes of learning, resulting in different "subjects". They should be compiled by knowledgeable people from the community, who are able to select various skills which have to be developed in order to unlock the way to adulthood for the learners. The development of Curriculum 2005 was guided by principles like relevance, flexibility, critical and creative thinking, a learner-orientated approach, and international comparability (Department of Education 1997a:2; McCombs & Whisler 1997:62). Curricula thus need to be compiled in relation to the life-world of the learner, but they should allow educators the freedom to select activities and present the learning matter from a personal frame of reference, including technological tools like computers.

## 3.2.1  CAI and the curriculum

Sewell (1990:78) voices the opinion that children grow up in a society which regards the computer as one of the "objects to think with", but that educational systems often cling to outdated methods and ways in teaching and learning. Learners are therefore unaware of how to use computers to enhance their learning. Also, education still does not address the fact that people need to know how and where to find information rather than to learn each and every concept in a textbook (Stebbins 1990:230). To rectify this situation, computer-related experiences need to become part of the lives and learning of children through CAI. Fung et al

(1998:110) compare this need for a new paradigm shift towards integrated computer use in schools, to the shift which occurred in reading some years before:

> "The potential of this paradigm-shift from computer learning as a center-based activity, to computer learning as an integrated part of everyday life is likely to be, in its importance for education, akin to the shift from the early paradigm of reading as an activity that took place only in centers of learning, to reading as an activity that has become an integral part of everyday life."

Modern educational technology can extend the learning environments available to the learner, for it is concerned with the use of equipment in the teaching process, as well as with the development of learning experiences (Sewell 1990:163). Computers in schools can help to do what needs to be done, only better, more quickly and more neatly. CAI can direct learning to achieve the curriculum goals, to develop learner competence and motivation, which lead to new and different modes of learning, affecting not only how learners learn, but also what they learn. Using computers in learning areas like language, reading, writing, history, geography, mathematics, process and result, science, physics and logic can stimulate both collaborative and individualised learning (Lawler 1997:49; Schwartz & Beichner 1999:43; Wegerif & Scrimshaw 1997:199). Casey (1997:1) states in this regard that:

> "Computer technology is a powerful tool for discovery, learning and self-growth. It is equally powerful in supporting the learning of writing and reading for all children. Indeed, it can level the learning field for all children, regardless of social, economic, or academic background."

CAI can benefit all learners, enabling them to develop concepts, conduct research and make presentations when the relevant software is used in accordance with a well-planned curriculum. It has, however, been found that disadvantaged schools continue to use curricula based on old

technologies.  They merely add courses on computer literacy to the existing curricula.  This is a very unfortunate situation (Schwartz & Beichner 1999:188).  Such practices should be avoided to give all learners with the support of an integrated curriculum to enhance their learning.

Educators should discard the notion of a curriculum as "a course to be run", and rather think of it as a network of ideas to be explored, thus moving away from a stable, mechanical view of the world towards one based on complexity and change (Knight & Knight 1995:145).  Blows (1988:20) reasons that the curricula should identify applications from which learners can benefit most and they should outline specific objectives, including

- to introduce children to the way in which computers are used in our changing technological society
- to develop particular skills which can be used cross-curricularly (word processing, information retrieval)
- to develop logical thinking, problem solving and control techniques which en-able children to take charge of the learning environment
- to match the use of specific and relevant software or hardware to the particular needs of an individual or group of children
- to develop the wider use of computers across the curriculum to enhance work already being undertaken.

Such long-range goals as well as short-term objectives of the implementation of CAI through appropriate software in foundation-phase classrooms will establish and reinforce the relevancy of computing, also in elementary education.  One might have the best instructional plan ever developed and a wonderful set of materials, but if it is not properly implemented, learners will not learn as they should.  For technological aids to be effective, the right technological tools have to be used at the right time, with the right audience, and in the right manner (Haugland & Wright 1997:45; Newby et al 2000:139).  The curriculum for CAI needs to be functional and practical to result in better teaching and learning and to be of real value.

The curriculum, teachers and technology are major role-players when introducing learning matter through CAI to learners in primary and foundation-phase classes. Computers are not a general solution to all the education problems in the 21st century, but they have become a powerful tool in the educator's repertoire of tools and techniques. The benefits of technology in empowering learners and supporting and enhancing learning cannot be fully accomplished without knowledgeable educators and the proper integration of CAI into curricula. The final responsibility for the implementation of CAI into foundation-phase classrooms is with the educator, who needs to understand how computers and the software function as part of the didactic situation as this integration progresses (Casey 1997:1, 123; Light & Littleton 1999:7; Simonson & Thompson 1990:42). Thorough planning which does not always start or end in the classroom is at the heart of properly administered CAI. What and how we teach is always a compromise between what children need to learn and what educators can cope with. This also applies to CAI in foundation-phase classrooms. CAI can only be as effective as the curriculum that supports it, taking into consideration educators' and learners' attitudes and skills and the applicability of the software being used.

3.2.1.1  Curricula for foundation-phase learners

The age, abilities and interests of learners are important when compiling curricula for use in schools. Understanding what goes on in a child's mind and what concepts he or she can manage is a complex matter involving close observation and different approaches to the curriculum content (Snowdon 1989:45). The curriculum has to be relevant to the learners it is intended for.

The foundation phase (grades R-3) is part of Early Childhood Development (ECD), an umbrella term used to describe the processes by which children, from birth to nine years, should grow and thrive physically, emotionally, mentally, morally and socially. A curriculum for foundation-phase learners should form an integrated, trans-disciplinary approach across learning areas and

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should not be subject-bound.  Primary schools thus need to have increasingly structured but less cluttered curricula with minimum baseline objectives in maths, science, language and the arts, and more opt-in programmes to match learners' interests and abilities (Department of Education 1997a:2; Paine 1994:8).  Haugland and Wright (1997:108) stress that the curriculum for foundation-phase learners should deal with activities coinciding with the developmental level of the learners:

> "Today, a great deal of attention is focused on developmentally appropriate curricula for young children, which promotes active, creative, child-centred, open-ended, discovery learning.  This type of curriculum is cited as being the most appropriate learning environment for the developmental stage of young children."

3.2.1.2  The CAI curriculum for foundation-phase learners

The curriculum supports learning activities in classrooms and should keep up with major developments in society.  Modern curricula should thus aim to expand the technological skills of all the learners.  Schwartz and Beichner (1999:15) report that:

> "Skinner did reinforce the idea that learning could be improved if one had both a proper piece of technology and a proper theory to use with it."

The curriculum for CAI represents this theory in schools.  Educators should engage the curriculum to support the learning efforts of learners in foundation-phase classrooms as well. This does not always happen.

Computers are sometimes, for various reasons, used at random in classrooms.  Clear objectives and full integration of computer-related activities with the curricula to result in effective learning remains a problem.  Evans-Andris (1996:31) says:

"Clearly defined goals and policies, sensitive to the concerns and needs of users, promote effective innovation, yet these were omitted in the process of computer implementation in local (elementary) schools. Although school communities advanced technical change with computers, perhaps because of its capacity to lend efficiency to schools, enhance instruction, and increase the quality of education, other more immediate and narrowly focused concerns, particularly the acquisition and use of computing equipment, gained salience among educators."

Similar situations prevail in primary schools where all sorts of superficial activities and methods are sometimes dressed in computational clothing to pretend that children are learning about computers (Papert 1992:222). A first-grade teacher also admitted that whereas teachers in her school seemed eager to get computers for their classrooms, few had any ideas on or plans for using them (Evans-Andris 1996:15). Haugland and Wright (1997:3) state in the same vein that:

"Most computers in early childhood classrooms are used for remediation or for rewards. These computers are never integrated into the curriculum in developmentally appropriate ways. Statements like: 'Currently children in classrooms use computers primarily for drill-and-practice....', are frequently heard. Unfortunately, they are true in many cases. This type of practice doesn't result in effective learning."

Such problems are common. Young learners need exposure to CAI through various activities that are embedded in an integrated curriculum to enhance their learning.

Effective learning is ensured when alternatives are compared and tested, that is when learners think, rather than memorise through passively receiving another person's understanding (Sewell 1990:101). Computers provide the means by which children can explore, investigate, experiment and construct their own understanding through a set of computational tools. When offered independence through CAI, children will spend minimal time just sitting, listening and waiting. They will work individually or informally in small groups, freeing educators to move

around and extend learning by making suggestions, asking questions or proposing problems (Haugland & Wright 1997:45). Independent learning can become reality in foundation-phase classrooms through the integration of computer-related activities that could extend and enhance the curriculum for foundation-phase learners.

Educators should take the initiative in CAI and rethink and adapt the curriculum to make the best possible use of computers in the foundation phase. They become disillusioned about the value of using the computer when they integrate programs with limited potential into the curriculum. Results are disappointing when a program is used only because it is "about the right topic" (Casey 1997:123). The question to ask when selecting software for integration into the curriculum is whether it will play a supportive role in promoting the learning process (Haugland & Wright 1997:80). Computers can only be as good as the programs used and the programs are only useful when educators realise how they can contribute to the curriculum plan.

### 3.2.1.3 Software in teaching and learning

The hardware of computer systems is driven through the systems software, which enables a computer to perform. Application software refers to specific programs and packages like word processing, spreadsheets, databases, games and graphics that are especially designed to perform specific functions for the user. Applications software includes the common computer tools as well as educational software. It is through the applications software that most of the real work gets done (Newby et al 2000: 272). Educators need to be aware of what is available, and how the different applications influence one another, to be able to establish what computers are able to provide in terms of teaching and learning, especially for foundation-phase learners.

Properly selected and well-presented software can make a difference to teaching and learning in modern schools. Schank and Cleary (1995:15) reason that:

"Teachers ....(are usually limited in schools) .... to the three roles of selector, presenter, and evaluator. Teachers should help students figure out how to do stuff the students actually want to do. Practice (not studying) is an important part of learning .... (and) high-quality software could help make these possible."

The potential of modern educators to accommodate what really needs to be done in education is thus caught up in what CAI can provide through the software used. Wegerif and Scrimshaw (1997:98) express the same line of thought, but add that supportive and suitable learning activities, especially through learner exploration and group work, are beneficial to the software:

"To facilitate the exploration of ideas, teachers need to be aware of the importance of their own role in choosing appropriate software and in providing their learners with a learning context which encourages and supports exploration. This includes providing suitable activities to accompany the software, as well as developing learners' group working skills through explicit teaching."

It is thus clear that educators should take great care and consideration when selecting software for use in CAI in foundation-phase classrooms.

- Selecting software for use in schools

The applicability of computers in the didactic situation is dependent on the selection of software. Selecting software is not a fast and simple process. It requires time, experience, patience and awareness by the educator. Haugland and Wright (1997:4) say in this regard:

"Software selection is the most important decision teachers make. It can be time consuming, frustrating and expensive."

The selection of software is of the utmost importance in terms of the curriculum. Liang and Johnson (1999:57) report that too much complexity or rigidity in the software or computer environment could inhibit educational play and learning. Software for use in schools should include aspects of creativity, imagination, challenge and curiosity. Software which is open-ended and aimed at problem solving makes concepts simple and concrete, promoting understanding. Learners will engage in positive play with computers if the software provides developmentally appropriate activities and materials. Evaluation is the task of every user, be it educator, child or parent. Educators can review programs and have their possibilities for use by children tested when a group of children utilising the program is observed. Testing gives the educator the opportunity to select the software most appropriate for specific lessons (Haugland & Wright 1997:22; Simonson & Thompson 1990:261). However, the majority of educators have little time to spend on finding and evaluating software, let alone relating what is available to classroom practice and curriculum development. Faced with an increasing range of programs, many educators are inhibited, disarmed and unsure of how they can make good use of the new technology in the curriculum (Royle 1989:171). Educators should, as in any instructional activity, determine and assess their needs in relation to the computer, and should specify the desired software characteristics accordingly (Newby et al 2000:124). Blows (1988:21) warns of the importance embedded in the selection of software in terms of learner needs:

> "There are so many exciting things that could be included. But you will have to be realistic. The approach should be 'I am planning this work, would the use of a computer enhance it in any way?' The trap to avoid is 'I've got this software, how could I use it!'"

The implementation of CAI in schools has resulted in the proliferation of software intended to complement regular instruction and also for enrichment and remediation - a development generally appreciated by educators and parents. Initially, manufacturers and distributors did not consult educators before software appeared on the market, but more realistic educational contributions are being made now that the opinions of educationalists are being taken into

consideration. Modern software continues to improve in its ability to engage learners and to provide realistic and stimulating learning environments due to wider consultation and greater financial input by the industry (Evans-Andris 1996:1; Ross & Schulz 1999:5). Wegerif & Scrimshaw (1997:210) say the following about the latest developments in software intended for use in schools:

> "First, software content is integrated with a programme of off-computer lessons that give children the skills to work effectively together at the computer. Secondly, the interface is expressly designed to support collaborative learning. And third, the software is designed to relate directly to the specific demands of the school curriculum."

Programs developed in foreign countries demand special attention from evaluators since they are not always completely suitable for local use because of the cultural, language and social differences. However, Lawler (1997:16) acknowledges the positive side of some of these programs:

> "This could lead to software and instructional products, embodying our best understanding of the world but designed for cultural adaptation. .... (W)e can help educate the world's children as well as our own .... without undercutting cultural diversity."

Stonier and Conlin (1985:43) discuss the connection between books and computer programs. They explain that the main reason for buying a child a book is for the child to enjoy the story, to enjoy reading, and to be encouraged to read other books - not to learn the meaning and spelling of every new word by heart. In a similar fashion, computer programs should provide pleasure as the child explores the world. Stonier and Conlin (1985:44) continue: " .... (I)n principle there is not much difference between buying a good book and buying good software." This advice

provides a general guideline for educators when selecting software for use in foundation-phase classrooms, although other features could also be considered.

- Characteristics of applicable software for schools

Computers should be used to build learning-related skills and experience in foundation-phase classrooms, and should not cater for fun alone. Haugland and Wright (1997:4) maintain that software determines the kinds of computer experiences young children have. Learning gains can only be significant when software is developmental, that is exploratory, open-ended and user-friendly. Non-developmental software is frequently termed drill-and-practice, for learners are drilled to learn certain work and are rewarded when they provide the correct answers. The computer thus controls the action while the users react or respond to it (Sewell 1990:83). Liang and Johnson (1999:57) agree with these views and add that educators should select and apply software according to their learners' needs. Software that promotes interactivity enables user initiative and encourages testing of hypotheses and provides relevant feedback that is meaningful to both the task and the user should be selected. Software for use by young children should be challenging and include elements which stimulate the learners' imagination, creativity and curiosity. The software should emphasise aspects such as

- problem solving orientation
- developmental appropriateness
- playfulness and
- incorporating new technologies (e.g. multimedia and humanised software).

Children are curious and inquisitive and want to explore and discover how and why things happen. They want more information about the world and want to become more independent in their learning as well. Innovatory software should be offered to learners to help them realise their potential through interaction, participation and challenges, and for them to be recognised as sophisticated users of programs. More programs that offer innovation and flexibility are thus

needed for use with children (Griffin & Bash 1995:79). The concise but embracing Haugland/Shade developmental scale is an evaluation sheet for evaluating the applicability of the software. It includes criteria like age, child control, language, gender, culture, violence and graphics (Haugland & Wright 1997:27). Haugland and Wright (1997:9) also provide a summary of features to be kept in mind when selecting software:

> "The content of software must be suitable, accurate, didactic, aesthetic, motivating, flexible, current, balanced, educationally sound (blending in with the school's established curriculum), top quality, provide immediate feedback and easily understood and operated, allowing active involvement from the learners."

When selecting software for use in foundation-phase classrooms, educators should insist that the software facilitates independence and does not require frequent prompting or assistance. Such software should be developmental, innovatory and flexible and provide a challenge as well as fun for every user. However, the success of CAI in classrooms is largely determined by the ingenuity of the educators, who have to exploit the abilities of the learners in terms of the potential embedded in the curriculum and the software.

- Integrating software with the curricula

Teachers and their human qualities are irreplaceable in the didactic situation. However, computers can render valuable assistance when CAI is firmly woven into normal classroom activities and the curriculum, and used as an asset instead of a liability (Haugland & Wright 1997:43). Casey (1997:123) says in support of this view that:

> "Despite revolutionary advances in the field of educational computing, technology is simply a tool. Potentially powerful and stimulating, the computer is only an inert object that cannot substitute for the personal touch of the classroom teacher."

Educators are important partners in education. They are able to solve problems and to modify the didactic situation in such a way that it meets the specific learning needs of learners. The computer is only as good as the program that has been created for it. Educators interpret the curriculum and initiate the use of CAI to benefit teaching and learning in foundation-phase classrooms. Until they recognize performance gaps that are best solved by computers, it is unlikely that educators will perceive the equipment as relevant or important to their teaching. It would be difficult to integrate technology into classrooms with staff that is not interested or able to implement such an objective (Evans-Andris 1996:31; Ross & Schulz 1999:9). Educators should also have the technological skills to ensure that activities on computers are embedded in the curriculum and they should try to match the learner's capabilities and attitudes, and the demands and expectations of computer environments.

Educational activity is not only defined by the software, but also by the software in the pedagogic context. Educators should not focus on the computer alone, but combine it with familiar and effective teaching methods in the classroom. Combining the software with off-computer coaching can enhance the quality of interactions at the computer (Wegerif & Scrimshaw 1997:199). Newby et al (2000:120) remind educators that a variety of methods can be used in any instructional situation:

> "The combination of methods may be more powerful and result in more learning than either method used alone. The key is to focus on what will work best to help your students learn your content."

Computers are tools that provide learners with learning experiences according to the software that is used. When the software is developmentally appropriate and based on the curriculum, the progressive educator can expect teaching and learning gains through CAI in the foundation-phase classroom.

3.2.1.4  The Internet in teaching and learning

The Internet comprises an international network of computer networks that allows users to share information and to communicate interactively. Internet applications include personal messaging (e-mail), teaching and learning, entertainment, research and business (Gunderson & Anderson 1999:5). This facility can be a valuable tool in schools and should be available for use by all educators and learners. Moursund (1997:77) is positive about CAI in schools, and clearly links the use of the Internet to the didactic situation:

> "Many different computer tools can help increase teacher productivity. Examples include the word processor, electronic gradebook, databases of exam questions, stored lesson plans,.... (a)ccess to the Web ...."

Learner productivity increases when the same tool can be applied in several learning situations. According to Newby et al (2000:213), computer technology can be used for most educational goals in typical classrooms as well as in distance education for

- reaching individuals isolated by distance or geographical barriers
- reaching non-traditional populations of learners (e.g. adult learners or homebound individuals)
- linking classrooms together so learners can interact with one another to learn, solve problems, and communicate
- allowing teachers to consult with experts at remote locations regarding teaching practices, curriculum, research, and so on.

The educator is no longer the sole deliverer of information. As we move toward lifelong learning, it becomes increasingly important to know where to find information and how to use this information. The world of information is at our fingertips through the Internet, which is easy to access and simple and fun to explore. It can be used for learning at school, at home, or in the community. Internet applications should be available to children so that they can learn how to

locate, evaluate and apply information to solve problems in all types of classrooms. In the future learners will be judged on their ability to find and use information rather than by what they have memorised from textbooks. Electronic learning tools alter learning environments, because they make clearer demands on the quality and outcomes of learning, insisting on the review of aspects like curricula and assessment. They also demand skills and knowledge and smoother transitions between schools, colleges and universities that will give learners a firm footing in the job-market (Gunderson & Anderson 1999:6; Lewis 1999:142; Newby et al 2000:264). The Internet offers a wealth of curriculum-based tools and learning opportunities, as well as limitless fun and recreation for all.

Technology is becoming more sophisticated, yet more accessible, available and effective, putting unprecedented power in the hands of competent users. A major reason for the existence of school libraries has traditionally been to provide resources to support the school curriculum. The Internet is a tool of communication, information and fun and acts as a database with masses of information and resources like lesson plans, video and sound clips, photographs and games which can be downloaded. It changes the need for physical libraries, because a new information resource with computerised information storage and retrieval systems has now become available and is in routine use through online information services. People will not need to "go to the library"; rather the contents of the library will come to them from libraries throughout the world (Armstrong 1995:13; Schwartz & Beichner 1999:15; Sewell 1990:210). Moursund (1997:74) elaborates on this radical change:

> "There is considerable agreement that libraries will become 'virtual libraries' - that is, that library contents will be distributed electronically throughout the world, rather than being physically available only in isolated buildings."

This phenomenon influences information distribution in both societies and the schools that serve them.

The importance of the Internet in society needs to be addressed in schools through educators assisting learners in realising their potential when using this tool. Educators and learners should make proper use of the Internet. Lewis (1999:142) is adamant that education should provide learners with some structure for managing the complicated mass of information that is available on the Internet:

"The very nature of knowledge is being affected by the increased availability of information.... Information is no longer structured in a simple, linear, logical fashion: it is becoming fragmented, multi-channelled and simultaneous. Education must help the learner make sense of this new information age."

Educators should ensure that learners develop effective retrieval and evaluation skills to be able to use the Internet effectively. The Internet can only serve as a tool in the classroom if it extends and enhances teaching and learning. The educator therefore needs to plan and structure the lessons accordingly. Liang and Johnson (1999:58) state that:

"Teachers can use the Internet to enrich the curriculum by helping children to obtain information that is related to an instructional activity. The Internet provides teachers with an educational tool, but only if teachers plan and organize the environment for children to access it. Otherwise, children often end up wasting their time doing surfing and learning nothing."

If properly applied, the Internet could become a valuable tool in the hands of educators and learners. It is a great source of information and should be used in foundation-phase classrooms as well. However, educators and students must have realistic expectations of the Internet. It will not answer all questions and solve all learning problems. The Internet is a learning tool, and like all tools, it must be used properly to be of real value (Newby et al 2000:208). There is a difference between knowing how to use the Internet, and learning something from it. The exposure of learners to tool applications does not necessarily result in more meaningful learning.

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The potential of projects based on tool applications requires careful structuring, guidance and modelling by educators. Learners should not use the Internet just for its own sake or to find information readily available in the classroom. Schools need to provide access to the Internet while at the same time monitoring this access in various ways to insure that users do not abuse this privilege (Gunderson & Anderson 1999:9; Liang & Johnson 1999:61; Newby et al 2000:206). Haugland and Wright (1997:123) state that: "The Internet has the potential of opening the doors to worlds of additional classroom resources."

Global networking can click into action for all learners, for the Internet bridges distance. Computer conferencing in classrooms has great potential for changing the ways students and instructors interact with each other during the learning process. Cross-classroom collaboration is one way in which communication technology could change the context of the classroom to enhance learning. Educators would not be the only educators in the classroom, but could be joined by visiting educators from other locations and all sectors of society through the Internet. The learners would thus no longer be isolated from the adult community (Koschmann 1996:205; Newby et al 2000:208).

The Internet also has the capacity to heighten learners' awareness of the environment and other cultures. Walls and prejudices can be broken down when learners around the world communicate with one another. A rounded viewpoint of other countries, creeds and races can be built, while fast and direct feedback through facilities like e-mail becomes commonplace. This makes the world smaller and more comprehensible for the young (Spiller 1997:47). The Internet can overcome distance and barriers and constructively link people in a way never possible before.

The Internet makes masses of information available for use by all, including foundation-phase learners. Internet use has to be anchored in the curriculum to be used to its full potential in schools. It is a tool in the hands of knowledgeable educators and learners. The Internet can enhance CAI and assist to improve modern didactic situations.

## 3.2.2  Integrating computers into classrooms

Most educators taught successfully without computers, and many schools still generate excellent levels of education without using much technology, but times change.  Some time ago Skinner (1986:16) predicted that computers would benefit communication and lead to the more effective distribution of time in schools, for learners would learn to express themselves more effectively, while educators would have more time to talk with students.  This later proved to be true, because Evans-Andris (1996:148) reported that computers enriched the regular curricula, enhanced teaching skills and provided individual instruction in classes where CAI was successfully implemented.

Technological tools have become a part of the school and assist progressive educators in the didactic situation.  Both the educators and the technology should be taken into account in the study of IT.  Where educators had effective systems going for using computers in classrooms, these systems appeared to be working clear and straightforward (Birch 1995:43, 48).  Newby et al (2000:61) warn educators to rethink classroom practices:

> "Keep in mind that the computer with appropriate software is just a tool, albeit a very versatile one.  ....(T)he computer can do a lot of different things.  However, it is not appropriate for everything. ....(T)he computer is not particularly effective in many learning situations ranging from helping students learn handwriting to assisting with some types of complex reasoning and problem solving."

Computers revitalised teaching and brought a sense of excitement and enthusiasm to instructional settings. A fourth-grade teacher from a public school explains how she approaches CAI in the classroom, "We do a tiny bit of drill-and-practice.  But really, almost anytime I use a program, I want the kids to get to the point where they can think independently and creatively and use the computer as a tool" (Evans-Andris 1996:83).  Educators in primary education have

an important role to fulfil, by matching the work to the learners' needs and ensuring they make progress. The ultimate aim for educators using CAI should thus be to have learners use the computer as a tool to promote individual learning in every activity they undertake.

Children's compositions used to be done with blocks, art materials, crayons and pencils. Writing and drawing can now be enhanced with graphic and scanned images, sound, text, motion and colour through technologically enhanced multimedia centres. Such computer writing tools scaffold learners by providing feedback and support. The Internet facilitates children's literacy learning as well, for they can exchange stories and ideas with other children all over the world. Learners are usually more careful with their writing when it will be viewed by their peers or experts in another part of the country or the world on the Internet, because they want to communicate clearly to create a good impression (Armstrong 1995:13; Birch 1995:43; Liang & Johnson 1999:58). According to Newby et al (2000:205), the Internet provides additional information, but also acts as a notice-board, allowing learners to post their efforts in public. Foundation-phase learners do not need much encouragement to participate in new or exciting ventures. Casey (1997:131) says:

> "We are at a marvellous juncture in the freeing of the human brain's potential for learning. The three to six year olds are eager and willing to point out the way. Many new and exciting discoveries about the power of learning are being discovered daily...."

Young learners enjoy "finding new things", also when they are playing and learning while working on computers. They regard themselves as successful when they can "make the computer do new things". To ensure that effective learning takes place educators should be at least one step ahead, in setting up opportunities for their learners, to discover and explore. The primary class area can be an exciting environment for a young child in the care of a hardworking, skilful educator, ever ready to explore new situations and ideas (Stonier & Conlin 1985:104). Using computers as tools in foundation-phase classrooms implies the deliberate integration of computing with the curriculum, including selecting software and establishing how it should be applied.

Computers could assist learners in the accomplishment of the following reasonable goals at primary school level (James 1986:193)

- development of problem solving skills
- development and reinforcement of mathematical skills appropriate to age level
- creative problem solving
- divergent thinking
- group cooperation
- development of meta-cognition
- use of precision in language
- growth in confidence and self-esteem.

Stonier and Conlin (1985:105) warn that no computer can or should take the place of field trips in schools, although researchers like Schwartz and Beichner (1999:20) encourage "virtual field trips", for instance, for undertaking space travels. CAI opens many doors that have remained closed up to now but computers cannot replace the personal touch of the classroom teacher. How educators implement computers into classrooms is a critical matter, for the benefits of technology will not be fully attained without a properly integrated curriculum (Casey 1997:96). Ideally, computers should thus not be the only mode of instruction, especially not in foundation-phase classrooms.

## 3.3  Classroom organisation

In modern societies the role of the educator is changing as education changes. The educator is becoming more of a manager than a mentor in the classroom. Teachers' responsibilities are increased rather than diminished in modern day teaching and learning due to the rapid growth of

information and the consequent expansion of learning activities to include related skills (Cummings 1988:158). Effective classroom organisation can relieve the educator from some of the time-consuming responsibilities in the didactic situation and result in more successful learning activities.

The way in which teaching and learning is introduced, managed and promoted has become critical to success in foundation-phase classrooms. Different media and teaching methods can be combined and used simultaneously in classrooms through technology in an integrated curriculum (Newby et al 2000:158). The integration of new technology in the learning matter might motivate educators and learners who have lost interest in their endeavours (Evans-Andris 1996:33). Spiller (1986:159) alleges with regard to teaching and learning that:

> "(To a child a computer is) .... just another playground to explore, to manipulate, and even to get bored with. Children working or playing with computers use the same intellectual patterns as when they play with blocks or crayons, or tackle their homework."

Tested teaching and learning methods in tandem with CAI can enhance the normal didactic activities and open new worlds to both educators and learners in the classroom. Wasserman (1985:334) regards the implementation of technology to foundation-phase and other classrooms as vital:

> "Is it too much to ask .... to bring to the classroom, right alongside the computer, the primary tools of children's play: sand and water, finger paint, conversation, singing, daydreaming, crying, quarrelling, blocks, creative writing, clay, dolls, chalk, painting, loving, dancing, .... not just in the primary grades, but throughout the school."

New methods and approaches can be introduced through the flexibility and the wide range of possibilities offered by technology in the educational arena. However, as stated by Evans-Andris (1996:78; 153, 114) if educators are ignorant and indifferent about the application of CAI, they might be unable to make straightforward and unbiased adjustments to the related curricula and classroom practices. They would thus forfeit enriching computer experiences. Computing is mostly used as remediation and skill reinforcement through drill-and-practice and tutorial instruction in mathematics, language, arts or word processing when educators act without proper reflection about the possibilities computer applications can offer in teaching and learning strategies. Such educators might view the computer merely as a babysitter, or something to do when there is time, but computer-related activities are at the bottom of the list and mostly not incorporated into teaching.

According to Grabe & Grabe (1996:1) learners rarely use computers for content-area learning tasks, parents are not always involved in CAI and educators hesitate to use computers in group work and for assessment. When computer-using educators were asked how their students used technology in the classroom, they mostly referred to it as enrichment, while only (English) language teachers and students used technology frequently as a part of their regular instruction. Educators, administrators and co-ordinators agree that computer-based activities are often unrelated or, at best, loosely tied to classroom curricula (Stimpson & Ewing 1988:139). This might be true in teaching in the foundation-phase as well and thus demands urgent rectification to both the training and the attitudes of educators, as well as to the way CAI is incorporated into the curriculum. There is hardly any profit in using computers at schools just for the sake of being able to say: "We use them". The proper implementation of CAI in the curricula to achieve the intended outcomes of foundation-phase classes is of major importance.

Effective classroom organisation implies a well-developed and flexible plan for teaching and learning, thoughtfully implemented through learning programs by the educator who makes on-the-spot judgements about the application of rules and procedures and how to communicate the decisions to the learners (Van der Horst & McDonald 1997:87). Modern educators have a

special responsibility to allow the learners to use computers individually, or in groups, to reach the planned outcomes in the didactic situation through an integrated curriculum and suitable learning programmes based on the learning areas. Continuous assessment is necessary and parents have to be involved in CAI, especially in the foundation phase.

## 3.3.1 Learning programmes

Learning programmes are compiled to guide teaching and learning at a specific level. Learning programmes encompass organisational and management issues in every classroom (Birch 1995:49). According to the Department of Education (1997b:13, 32):

> "A learning programme is a set of learning and teaching activities and ways of assessing a learner's achievements, .... based on national guidelines. .... (that) will replace what we know as the 'syllabus'.... (It) consists of courses or units of learning (learning materials combined with a methodology), by which learners can achieve agreed-upon learning outcomes."

Learning programmes are thus portrayed as the vehicle which is used to implement and present the curriculum to the learners at various learning sites in order to benefit all learning-related activities. Learners in the different classes take part in the learning programmes of each domain or learning area, with its specific knowledge, understanding, skills, attitudes and values, to complete the various school stages and to become more independent learners. Curriculum planners thus arrange expected learning experiences according to the learning area, course, grade level and lesson, to allow both educators and learners to be creative in the classroom while adhering to the curriculum.

Foundation-phase learners are exposed to a balanced curriculum which comprises the main learning areas, known as literacy, numeracy and life skills. These learning programmes are expanded as the learners make progress and gain better skills. The intermediate phase has five

and the senior phase eight learning areas that integrate related subject disciplines. Information technology (IT) has become an integral part of these learning areas and has to be included in every educator's classroom routines, systems and teaching styles through the learning programmes and activities, involving the learners in working towards the achievement of specific computer-related outcomes at their level. The correct tools at the appropriate time can assist both educator and learner in the classroom to achieve the goals envisaged by the curriculum (Department of Education 1997a:14; Janse van Rensburg 1998:30; Van der Horst & McDonald 1997:144). Computers should thus be introduced to learners through the learning programmes in the foundation phase to enhance teaching and learning through CAI. A learning programme should include critical and specific outcomes and assessment criteria to assist the educator with continuous evaluation of every learner's progress, also in terms of CAI because CAI supports the outcomes of learning in every classroom.

## 3.3.2 Outcomes

Outcomes are the results of learning, a successful demonstration that learning took place. Specific outcomes are linked to a particular context or learning area in the classroom. Educators should use outcomes as focus points when making instructional decisions and when planning their lessons. Outcomes for the foundation phase will ensure that learners gain the skills, knowledge and values that will allow them to contribute to their own success through problem solving, group-work, effective communication and the effective use of science and technology. Critical outcomes are the aims and objectives relating to teaching and learning and they relate to the broader, intended results of education (Department of Education 1997a:12; Pretorius 1998:28; Van der Horst & McDonald 1997:7, 22, 50). How well learning has taken place in each phase can be measured against the outcomes for the applicable learning phase because outcomes are closely linked to assessment.

Computer literacy, at the very least, should be included in learning programmes to assist learners when contemplating learning outcomes for Information Technology (IT) for the foundation-

phase. IT-related learning area outcomes should enable learners to understand and apply the technological process to solve problems, to responsibly apply a range of technological knowledge and skills and to access, process and use data for technological purposes. They should also be able to select and evaluate products and systems, to demonstrate an understanding of how different societies create and adapt technological solutions to particular problems and to demonstrate an understanding of the impact of technology (Van der Horst and McDonald 1997:56). Outcomes should thus be applied to the way in which CAI is implemented in classrooms. Using computers in the classroom can assist foundation-phase learners to better reach these outcomes. Managing the outcomes would enable the learners to use computers independently, or in groups, to support even foundation-phase learners, for the use of CAI gives learners an opportunity to enhance each of these skills as part of the didactic program.

## 3.3.3  Group work

Group work or cooperative learning refers to small groups of students working together towards common goals. This kind of cooperation and interaction allow students to learn from several sources, not just the educator. Group work also provides them with the opportunity to share their personal knowledge and abilities with the other learners. The way in which learners are generally grouped together in schools - for various reasons and activities - has come under scrutiny in recent years, especially since computers have become more freely available. Crook (1999:103) alleges that computers assisted in making learner interaction visible to researchers. Learners are more inclined to enter into discussions about schoolwork when working in groups at the computer. All the learners in the group can see the work simultaneously on the screen, thus prompting the development of their critical abilities (Newby et al 2000:146; Royle 1989:173). Learners also begin to develop responsibility for their own learning through group work. Evans-Andris (1996:102) reports a view on group work and games:

"A third-grade teacher shared her enthusiasm: 'I use games on the computers that kids can work on in groups. The games really get the kids' minds to stretch and to think of alternative possibilities for solutions.' "

Interaction within the groups enhances the development of various learner skills at the computer and provides individuals with effective support systems, especially in foundation-phase classrooms. Newby et al (2000:61) found that:

"Using the computer with small groups of students who can work together on a project may prove beneficial to learning new software, gaining experience with the computer, reducing computer technology fears and anxieties, and engendering exploration."

Computers can be used to instigate learning when attempting group work with CAI, also with foundation-phase learners.

Learners generally do not feel intimidated by peers when working together in groups. They want the group as a whole to excel and be better than the other groups. Heterogeneous groups of students working on computers on collaborative tasks teach, stimulate, assist and evaluate one another. In the early phases of research, group members often work in isolation on making a real contribution to the final product. Individual reports are combined and improved by the group before the report is printed (Grabe & Grabe 1996: 27). Criticism is hardly ever seen as personal, but as an endeavour to better the product. When the computer serves as a tutor and problems are well defined, students often play the role of motivational facilitator, providing psychological support for one another. Learning in groups and with peers may be a more effective way of achieving some educational goals, because children solving a problem together, generally think more effectively than when they work alone (Underwood & Underwood 1999:12, 13). According to Crook (1999:115) collaboration is a rich seam of activity within classroom life. Learners enjoy well-structured group work. Educators should endeavour to

encourage cooperation and reduce competition between groups of learners in a class, so that the school and class ethos can help motivate learners, and direct learning in general.

Group work is reflected in the learning activities which take place in the classroom, rather than in the way the tables are placed. However, this does not just happen by itself. Effective group work is generally seen as the interaction, scaffolding and sharing that emerge when groups work together, and it is regarded as a positive development. Technology has the potential to direct the collaborative endeavour of learners in new and exciting ways (Light & Littleton 1999:193). Van der Horst and McDonald (1997:138) report on a view which was expressed in the *Sunday Times* in 1997 that effective group work requires meticulous planning, clear instructions, constant monitoring, assistance, guidance and careful assessment according to pre-planned schemes if the desired outcomes are to be reached. Thorough planning by educators ensures that the groups function effectively, that they serve a specific purpose and that learners are actively involved in meaningful activities. Educators need to set enough activities to keep groups occupied with interesting and challenging tasks, appropriate to their level of development.

The use of media can result in distraction instead of insight, and create confusion, frustration and discouragement among learners when the educator's preparation is not completed and questions from learners go unanswered. Educators should ensure that learners clearly understand their tasks, as well as their individual roles within the group, for group work at computers to be effective and efficient. Children should work in groups of three or four to facilitate orderly access to the keyboard, allowing each child to have a specific job to perform, like operating the keyboard, reading the screen display, or recording required information. The sharing of computers may reduce the amount of keyboard time each learner gets, but when only one learner is assigned to a computer, frustration resulting from complicated activities may have a more negative effect (Newby et al 2000:159; Wilkens 1998:69). Group work provides opportunities for dynamic, informal learning to take place.

Groups might be organised heterogeneously or homogeneously, according to age, interest, gender and the sizes of groups may vary, depending on the activity. Groups should not remain static or permanent, because working with new partners exposes learners to a richer variety in thinking strategies. Learners can take responsibility for their own learning from an early age. They also learn to operate effectively in groups when teamwork is a clear objective. Learners need to talk about their learning. Discussions or debriefing after a program has been done is one way of getting feedback on their performance while working together in groups (Pretorius 1998:70; Wilkens 1998:68). Such cooperation among groups of learners instils responsibility in individuals and assists educators with individual and group assessment.

### 3.3.4 Assessment

Assessment is an integral component of teaching and learning in every classroom, according to Van der Horst and McDonald (1997:169, 170). They go on to say that the terms, *assessment* and *evaluation* have been used interchangeably over time. The term *assessment* describes an ongoing process in education and implies strategies for measuring the worth or quality of aspects like knowledge, skills, behaviour, performance, values and attitudes through data gathering. The data help educators to evaluate and make decisions to increase didactic quality (Newby et al 2000:220). Educators thus need to continuously assess the classroom situation to evaluate learner progress and to make the necessary adjustments to learning programs in order to improve teaching and learning.

Outcomes-based assessment should be uninterrupted and ongoing, based on the educator's observation of authentic tasks performed by every learner over a period of time. In such assessment different assessment techniques are used to measure learning outcomes. Educators need to evaluate the curriculum and the effectiveness and appeal of the instruction, as well as conditions for learning, to identify learners' weaknesses and strengths. By doing this they can improve instruction and learning. This has traditionally been done by examining how well

learners completed their lessons and by determining whether they have attained the desired levels of performance (Janse van Rensburg 1998:83; Newby et al 2000:14; Van der Horst & McDonald 1999:171, 173). Educators should constantly assess all classroom activities to identify gaps between the current and the desired levels of skills and knowledge, and select instructional methods and strategies to meet the needs of every learner in the class.

Outcomes-based assessment criteria and performance indicators supply a list of the "little steps that the learners will be taking" in their learning. Reliable assessment procedures like observation, standardised tests, projects, questions and answers, self assessment and peer assessment or group assessment, interviewing, performance, conferencing with parents and learners, journals and portfolios, assist both the educators and the learners to establish whether the latter have achieved the desired learning outcomes. Criteria that are relevant to curriculum priorities, that are reliable, balanced, integrated, positive, transparent and fair and focus on the outcomes of the program, unit or lesson. Criteria are useful when educators want to standardise assessment and consider each learner's unique learning styles, abilities and characteristics (Department of Education 1997a:16; Newby et al 2000:13; Spady & Schlebusch 1999:113; Van der Horst & McDonald 1997:167). Computer programs offering results that can be called up and used for assessment afterwards make valuable assessment tools.

When the correct technology is applied in the most appropriate way, control such as assessment becomes almost natural. Sewell (1990:21) regards the ability of computer technology to record, store and play back every key pressed as a powerful feature. This feature helps to facilitate assessment. Good tutorial programs keep track of learners' errors and levels so that the educator can later access a synopsis of the work. Computers also render assistance with assessment through tests that can be administered either interactively (on-line, or by typing answers on a keyboard) or non-interactively (off-line, or with pen and paper). Modern technology has the power to make one's own thinking concrete in a way that has never been possible before. Educators can now emphasise the process and not only the product of learning

and understanding, not just knowledge (Kinzer 1986:228). Evans-Andris (1996:102) reports that:

> "A teacher said that: 'The computer gives me a chance to look at the kids' individual learning patterns.' Whether in reading, math, grammar, or other area, most of the teachers contended that computers enhanced their ability to assess student skills and better target students who need individualized instruction."

Assessment is concomitant with effective teaching. It is useful in determining whether remedial action is necessary and in deciding whether retention or promotion will be better for a learner (Van der Horst & McDonald 1997:207). Assessment to determine a learner's skills and abilities as well as what should come next must form an integral part of preparation and planning, also with CAI in foundation-phase classrooms.

## 3.3.5  Parental involvement

Parents should share the responsibility of education for their children with the educators. Parents and educators of foundation-phase learners have to ensure that successful CAI becomes part of the curriculum to benefit the development of the learners. Parental involvement in learning and using the computer as a tool both inside and out of the classroom has become a necessity. Winkley (1994:68) states that:

> "The 21st century curriculum .... focus on key targets in achievement for the early years. Much more use is made of individualised computer programmes, parent-training and support, and confidence building.  ....(T)he curriculum is shaped into a myriad of planned components.  The objective of these curricular programmes is to provide

children with the best possible facility to successfully develop all their talents and interests as rapidly and as far as possible on the learning journey."

Schools function as part of a community. The community provides inputs to help direct the teaching and learning in schools and determine the ethos of schools through parent associations and governing bodies. Good relationships between parents and educators take time to develop, but are rewarding, and can influence teaching and learning as well (Department of Education 1997b:22; Van der Horst & McDonald 1999:175). It is no longer feasible for parents to "dump" a learner at a school, pay huge school-fees and expect to find a grown-up after twelve years.

Children learn from experience. The fact that computers offer individual tuition is a positive development and parents should delight in the development of micro-technology, for this enables their children to learn at home, at their own pace, and allows them to follow their individual inclinations (Stonier & Conlin 1985:133). Encouragement from both parents and educators provides motivation when foundation-phase learners want to reach goals that are important to them. Computers and applicable software have been credited with motivation, success, the enhancement of technological abilities and the development of cognitive skills characteristic of high-level thinking. It results in a powerful appeal to educators and parents of foundation-phase learners, but parents and educators who apply force can rob the young child of a childhood unfettered by economic expectations, and cheat them out of a portion of their childhood. In pushing the children, parents may create learners who experience the world through the eyes of a software program designed by adults. Their critical learning experiences could benefit if learners are motivated to extend their limits during the developmental stages, but the promotion and acceleration of the development of intellectual skills in young children should not neglect the significance of childhood. Liang and Johnson (1999:61) also warn over-enthusiastic parents and educators about popular, but deceiving views, reminding them that computer proficiency does not necessarily imply cognitive development. Learners can become

active partners in developing their maturity, while outcomes like creativity and critical thinking can also be established by using CAI in foundation-phase classrooms.

Parents have to ensure that their children become independent learners. To do this they need to be involved in CAI, at home and with educators as part of a team. Building a software library at home, based on the same principles as building a library of books, is a valuable starting point. A variety of software categories including reference, activity tools and learning activities could be considered. Magazines often offer information on what to buy and how to plan such computer-related activities at home. Individual interests should be taken into account when selecting software but common interests should also be considered to promote collaboration among family members (Haugland & Wright 1997:4, 109). Developing and using computer home libraries could improve personal relationships and promote shared interests within a family.

Stonier and Conlin (1985:31) are in favour of young children learning at home rather than at school. They regard appropriate computer programs as invaluable in providing such opportunities for all young learners:

"The home is the most important single learning environment a young child has. The computer, with its potential for fun and with its infinite patience will be a most valuable aid to home based learning systems. In short, home will become the place to go to learn - school, where you go to play...."

Parents should become more involved in educational computing and insist on buying educational programs with direct ties to the core curriculum. MacKay (1986:83, 84) says it is critical for parents to be able to make informed choices about the educational value of software, for they form a large consumer group. They also provide the bulk of the money for the purchase of equipment. Developers of technological appliances would be forced to take note if parents were not satisfied with educational products. According to research by the Software Publishers

Association in America, parents feared that their children would become hooked on the computer, some were concerned that their children would play too much games on computers, but virtually every parent bought a computer in the hope that it would help the children to get ahead in school (Haugland & Wright 1997:108, 121). Evans-Andris (1996:55) reports interesting perceptions in this regard as well:

> "Some teachers indicated that they were very conscious of a responsibility to community constituencies. These teachers commonly mentioned that they felt obliged to use computers because of expectations held by their school community, particularly parents. One teacher said: 'Parents insist that computers be used. In my 22 years of teaching, that has been the only thing a parent has ever insisted on, not math or English, only computer.'"

Newby et al (2000:205) allege that parents and members of the community can get a sense of what goes on in a specific school by looking at work posted on its Website. CAI enables modern parents to be closely involved in their children's educational development. Parents should take up the challenge technology offers and become a partner of the educator, investing in the future of their children.

## 3.4 Summary

Educators should use computers in classrooms to complement and supplement teaching and learning. Educators should take up the roles of classroom managers and facilitators of learning to secure an orderly didactical environment that enhances teaching and learning in schools. CAI enables educators to spend more time on communication and on actively supporting learners on their way to independence and adulthood. However, teaching and learning change continuously in trying to keep in step with the world and its realities, and also to keep abreast with new

information and technology.  Educators thus need to accommodate these changes in the didactic situation to adequately prepare the learners to eventually participate fully in their own future.

The educator facilitates learning when the didactic situation is managed to effectively accommodate each learner in such a way that every opportunity can result in maximum learning. This can also be achieved using CAI in the foundation phase.  CAI is a fairly recent development in the didactic situation, but it can result in positive changes to teaching and learning when included as a part of the regular curriculum.  The curriculum for the foundation phase should include CAI through suitable software as well as the proper incorporation of the Internet.  The benefits of the Internet in the classroom include that it allows learners to construct their own body of knowledge through well-structured searches.  Learners have to be able to quickly find, select and retrieve necessary information.  It not only opens new worlds for exploring, it can also support independent learning in the classroom.  All learners need to be confident and computer literate to be properly prepared for independence and adulthood in a modern world flooded with information.

Using computers as tools should be part of the learning programme at each level, to ensure that learners reach the specific outcomes.  Educators should follow the learning programmes according to the learners' needs and levels of competence to enhance cognition and purposeful learning.  Learning programmes should incorporate aspects like problem solving, independent learning and group work especially when using CAI, in the foundation phase. Educators have to keep the identified learning outcomes in mind and assess their teaching as well as the learning progress of their learners on a continuous basis, to be able to make relevant adjustments to improve both teaching and learning and to ensure success in the classroom.  Success can be within reach for all learners when their cognitive abilities are maximally challenged, both through individual effort and when they participate as members of a group.

Full integration of CAI into educational systems will remain a distant goal unless there is total reconciliation between educator and tool.  CAI can result in positive changes when it is properly

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conducted and implemented in classroom-activities. CAI can help to expand the capabilities and effectiveness of teaching and learning in the foundation phase. However, educators should be adequately trained and they should have the relevant skills as well as a positive attitude towards using modern technology in the classroom. Educators are in control of the use of computers and software in the didactic situation, and need to thoroughly rethink their teaching aims for each lesson in relation to the curriculum.

# CHAPTER 4: LEARNING AND THE COMPUTER

## 4.1  Introduction

Learners in the foundation phase in South African classrooms are currently introduced to literacy, numeracy and life skills.  In the learning programme literacy, numeracy and life skills, literacy deals with the largest volume of learning matter and is allocated the most teaching time.  Literacy also comprises a number of sections that have to be treated as specialist teaching areas.  Much has thus been said about literacy in this study, while literature on numeracy is less abundant.  Of the three learning programmes, life skills is not only less complicated to teach, but much of what is relevant in literacy and numeracy is also applicable and thus not repeated.

It will be shown that CAI enhances the literacy skills of the learners through communication, reading and writing.   Learners' numeracy skills can benefit when educators use software that encourages the discovery and manipulation of numbers to improve problem solving and higher order reasoning skills.  CAI also influences the personal development of young learners when the learning matter that deals with life skills is properly planned and managed in foundation-phase classrooms.

## 4.2  The foundation-phase learner and computers

When dealing with foundation-phase learners, one has to remember that they are individuals with unique learning needs.  Young children are likely to become actively involved in learning activities when they are reasonably acknowledged, guided and challenged, and when they feel secure in the didactic situation.  Educators can achieve this when CAI becomes an assistant in the classroom.

Computers should be used in the classrooms to assist learners to cope with the learning matter. Bonk and King (1998:1) state that the relevance of schools in the communication age depends on whether schools can successfully prepare learners to use the available technology. A vast amount of information is available and needs to be organised to be useful to the learners. Armstrong (1995:72) says in this regard:

"In the past we have treated information as a scarce resource that educators deliver to students. In the world of universal access to telecomputers, information is an abundant resource that learners can access on their own in response to questions raised by teachers. Learners in future will become nomads in cyberspace, unfurling their magic carpets of the mind as they sail across the infosphere...."

The potential of CAI as a powerful enabling strategy for modern learners should be exploited in foundation-phase classrooms, taking into account every learner's cognitive and affective development, well-being and computer-related skills.

## 4.2.1  CAI and the cognitive development of the foundation-phase learner

The learner's level of cognitive development determines the activities to be included in CAI in the foundation phase. Cognitive development results from the child's interaction with the environment, which includes other people, objects and ideas (Du Toit and Kruger 1991:50). McCombs and Whisler (1997:5) state that cognition includes the strategic use of cognitive tools, the ability to evaluate the success of mental behaviours and learning, thinking about one's own thinking and learning by overseeing and monitoring one's own mental operations, facilitating creative and critical thinking, developing expertise and taking responsibility for one's own learning. Cognitive development could thus be seen as the development of learning and thinking processes by way of different types of interaction, including, for instance, the use of computers.

A study of the cognitive development of the foundation-phase learners is necessary to assist educators in selecting suitable learning matter and didactic activities in the classroom. Knight and Knight (1995:142) say Piaget's theory proposes that there are four qualitatively different stages of cognitive development that all children have to pass through, namely sensory-motor (birth to two years); pre-operational (two to seven years); concrete-operational (seven to eleven years); and formal operational (eleven to sixteen years). This description of the cognitive levels which normal children reach in a predictable order and at predictable ages helps educators to determine learner abilities, and to link new information with existing knowledge more effectively (Spiller 1997:160). Concrete operations usually emerge in the foundation phase, when children learn from mental representations of the actions they observe in the concrete world around them.

All learners should be given opportunities for optimal cognitive development. Learners need to create personal meanings when they want to learn to work independently and give structure to new content. When learners are successful in challenges in the classroom, they start to trust their own cognitive abilities and judgement. Success in critical factors, such as powers of memory, reasoning skills, emotional and personal sensitivity, self-awareness, problem solving, mental play, divergent thinking, concentration and imagination subsequently improves and results in personal learning gains. Learning experiences in which the learners frequently face problems that can be solved through "hands-on" approaches like exploration, can help develop the cognition of young learners who are still operating at concrete levels in exploring relations among objects and concepts (Lawler 1997:16; Mc Combs & Whisler 1997:7; Newby, Stepich, Lehman and Russell 2000:19; 136). Cognitive levels improve when foundation-phase learners solve problems in their life-world and when skills related to independent thinking and learning develop.

Chambers (1999:152) claims that children are actively in charge of their own learning and exploration of their own thinking processes when they are in control of a computer. CAI can boost learners as problem solvers because they are encouraged to think critically about the

information provided by the computer. When used in this way, CAI promotes initiative, independence and cooperation. Exposure to CAI from as early as the foundation phase might provide the intellectual stimulation that results in learners reaching the formal operational stage earlier. CAI could even promote a new, more advanced stage of mental development if the use of computers is able to change the basis of human thought and lead to ways of thinking that can solve relevant problems (Spiller 1997:160, 162). CAI might even assist learners to reach higher levels of cognition than was possible before.

Foundation-phase learners can experience control and become more independent in their learning when using CAI. In order to achieve this, the technology-related needs of the learners in the classroom should be accommodated. Bonk and King (1998:100) state that modern learning environments should be designed to

- allow learners to collaborate in social activities
- foster learner-centred instruction
- provide for adaptive instruction to meet individual needs
- empower the learner with cognitive structures to facilitate his or her learning
- encourage learners to guide and assess their own learning
- nurture reflexivity.

If learners are exposed to learning environments as described above, they should experience their working area as friendly and supportive. This will not only encourage learners in their efforts to manage the computer as a tool, but will also enhance their cognitive development. Effective learning can be enhanced when CAI is tailored to the cognitive style and development of foundation-phase learners.

4.2.2  CAI and the affective development of the foundation-phase learner

Affective development refers to the development of the learner's feelings, emotions, moods and sentiments.  Casey (1997:2) claims that if the classroom environment can meet learners' basic need for affection, educators would have succeeded in helping them to be self-actualising and independent.  Relationships thrive when trust and security are established in the classroom and learners participate freely in activities.  Learners are naturally curious and they enjoy learning, but intense negative emotions like a feeling of insecurity, extreme self-consciousness or shyness, as well as a fear of failure, corporal punishment, stigmatising labels or ridicule, can thwart this enthusiasm (McCombs & Whisler 1997:1).  When learners feel emotionally secure in a didactic environment they become motivated, independent and successful in their learning and accomplish various learning tasks and skills such as concentration and perseverance when working independently and in groups.

Young learners generally test, consider, accept and utilise learning matter by imitation and game playing, and thus relate well to computer-based activities.  CAI could be an enabler in the classroom, a means to help learners develop competence and become motivated.  Learners engage in positive play with computers when given developmentally appropriate activities and materials, and when a match is achieved between challenges and their abilities and interests (Liang & Johnson 1999:57, 60).  Sewell (1990:90) is also positive about the importance of individual gains with CAI:

> " .... (T)he use of a game-like context is widely seen as one way of increasing student motivation, .... (that) will result in better learning, presumably because the learner pays more attention, becomes more actively involved with the material, or has more practice than is available with conventional methods."

Motivation links up with previous success and positive attitudes towards learning.  Learners need to experience success in order to want to learn more.  The task of the  educator  or

instructional system is to present the stimulus, observe and analyse the response and reward desired responses by praising correct answers. In this way the associations between particular situations and certain responses are strengthened. Positive teacher attitudes towards the learners and their efforts help determine how successful the implementation of CAI in the classroom will be. In general, computer software is motivational because it includes activities which are rewarding. Foundation-phase learners regard their own learning as being successful when they find delight in what they are doing. CAI offers learners more opportunities for success and joy if it includes games (Evans-Andris 1996:58; Rodda et al 1991:25; Sewell 1990:62, 92). CAI supports the affective development of foundation-phase learners, for it helps learners to generate the motivation to learn, experience success and really feel "at home" in foundation-phase classrooms.

## 4.2.3  CAI and the learning environment of the foundation-phase learner

As with all educational tools, foundation-phase learners have to be introduced to the computer and its qualities in order to use it successfully in the classroom. The types of computer experiences provided for foundation learners will largely determine whether computers will eventually enhance or inhibit the quality of their learning experiences. Spiller (1997:159) writes that:

> "On the one hand, the developmental level of children in a certain grade determines the computer literacy activities and concepts appropriate for that grade. On the other hand, appropriate computer experience can stimulate development in children's mental patterns."

It seems natural that learners should have their first formal experience with computers in the foundation phase. Learners' experiences and capabilities with technology vary, and their rate of progress with CAI is linked to their level of introduction to computers and their applications

(Simonson & Thompson 1990:135). Stonier and Conlin (1985:139) observed that learners are curious and eager to experiment with and use computers:

> "Young children automatically want to touch the keys, use the light pen and draw pictures, as they do with any article in the house. Gradually they can be led on to early language and maths programs - programs which will make them talk, express opinions, and learn basic language and maths skills."

Early childhood interactions can be viewed as play activities which lead to understanding. Learners associate the computer with fun and games and they want to investigate its qualities, like they do with all objects and toys. As learners progress they acquire skills which help them to think and work independently (Sewell 1990:78).

Computer literacy and keyboard control should be introduced to learners from as early as the foundation phase. Outhred (1986:345) says younger learners often struggle with tasks involving the use of their small muscles. Writing is a complex process linking thought, language and motor skills. Inhibited muscle control causes foundation-phase learners to struggle with writing tasks, but the use of a computer in the classroom can help to bypass the problem. Games offer possibilities for improving certain skills at the computer. Ward (1994:45) refers to computer games as interactive technology which challenges fine motor coordination while developing skills in logical thinking and the mastery of abstractions. On the other hand, Boltman (1998:20) alleges that:

> "Kindergartners have a very difficult time with the mouse. Clicking and dragging is very difficult to do because their fine motor skills are (still) developing."

CAI thus provides additional opportunities to practice skills that benefit the visual and motor development of young learners, for example, provided it is properly introduced and managed.

Learners need to know how to turn computers on, make programs run and how to operate the keyboard, in order to be in control of the computer and to explore its qualities for successful CAI at their level. Boltman (1998:21) writes that once young children get a sense of clicking and dragging and even a vague familiarity with the computer, they want to explore on their own. Learners should be encouraged to explore and to use the different computer components such as the keyboard and the mouse, to create, save, edit and print documents. They should be shown how to load and run programs and save and retrieve data to become self-supporting and independent computer users. Learning materials on computer literacy should introduce the child to the computer and how it works, as well as to ways to use the computer as a learning tool (Rodda et al 1991:30; Rumsey 1988:31). Procedures and content should be kept simple in the foundation phase, but learners should be introduced and exposed to the challenges posed by CAI. Adequate computer literacy training ensures that learners develop the self-confidence and physical expertise to use computers as tools in the classroom.

Good typing skills can be taught as soon as learners begin to use computers. Casey (1997:3) is of the opinion that children are as fearless exploring the keyboard as they are exploring other exciting parts of their environment, and should be taught to use a keyboard effectively as soon as the opportunity arises. Various programs and games are designed to teach typing skills, and to develop familiarity with the keyboard in such areas as letter, number and function keys, cursor control, and the ability to execute simple programming commands. The physical development of a child's hand and hand-eye coordination determines his or her ability to touch-type. If this development is delayed it can result in learners using the "hunt and peck" mode of typing with learners deciding rapidly on the input, but then spending a long time typing it into the computer. Educators should concentrate on accuracy and the correct positioning of the fingers before attempting to improve the typing speed of young learners (Rodda et al 1991:25, 29; Simonson & Thompson 1990:136; Wegerif & Scrimshaw 1997:182, 183). Haugland and Wright (1997:12) do not regard poor typing skills as a major obstacle and suggest additional forms of writing assistance to very young learners using computers:

"When children compose using a talking word processor, their writing is more fluid, they write more, their stories are more complex, they make less mechanical errors, worry less about mistakes, and they are more willing to make revisions."

Haugland and Wright (1997:14) also suggest that pre-school teachers may type the children's ideas on the computer while they dictate, making the process easier and faster. However, the earlier learners develop the competence to independently use the computer as a tool, the earlier they will really benefit from CAI in the classroom.

Foundation-phase learners need to be comfortable in their didactic environment to fully exploit the qualities of the computer as a learning tool in the classroom. Ordinary school furniture was designed and selected for reading, writing and listening activities. Learners can easily adopt poor postural habits which could impair their skeletal development. It is therefore important for educators to insist that learners sit properly right from the outset. Berman (1986:277) adds the following in this regard:

"When operating a computer, the recommended posture is a nearly upright trunk with the maintenance of the lower lumbar curve. The forearms should be parallel to the floor and at the same height as the home keys. Upper arms should not be abducted from the trunk. It is important that the body moves from time to time, to enable adequate blood circulation in muscle tissue."

Educators of foundation-phase learners should allow the learners frequent rotation while working at the computers, keeping in mind that young learners find it difficult to sit still for long periods. Learners should also refrain from spending every available minute of every day on computers. Bickart and Pierrel (1999:22) comment that:

"There are also health risks for children related to prolonged use of computers, and the American Academy of Paediatrics recommends that school-aged children limit their

time in front of a screen - including TV and computers - to no more than two hours day."

Foundation-phase learners will learn well through CAI when they can use the computer confidently as a tool in the classroom. Basic typing and computer literacy training will give all learners the necessary technological expertise and independence and help them to be successful at CAI, at their level.

## 4.2.4   Learning and the computer in the foundation phase

Learners are motivated when they experience success, whether they are working alone or as part of a group. Learning is an ongoing act of orientation whereby learners acquire potential meanings embedded in their culture with educational help in order to eventually make independent choices about related matters (McCombs & Whisler 1997:1). Learners are most receptive to information when they want to do something but lack the necessary knowledge to perform the task (McCombs & Whisler 1997:18). They learn from their environment when they realise that they need information. Foundation-phase learners are concrete-bound and assimilate best through their own efforts. They can do this by repeatedly reading, hearing, saying and doing. Unified comprehension or integration of knowledge usually derives from later experiences (Du Toit & Kruger 1991:51). Learning in the foundation phase must be seen as an ongoing process of discovering and constructing meaning from information and experiences, filtered through the learner's unique perceptions, thoughts, and feelings.

Learners gather information and reason about the world by asking questions. Schank and Cleary (1995:18) explain that learners have to become curious enough about a subject to want to know more:

"The (teacher as) motivator is concerned with helping the student develop the right questions. There isn't all that much that is important to know. There is a lot that is important to know how to do."

Kahn and Yip (1996:187) regard explanation questions as vital in learning:

"The basis for explanation questions (EQ) .... (is that) the greatest reasoning is involved in converting a specific question about a domain into one of the general EQ's, from which an answer can be obtained. The pedagogic principle here is that in order to understand something, students must ask enough of the right questions to elicit sufficient information for them to make the necessary generalizations, allowing them to understand the situation and transfer this knowledge to problem solving. Since a student is not knowledgeable enough to ask the right questions, dialogue is initiated by the (computer) system and it involves the system 'asking' as many explanation questions it needs, to allow the student to appreciate the pedagogic goal. Teachers incorporate their prior explanations in the derivation of new explanations. The new explanation is not strictly new, and is not an adaptation of an old explanation, it is a derivative of prior dialogue."

Asking questions will result in reasoning. Learners have to be able to use high-order reasoning skills to solve the complex problems of today's world (Lawler 1997:86). CAI can provide foundation-phase learners with relevant questions to encourage independent problem solving. Schank and Cleary (1995:20) state that teaching should focus on how learners reason, rather than on how well they might recall facts in a test. They therefore advise schools to concentrate on learning and teaching rather than on testing and comparing. Lawler (1997:7) believes that CAI can enable the construction of intellectual worlds where children are able to learn effectively and on their own depending on

- the initiative of the child ….
- the flexibility of .... systems

- the knowledge and values of a teacher in shaping particular procedures through which the child's objectives are achieved.

Whether CAI will benefit young learners depends on what kinds of experiences they have at the computers (Haugland & Wright 1997:17). Young people increasingly use advanced technology and different communications media simultaneously, and expect high levels of interactivity, also in their learning (Lewis 1999:142). The advantage of the computer in comparison with other audio-visual aids is that its interactivity is immediate. Children work in the present and they often find activities like re-writing work and looking through books frustrating and time-consuming (Stonier & Conlin 1985:101, 103). Computers provide the learners with immediate answers to their questions. The effective combination of learners, learning matter, educators and technology could thus help to create winning teams and positive learning experiences in education.

CAI can make a difference to learning, but computers alone cannot change a poor learning situation into a good one. For example, a group of learners who were allowed unstructured practice at computers did not progress as well as a group provided with feedback about why some strategies were more effective in solving problems. The latter group was more orderly and thoughtful, and their solutions had fewer errors (Firkin 1986:50). Newby et al (2000:164) report on the ability of computers to produce positive learner outcomes, even at foundation-phase level:

"When used as a teaching machine, the computer can be highly interactive, individualized, engaging, and infinitely patient. Research analyses of studies comparing computer-assisted instruction with traditional methods suggest that it produces slightly superior achievement, usually requires less time, and may produce improved attitudes toward computers and sometimes toward the subject matter itself. The positive effects are somewhat greater in the lower grades."

McRae (1986:256) states that to relate to the learner, the computer room should be a place where the activities

- have clear learning outcomes for the learners
- provide tasks related to the learning needs of the learners
- include help, encouragement, challenge and extension
- are relevant to and link different areas of the curriculum
- create a lot of interaction between teacher and learners
- proceed according to well-established rules
- develop skills which are useful elsewhere
- use group work as well as individual work.

Learning is a natural and ongoing process that occurs continuously for all learners (McCombs & Whisler 1997:18). The following paragraphs will show that some learners learn better when they work as individuals, on their own, while others thrive in groups. However, success is an important motivator for every foundation-phase learner. The discussion highlights the fact that CAI can help learners to develop their skills, knowledge and experience by repeating the learning matter to suit the learning needs of the individual learner at that moment.

4.2.4.1  Individualisation and CAI

Education needs to facilitate individual achievement for every learner. McCombs and Whisler (1997:1) say in this regard:

".... (T)he educational system of the future must embrace a learner-centered perspective to maximize high standards of learning, motivation, and achievement for all learners."

Schools must thus value learners, respect their differences, and challenge their abilities to realise research-based and learner-centred practices (McCombs & Whisler 1997:9, 33).

Skinner (1986:16) is one of the earlier supporters of the use of computers in schools and values the vigour it could induce in individuals:

> "The small computer .... should be called a teaching machine because it arranges contingencies of reinforcement. .... (S)chools can be designed so that students will profit from an immediate evaluation of what they have done and will move forward as soon as they are ready. Those who move quicker will cover many more fields .... possibly beyond the range of available teachers. Those who move slowly will survive as successful students."

CAI offers diverse forms of didactic support, which vary from interactive books to on-line communication and multimedia tools that enable learners to be, amongst others, authors, artists and scientists. Literature on education increasingly suggests that technology can support powerful learning opportunities for learners with varied weaknesses, strengths, interests and experiences (Druin 1998:15). Educators should take up the challenge and empower all learners through CAI. Learners need to follow their own learning pace. With CAI, faster learners will not have to wait, and slower learners need not develop negative feelings because they keep educators or other learners waiting. Whether gifted or slow, the individual learner can only win when CAI becomes a partner in the didactic situation.

- Gifted learners and CAI

Gifted learners in schools have been an issue in education for some time. Gifted learners' needs should be nurtured from as early as the foundation phase. Kokot (1997:18, 21) reports that it is important for educators to plan for students who learn at faster and slower rates. The plight of the gifted child is seldom mentioned in literature and the media. Educators and parents can

only hope that the inherent flexibility of the outcomes-based educational approach will benefit the gifted learner.

Gifted learners need to be creative in their own ways. Whatever the quality of the talents these children have, they must be able to develop them to the fullest extent, without hindering the development of other, perhaps more ordinary, skills. These learners have to be accommodated at their different levels of ability and interest. According to the concept of inclusion, gifted children could be homogeneously grouped for a part of the school programme, at neighbouring schools or in extramural enrichment programmes. More individualised education, where gifted learners can move through the curriculum at their own pace, could also be offered if parents became involved in classroom assistance (Kokot 1997:18, 21; Stonier & Conlin 1985:128). CAI in classrooms could also assist gifted learners to improve their intellectual and creative skills. Casey (1997:60) says the following about gifted learners and computers:

> "Schools are often geared to teach the norm. Gifted children must be allowed to explore and achieve their own level, a level often higher than the teacher. Using computers helps educators meet the intellectual, creative, and personal needs of the gifted child."

Gifted learners have the right to educational support to develop their special talents. CAI can accommodate this right.

The handwriting of gifted learners often lags behind their mental development, because their minds seem to work faster than their fingers. With CAI fast learners experience cognitive independence and are not held back by low level tasks like practicing handwriting. Using word processing in the classroom could help overcome the secondary problem of deciphering illegible handwriting for all gifted learners and their educators (Stonier & Conlin 1985:128). The implementation of CAI in classrooms could thus solve some of the real educational problems with which gifted learners struggle.

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- Slow learners and CAI

Slow learners have special learning needs. They see the world differently and deserve to be catered for in a different way (Druin 1998:15). CAI can support the learning needs of slow learners. Slow learners need to repeat and practise a particular skill in order to master it. These learners become as bored as any child if re-dos are not presented in different and interesting ways. Drill-and-practice on computers in the form of lively games with colourful graphics, music and rewards are more motivating than endless worksheets. Instruction at the computer seems to be able to hold their attention where other approaches have failed (Slifer 1986:227). However, Oliver (1986:125) says the following about teaching slow learners to use computers:

"Special care and extra attention seems to be warranted when dealing with children of low ability. They appear to gain least from such (computer literacy) courses, and in many cases finish the course with fewer skills than the entry point of the more able students."

The scaffolding properties of computers can offer relief to struggling learners in the foundation phase. Computer writing begins at the top left-hand corner of the screen, and works systematically downwards from left to right, reinforcing the left-to-right, top-to-bottom sequence required in reading and writing. Using a word-processor may reduce the reversal errors prevalent in disabled children's learning. Problems with spatial and coordination skills no longer interfere in the formation of letters and the spacing of words of younger learners, so editing may pose interesting challenges instead of being an arduous chore (Salvas 1986:346). According to Rodda et al (1991:9) educators often give testimonies of changes in learners' attitudes. One teacher reported:

"A factor that has greatly impressed me is the way 'not-so-bright' learners have been attracted at this medium of instruction. They spend more time doing their homework on the computer than they do with written homework."

Computers in the classroom can empower learners with differences and thus support individuals with special needs.

4.2.4.2  Success and CAI

Success is an important experience in the lives of young learners. Learners will sometimes see failure in one small area as "total failure". This can cause them to lose heart and feel inadequate as learners. Unreserved participation, on the other hand, can assist them to become successful learners. Computers with good instructional programs can have a powerful reinforcing effect. These programs require learners to take very small steps and help them to successfully do so (Skinner 1986:14). Learners should become successful in realistic ways in terms of their capabilities as young children. Schank & Cleary (1995:4) say about success in schools that:

"Success comes to mean 'academic success,'…. When we ask how our children are doing in school, we usually mean 'are they measuring up to the prevailing standards?' rather than 'are they having a good time and feeling excited about learning?' "

All five-year-olds want to succeed and be literate, but most of them struggle to make the transition from oral to written language. They often do not experience early school success, and if learners believe they cannot write and read successfully, they will not. This leads to a cycle of failure which begins very early for these learners. However, learners can become involved and achieve success in a supportive learning environment. CAI provides the tools that can help create such an environment (Schank & Cleary 1995:15). Casey (1997:1) says:

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"…. (A) new way of communication has opened a window and shown us a key. The window is the computer monitor, and the key is the keyboard. Together, they have made it possible for those who have been silent for many reasons to tell us their story. They make early school success possible for students who once would have been doomed to failure at age five."

Eastwood (1994:81) explains how this is done:

"The management system ensures that pupils are presented with screens at the appropriate level of difficulty to generate scores which are typically in the range 60-80% correct. Thus the experience for pupils most of the time is one of success. For the majority of pupils it seems that this success generates interest."

Learners who experience success are able to understand what they have accomplished (Casey 1997:64). CAI is not the solution to all educational problems. However, the computer is an effective tool that can engage and empower learners who have not experienced much success in classrooms before (Casey 1997:1). Motivated children become successful learners (Griffin & Bash 1995:79). Those who enjoyed working on the computer will try working with modern technology again. They are motivated because they believe they 'can'!

4.2.4.3  Motivation and CAI

Motivation is made up of a complexity of wishes, desires, drives and anxieties which activate individuals. It is the impetus and driving force of the personality and is related to the purposeful fulfilment of aspirations (Du Toit & Kruger 1991:57). People experience the desire to reach goals that are significant to them. Learners mostly become motivated to learn when they realise that they do not have enough knowledge when they need information (Schank & Cleary 1995:13). The best time to present new information to learners is when they want to learn

(Kahn & Yip 1996:183). When learners discover their own learning abilities, it motivates them to try to do better. A learner must WANT to be totally involved to be able to learn well.

A positive learning environment is motivational for learners and educators, on different levels (Department of Education 1997b:28). Researchers like Newby et al (2000:71) regard motivation as one of the keys to a successful didactic situation and say motivation makes a direct contribution to learning by focusing students on desired learning goals

- extrinsic motivation is generated by factors unrelated to the experience or task (such as grades or recognition)
- intrinsic motivation is generated by aspects of the experience or task itself (such as challenge or curiosity). Intrinsic motivation is generally more effective. Students who are intrinsically motivated will work harder and learn more because of their natural interest in the material.

Motivation is initially extrinsic, but should gradually become more intrinsic for independent decision-making to follow naturally.

CAI encourages learning-related undertakings because it simplifies activities which would be too demanding for learners if they were to attempt them on their own. Revision of the written matter becomes a more natural process through word processing. Not only are mistakes indicated, but the author can also make corrections without much effort. CAI is also an incentive for reading activities because the software presents colourful and animated reading matter accompanied with elements of surprise which can support the learners in reaching their learning goals. Learners' level of motivation will increase as their confidence increases. Also, educators are motivated by the effects of instructional strategies and program content, and they value the joy and fun that learners experience when using CAI (Birch 1995:48; Newby et al 2000:159). CAI saves time and gives foundation-phase learners joy and motivation in their learning.

4.2.4.4  Repetition and CAI

Repetition is part of the life of every foundation-phase learner.  Children repeat familiar songs, verses, stories, jokes as well as the same programs and games on computers.  CAI provides repetition with a difference through the application of aspects like colour, sounds and animation. Learners appear to find the boring drill-and-practice exercises done on a computer more enjoyable and motivating than workbooks or the worksheets prepared by the educators (Simonson & Thompson 1990:103).  Drill-and-practice, as a teaching method, is often criticised, but it can effectively support the mastery of some aspects of the curriculum like mathematical combinations, times tables and spelling lists.  Bright (1987:25) says in this regard:

> "As long as drill-and-practice is necessary for attaining the goals of elementary school education, drill-and-practice CAI will have a role to play in providing that instruction. The research clearly indicates that there is at least one advantage of CAI over other modes of drill-and-practice; namely, time can be saved."

Strictly speaking, drill-and-practice programs do not teach.  They use a game format to allow learners to practice what they have learned.  Tutorial programs are intended to teach the learning matter, followed by drilling exercises to reinforce the content of a lesson (Kinzer 1986:227).  CAI can present the repetition of critical learning matter in unique and interesting ways.

4.2.4.5  Group work and CAI

The computer provides an area that is rich in social interaction.  Learners can experience interest, enjoyment and surprise as they explore software, discuss what they are doing or ask someone for help (Haugland & Wright 1997:8).  Learners' social development can benefit from group work when they are in a position to enquire about things that surprise them while exploring programs, and also when they share their results with friends and educators.

CAI allows substantial opportunities for negotiation and the sharing of responsibilities among peers.  Computers were designed for individual users, but are often used by groups of learners in schools.  It is not easy to share a computer keyboard and the mouse even less so.  This often results in conflicts about who can use what.  This problem is not insurmountable and can be solved to the satisfaction of all the members through group work at computers.  Three or four learners can comfortably sit around a computer and have access to the keyboard.  Each learner should have a specific job to perform: operating the keyboard, reading the screen display, or recording specific information and decisions taken.  Sharing a computer reduces the amount of keyboard time each learner gets, but when a single learner is assigned to a computer, frustration with a lack of skill or complicated activities may have a more negative effect than waiting for a turn (Light & Littleton 1999:2).

Flexibility and a more relaxed atmosphere are particularly important when attempting group work with foundation phase learners.  Learners enjoy exploring new domains at the computer.  Placing two chairs at each computer suggests that learners can work together or learn by watching a friend.  It is sometimes useful to place the same program on adjacent machines, because young learners enjoy "borrowing" ideas from neighbours and they will often cooperate with them to create matching screens (Haugland & Wright 1997:73).  Bright (1988:51) states the following regarding computers and group work:

"….(W)orking with a partner will help prevent students' reaching an impasse and will expose them to a richer variety of strategies…."

Foundation-phase learners thus get the opportunity to share skills and scaffold other learners when they participate in groups and learn through CAI in the classroom.

## 4.3  Computers and literacy as a learning area in the foundation phase

Literacy as a learning programme gives foundation-phase learners the opportunity to learn to read and write.  The information age demands improved literacy and learning levels to empower children to become competent thinkers and lifelong learners (Dahlberg 1990:17).  Literacy was initially seen as a cognitive process enabling only reading, writing and numeracy.  The use of the term has gradually expanded to include language, critical, visual, media, numerical and computer literacy.  Language literacy aims to improve skills like speaking, reading, writing and listening, whereas computer literacy intends to develop the ability of learners to access and use information on computers.  While learners traditionally learned to read from books and expressed themselves by writing with pencil on paper, technological developments have resulted in more diverse tools, like computers, that can be utilised for teaching and learning in modern classrooms.  The computer has become one of the tools used to promote literacy and learning in schools.  The use of appropriate programs can provide entertainment as well as powerful environments for textual, graphical and musical creations (Sewell 1990:13).  CAI offers a variety of tools that could help to improve literacy in modern foundation-phase classrooms.

CAI not only fosters early literacy development in several learning areas through various activities like communication, reading, writing and listening, but can also help to improve social skills by creating opportunities for reasoning, collaboration and scaffolding.  Researchers like Bickart and Pierrel (1999:24) confirm the potential of CAI in promoting literacy in modern schools:

"Appropriately used in (K-3) classrooms, computers can enrich the learning experiences of young children by encouraging reading and writing, providing tools for creativity, involving children in problem solving activities, increasing access to information, and facilitating communication and collaboration."

The computer can be regarded as a modern tool of teaching and learning that can assist even foundation-phase learners to amplify various literacy-related facets of learning like communication, reading and writing in the classroom through CAI.

## 4.3.1 Learner communication and computers

Communication sustains teaching and learning. Communication implies exchanging ideas and information with participants encoding, transmitting and decoding messages. The same occurs in didactic situations. Learner communication focuses both on the spoken and the written word, with the spoken word as the main form of communication in the foundation phase. Literacy skills improve when learners are involved in meaningful and collaborative activities like purposeful listening and talking that facilitate writing and reading (Department of Education 1997a:21; Labbo et al 1995:316). Bonk and King (1998:82) elaborate on these views:

"Learning how to read and write can most effectively take place in learning environments where learners engage in a process of socially constituted and constructed meaning, and where a language awareness support structure is provided. We believe that computer-mediated systems can effectively support innovative environments for language development where such reflective dialogue can take place. Our experience .... illustrates that literacy is not a game of trivia. Instead, it is a process of exchanging ideas, jointly constructing and negotiating meaning, and becoming aware of the dialogic process."

When appropriately applied in foundation-phase classrooms, CAI can offer a variety of opportunities to improve the communication skills of learners in several areas. In the following sections communication skills like understanding, vocabulary building, the ability to argue, peer group conversation and collaboration, learner confidence and listening are highlighted as aspects to be developed, supported and promoted by using computers as tools in schools.

4.3.1.1  Understanding and computers

Learning depends on learners' ability to understand communicated information, especially in the foundation phase where verbal instruction tends to be the prevalent mode of communication. According to Newby et al (2000:18):

> "Learning will .... be obstructed if the message is well designed but delivered in such a fashion that the learner can't understand or interpret it correctly."

Power is no longer lodged in knowledge - it is vested in understanding. Everyone wants to be heard and understood and wishes for easier ways of reaching others. The computer promotes understanding, for it can be used as a teaching aid, a learning resource or a tool to reach conclusions in modern classrooms. CAI gives learners the opportunity to make progress at their own stage of development in every learning area, while neutralising negative feelings and experiences of frustration and isolation in communication, even with very young learners (Druin 1998:16; Sewell 1990:217). CAI thus makes individualised learning experiences possible in foundation-phase classrooms that enable learners to progress at their own level of understanding.

4.3.1.2  Computers sustain vocabulary building and the ability to argue

Conversation obviously builds vocabulary.  Giving meaning to different actions and objects comes naturally to learners as they progress and develop.  However, children do not always grow up in circumstances where rich forms of vocabulary prevail.  Learners who do not have a large spoken vocabulary usually have difficulty in learning to read.  CAI provides learners with a variety of opportunities to develop their vocabulary and literacy at their own pace.  The more learners are exposed to a variety of stories in books or films or on computer, the better their vocabulary will become.  Several computer programs contain words, sentences, scenes and stories about themes which are familiar to foundation phase learners for example schools, shops, playgroups and the home.  If programs are presented in interesting ways, learners will repeat the programmes again and again and learn the vocabulary (Casey 1997:18; Stonier &  Conlin 1985:99).  CAI thus supports literacy development and the building of vocabulary by creating an opportunity to repeat enjoyable programs.

Knowledge is essentially a matter created by learning to argue.  Educators can facilitate learners' ability to argue by using strategies like *exploratory talk* in the classroom.  Knowledge is made more publicly accountable and reasoning becomes more logical when the  educator gives structure to learner conversations, by acting as the discourse guide (Mercer &  Wegerif 1999:190).  Topics for exploring could sometimes be suggested by the learners.  Group work can result in a positive social experience for children because the presence of a partner affords the opportunity to negotiate tasks.  Negotiations become complex and socially mediated when participants have to make meaning that satisfies each of them to avoid conflict.  Learners could argue intensely while working in groups without any serious break-ups of relationships when a problem and possible ways of solving it are discussed.  The computer has "the correct answer" and provides solutions for disagreements in the classroom.  It acts as the referee, thereby preventing further arguments (Light & Littleton 1999:5;  Säljö 1999:158; Scanlon,  Issroff & Murphy 1999:75; Wegerif & Scrimshaw 1997:113, 217).  CAI thus provides opportunities for

group learning and social interaction when learners start to negotiate and give and take turns at the computer in the foundation-phase classroom.

4.3.1.3  Computers sustain conversation and collaboration

New things, like technology in the classrooms, fascinate learners, arouse their curiosity and provoke conversations.  CAI thus allows the building of rapport through the different learning environments that it is able to create.  Learners need to converse with peers who share their interests, and computers offer the means.  CAI can provide learners with ideas or themes that encourage conversation, however technology can and is not intended to replace human interaction (Evans-Andris 1996:103; Littleton 1999:190, 193; Säljö 1999:158).

Learners like to explore the capabilities of computers and discuss results, new approaches to try out, or ways to beat the computer at tasks in the classroom.  Educators sometimes express concern about the amount of discussion that takes place when children work in groups. However, when learners are engaged with computers, their talking tends to be task-orientated, supportive and constructive, according to Underwood and Underwood (1999:14).  Learners often ask for assistance, demand answers, or seek conversation from any person who happens to be in the vicinity of the computer (Boltman 1998:21).  Literacy improves when learners use CAI, for they have to converse in a sensible way when they want to share their experiences at computers with others.

4.3.1.4  Learner confidence and computers

CAI benefits less academically oriented or more reserved learners because these learners get to use their technological talents and show that they can also be successful in the classroom. Learner confidence is built through achievement when learners who have experienced early failure and developed a negative attitude toward learning, are able to help their peers at CAI. They can help their friends to master aspects of the computer or word processor at their level,

with a resultant boost to their own self-esteem. Learners can change roles when using a computer program, from initially being a learner, into a teaching role, instructing others on how to work through programs (Stonier & Conlin 1985:56). Peck and Hughes (1997:115) support this view by saying that learners often identify classmates as "experts" with certain programs and approach them for help and support. Such an honour is invaluable for developing the communicative skills of a learner who lacks confidence or is shy or inhibited (Casey 1990:25; Evans-Andris 1996:103). Learners' communicative abilities of learners are also supported when learners attempt to explain to peers how to improve their skills at the computer.

4.3.1.5  Listening and computers

Modern technological developments influence children, their way of life and their learning. Schwartz and Beichner (1999:79) allege that learners gain less information by reading, listening and direct experience than was the case a generation ago. They also maintain that the listening skills of normal children are complemented by watching. Watching television has influenced the attention span of the modern child. Teaching has to adapt to the changing modern society to achieve relevant learning because it has to cater for the current needs of learners.

CAI supports listening, for most modern programs and games make use of a combination of visual- and audio-based images, forcing learners to listen better. Stories, rhymes and songs on audio discs or cassettes can be used alongside computers and can be repeated by individuals or groups of learners at convenient times in the foundation-phase classroom to improve listening skills (McLullich 1989:35). CAI in the foundation-phase classroom can assist educators in accommodating the changing listening patterns of young children to ensure that the intended didactic message reaches every learner.

Listening is an essential skill that enables learners to make progress in literacy and learning and it is often regarded as the first step towards language acquisition and communication. Prior to learning to read, children must learn to listen to be able to follow instructions in the crowded

classrooms in modern schools. Listening aids understanding and understanding aids reading. Children who can articulate clearly and listen well have an advantage in the classroom when the more complex skills like reading and writing are learned. Learners do not need to listen *more,* they just need to listen *better.* Language development is best nurtured if based on talking, listening, reading and writing. Language growth goes hand in hand with growth in student thinking abilities. Good listeners are better learners, for they think about the task at hand (Mann 1989:48; Muente 1989:245, 246). CAI in the classroom can be fundamental in the effort to put foundation-phase learners on the road to improved communication and better literacy because it improves listening skills.

## 4.3.2  Reading and computers

Reading has been a prominent issue in education for several decades. Reading is seen as a complex part of literacy by which the reader reconstructs a message encoded by a writer in graphic language. It involves the recognition of printed or written symbols that serve as stimuli to recall meanings built up through a reader's past experience (Ambron 1984:2). Reading implies that symbols are recognised from text and given meaning thereon. CAI can support the foundation-phase learners in learning to read, as well as in the necessary related activities.

4.3.2.1  Reading as a skill of the foundation-phase learner

Reading is an essential skill that learners need to master in the foundation phase. Reading ability and comprehension are linked to independence in learning and a broad experiential background is essential for success in reading. Learners have to be familiar with the concepts and vocabulary they see, in order for it to be meaningful. Learners with a large spoken vocabulary usually do not have much difficulty in learning to read. Educators and parents have to motivate learners to read or develop a reason for learners to want to read, because literacy develops better when learners read because they want to. Suitable reading matter has a positive influence on the desire to read, from a very young age. Those children who learn to read first are those

who find things they want to read. These young learners read for pleasure, get "hooked on books" and "effortlessly" acquire language skills. Voluntary reading, that is, reading because you want to, for enjoyment, as well as the motivation to accomplish new skills, are important steps in the process of learning to read, but they are often not acknowledged and are thus absent in many schools (Casey 1997:3; Grabe & Grabe 1996:228; Schank & Cleary 1995:6). In other words, young learners become independent and successful readers when they are interested in the content and consequently find the reading act meaningful.

Learning to read simple sentences can be accomplished through training, whereas reading with comprehension involves education. Schools mostly focus on the mechanics of reading, like syllables and prefixes, instead of on more critical skills like understanding. The more correctly readers can interpret a message, the better they will be able to analyse and apply the information contained in the message. There is no point in reading without understanding (Dahlberg 1990:17; Schank & Cleary 1995:112). Educators have to provide learners with understandable reading matter that will fascinate them. Modern learners grow up in a world where visual, verbal and auditory images, like beautifully illustrated books, videos, colour television and computers, are freely available for them to respond to. Learners who have discovered these and heard stories, rhymes and songs in their pre-school days, have already taken their first steps toward literacy. Children from six to eight years of age may have acquired initial reading skills, but they might regard reading as a difficult task due to a lack of proficiency (Calvert 1994:141, 142). CAI offers interesting software and techniques that can assist foundation phase learners to master the important skill of reading in the classroom in game-like fashion.

4.3.2.2  Reading skills and computers

Schools can no longer teach learners all the content and skills that were once possible. Alternative routes, like those provided by computer programs, when authored with genuine insight into the reading process, are therefore used to prepare learners to be more receptive to literacy, and help them learn to read.  Blanchard (1999:2) comments that knowledge of both the skills and the tools is vital when teaching literacy with computers:

> "Teachers concerned with literacy instruction and achievement cannot afford to slink around the edges of these new ideas and practices, uncertain of their roles.  Educators who do not possess the knowledge or training to use technology effective and to turn aside its chirpy theatrical claims, will be dependent on those who, by luck, leisure, or labor, have commanded it.  Students must have exposure to the workings of the computer and develop ease with various hardware and software to acquire a high degree of competence and skill."

The responsibility of teaching reading by means of CAI remains with the educators, who need to have the expertise to properly introduce this important skill to learners.

Learning to read is a tedious job, but Stonier and  Conlin (1985:31) predicted that children working with computers would learn to read and write almost as fast as they learn to talk. Computers can create learning opportunities for foundation-phase learners that were not previously possible.  Modern software is specifically designed to teach reading.  The software is more versatile than conventional reading schemes.  This type of software adds elements of repetition, individualisation and fun to ordinary learning activities, promotes skills in reading readiness, word recognition and comprehension on an interesting and individual basis. Programs can be altered to suit individual learners' personal levels of proficiency and requirements.  The earliest memory strategies are ones in which children name, or label, the objects and actions that they encounter.  Action and labels are particular features that are

fundamental to the use of computers for they act as reinforcers of visual and auditive concepts. Action provides a concrete way to represent visual or verbal content, while verbal labels for objects help young children to remember information previously encountered. Gaining phonemic awareness, or the insight that words consist of the progression of spoken sounds, also becomes an informal and playful experience for young learners when presented as computer games. Rehearsal activities usually increase when learners believe they are playing (Casey 1997:18; Henderson-Lancett 1986:115). Learners can thus experience success and enjoy activities offered by computers while developing better reading skills because CAI integrates learning with playing.

CAI can sustain improved reading efficiency. The software allows interaction with the text and provides pleasant opportunities for learners to practice the recognition of words and their components, to make decisions about the meanings of words and phrases and to practice higher-level skills. CAI allows learners to reflect and talk about problems and solutions, engage in commentary and analysis and develop a sense of organisation and clarity that enables them to extend their own cognitive abilities. Reading texts out loud and questioning them from the point of view represented by "if this? .... then what?" helps learners to see where the text is going and where it has been, and appears to enable them to transform the information into learned and memorable forms. Learners have to be competent readers to follow instructions that make computer programs run smoothly (Chambers 1999:152, 157; Haugland & Wright 1997:39; Schwartz & Beichner 1999:57). Substantial volumes of appropriate learning matter are available for use with computers and can provide both fun and motivation in the teaching of reading skills, especially in foundation-phase classrooms.

Frustration builds up, even in foundation-phase learners, when literary failure is apparent. Learners who struggle in school and find it difficult to learn to read give up, try to hide or can easily earn the reputation of being a problem in class. These are often signs of frustration when learners lack literary success (Casey 1997:18). This type of frustration can be resolved to when CAI is applied to support literacy in the classroom. Beginner learners cannot always make the

transition from talking to reading and writing. CAI could support the reading skills of these very young learners as well. Components that translate text into speech afford the non-reader the opportunity to hear words while the text is displayed (Liang & Johnson 1999:59). Before being proficient with a keyboard, children can speak into a microphone with the computer translating their words into text. Learners quickly learn that the written words represent spoken words when they say sentences and immediately "read" their own words. Computers in the classroom can thus establish a connection between speaking, writing and reading that could give foundation-phase learners with opportunities for the natural order of learning to be initiated (Schwartz & Beichner 1999:165). According to Labbo et al (1995:316) computer programs can offer repetition, adjustable reading speed, creativity, variety and sound to enhance the reading skills of foundation-phase learners. These features will also help those who feel neglected or lost in the literacy class. Exercises designed to widen peripheral vision, increase eye span, reading rate and comprehensive level are also available and quite valuable in teaching reading (Miller 1986:290). CAI can thus actively promote literacy in young learners.

Literature on CD can be presented in different and interesting ways on computer. Learners can decide for themselves on how much assistance they desire. A book-like interface is presented on the screen, allowing learners to have an entire story read to them by computer voice, or they can read the story themselves and just get "help" on the words they do not know (Schwartz & Beichner 1999:171). The initiative and choice thus remain with the learner. Talking books can help learners develop a relationship with books, and develop excitement about reading. Introducing quality books to learners helps them to practise skills like "reading while listening", fluency, review and enjoyment. Benefits for learners whose second language is English include acceptable pronunciation and positive motivation through repetition (Grabe & Grabe 1996:228). Liang and Johnson (1999:58) identify three advantages of using the talking-book type of software

- digitised feedback provides children with cross-checking information
- a decoding strategy fosters independence

- the use of colour, illustration, and animations motivates children.

The educational worth of stories is measured in more than just the ability to read the text. Reading with their parents is a personal and special activity for all children, but some learners are deprived of this privilege. Computers can assist these learners so that they can also experience the joy of reading and the building of individual reading and listening skills (Schwartz & Beichner 1999:172):

> ".... (I)n an ideal world all children will have the benefit of sitting on the lap of a loving adult while that adult reads children's books aloud. No computer can offer anything near a substitute for this most effective environment for shared reading. However, .... some children are denied this experience. For such children the benefits of interacting with books through computers are worthwhile. The child can 'ask' the computer to read a word as often as is necessary. Through much repetition the child will begin to recognise words as sight words. The child can read along with the computer as often as (s)he likes."

CAI can result in independence, motivation and self-confidence in literacy for all learners.

Learners experience a sense of independence when they start reading. Underwood et al (1996:38) report that those learners who had the lowest starting point gained most in reading in a project that applied integrated CAI in foundation-phase classrooms. This new independence comes about through various related activities with which computers can render assistance, even to weaker readers.

The ability to read sometimes develops more effortlessly when learners do not realise that "reading" is being taught. Willing (1988:404) says learners reading from screens were observed to be reading aloud, sub-vocally and silently; their eyes scanned the screen, and they

often mouthed the words as their fingers pointed to the text. He regards this as a good sign when less competent or inhibited learners say, "I liked it because I didn't have to read," but were seen and heard, to be actively reading. CAI can assist all learners in learning to read and write, fairly quickly and easily, from as early as the foundation phase.

### 4.3.3  Writing and computers

Writing offers learners a special means of communication and empowerment, but children cannot use written words for their own purposes until they can write. Writing is a laborious endeavour that does not necessarily come easily for all young learners. Some learners find written expression by means of pencil and paper difficult. Computers combine reading and writing from the start and can help learners to overcome writing-related difficulties (Slifer 1986:228). CAI supports creativity in writing and can assist learners in a variety of writing-related activities that could result in achievement in several learning areas.

Writing is not a separate language entity, but part of a whole language process. Creative writing, like reading, follows a set pattern in order to develop into a skill. Hall & Brown (1986:231) identifies the steps in the writing process. He says: the writer makes a decision to write based on previous experience, ideas become coherent, words and phrases are jotted down, questions may be asked and research may be necessary as part of the pre-writing phase. The writer then starts drafting, freely concentrating to express ideas regarded as important. The draft is (repeatedly) revised by conferencing, adding, cutting and reordering. The final format of the writing is selected and published, that is made available to others. Ideas are thus shared and then readers' reactions or responses are conveyed to the writer. This approach has four important prerequisites

- adequate time must be made available (daily) for process writing
- the writer owns the writing and may use invented spelling where necessary
- the process of writing is emphasised

- conferences are held before, during and after the writing.

Writing is not an inborn capability in young learners. CAI helps to make literacy easier because learners can type words instead of writing them by hand. Computers and their applications are more versatile than tools like pencils or typewriters, since they allow accelerated storage, retrieval, revision, polishing and printing of learner-initiatives. This versatility turns computers into invaluable aids for teaching literacy in foundation-phase classrooms. CAI can thus strengthen positive relationships between educators, learners and learning matter (Säljo 1999:158). CAI can provide individualised and enriching learning experiences and build learner confidence through the use of word processors and spell checkers when used to teach writing skills.

4.3.3.1  Spelling and the computer in the foundation phase

Spelling as a skill should be developed from the foundation phase onward, for it is related to beginner literacy. Educators want learners to spell properly, but spelling is a function of visual memory, not cognitive behaviour like reading or scientific or mathematical reasoning. Spelling should thus not be given too much attention when curricula are compiled. However, a lot of learner time is spent on spelling-related activities, and literacy is often unjustly gauged by the spelling ability of the foundation-phase author. The use of spell checkers makes it possible for learners to spell correctly and experience themselves as successful spellers, even though they may not really be proficient at spelling. Learners need to develop an awareness of proper spelling and to learn to revise their work (Crompton 1989:56; Kelly 1992:638). CAI supports proper spelling for beginner spellers in a natural way. Learners who use computers are forced to concentrate on accurate spelling, for literacy and spelling programs normally demand correct spelling as a prerequisite for the software to progress, and the learners to experience success.

Creativity is an important issue in literary activities that should not be suppressed by spelling inadequacies. When learners want to create their own stories they will often use invented

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spelling, which sounds like the word they mean, but does not follow conventional spelling rules (Casey 1997:1; Grabe & Grabe 1996:171). Spelling should not be regarded as a major problem in this case, for it can be attended to at a later stage without smothering initiative. Proper spelling cannot be learned, it is something you "see" and remember, or "don't see" and forget. Human imperfection is universal and at least 15 percent of populations just cannot spell (Kelly 1992:638). Kelly (1992:639) listed possible consequences of requiring people to "learn" spelling

- the consistent demand that learners learn correct spelling creates a pattern of failure
- emphasis on good spelling creates a poor self-image for poor spellers, which is reinforced by others who view bad spellers as 'dumb'
- poor spelling often causes educators, parents and learners themselves to lower their expectations with regard to other areas
- time that could be used for learnable things like vocabulary is wasted on spelling
- teachers grow frustrated and feel like failures, because they cannot teach this unteachable subject
- unfounded parental guilt is common.

The inculcation of spelling skills should thus really be treated with care, especially with young learners in the foundation phase where the feeling of failure can suppress the desire to be successful.

Kelly (1992:640) advises that learners should hand in projects that are spelled correctly, but that the educator should allow them to use a variety of available means like computerised spelling checkers, dictionaries or friends who can proofread accurately to accomplish this. Spelling checkers can be used to replace spelling tests, as a way to have students practice their spelling. If one student dictates the spelling list, and the other types the words, the spell checker can be used to search for errors (Grabe & Grabe 1996:36). Some software programs expect the user to type words that have to be correctly spelled before the program moves on. These

programs are motivational and suitable for use with foundation-phase learners (Hopkins 1989:141). Learners enjoy using game-like programs that support good spelling behaviour, for they see it as testing their skills against those of the computer. Foundation phase-learners will unwittingly concentrate on proper spelling, just to outwit the computer.

4.3.3.2 Computers and writing as a skill of the foundation-phase learner

For some children learning to write is an important motivating reason for initially wanting to go to school. Hall & Brown (1986:231) write that:

> "Children .... want to write. For years we have underestimated their urge to make marks on paper, because of a lack of understanding of the writing process."

Foundation-phase learners are eager to write, but they find it difficult to link language, thought and motor skills. Learners must keep a single idea in mind, and present it in an appropriate syntactic and semantic form, while simultaneously remembering and producing the correct forms of letters and words (Lawler 1997:24). Writing by hand can be a significant barrier to written expression because of the limited fine motor abilities and varied attention span of young learners. The individual production of alphabetical symbols, even one word at a time, becomes very powerful for young children when they use CAI in the classroom. Computers can provide a patient, responsive intelligence to interpret learners' writing skills. If a learner makes an error on a computer program, it is part of the learning process, rather than a major offence. Learners also find the rewriting of texts time-consuming, with the result that their first draft is often presented as the final copy and they do not acquire the skill of re-reading with a critical eye (Grabe & Grabe 1996:169; Haugland & Wright 1997:73; Outhred 1986:345).

Word processors and printers alleviate the demanding physical act of writing, giving young learners freedom to write. Schank and Cleary (1995:6) support the view of Stonier and Conlin

(1985:141) that word processing has distinct advantages over conventional writing in the foundation phase

- children become confused with b, d, p, *but* on the word processor the letters are always shown correctly
- children have to be taught to read left to right, *but* when using a word processor the writing always starts on the left-hand side
- when they learn to write, their words are usually joined together in a continuous line which often slopes down or up the page, *but* word processors produce straight lines, letters of the same size and children generally do not forget to press the space bar.

CAI can thus motivate learners to establish better writing skills in foundation-phase classrooms. It also offers relief and renders assistance to young learners in performing this major learning task.

4.3.3.3  Creative writing and computers

Learners need to develop a sense of pride in their own creative abilities and the products that they can create.  Computers can provide unique support for writing and language development through word processing.  Casey (1997:97) identified four steps in the process by which young learners achieve literacy when using computers as writing tools

- **exploration** - learners explore the keyboard and type letters randomly
- **encoding and copying known words** - next, learners type their names and words familiar to them (like Mom, Dad, cat), in search of meaning and patterns in the letters and words they create
- **writing explosion** - learners begin to put their own thoughts together with all these words.  The extension from one sentence to long stories occurs rapidly

- **printing** - the final proof of membership in the literacy club is the professional looking computer printout of their own writing.

Newby et al (2000:173) explain how the computer becomes an assistant and helps learners to write:

"When ....used as an assistant, the computer and its software play a secondary role to the subject matter itself. Word processors take much of the drudgery out of creating and editing written work. Students can use them to write papers, stories, poems, letters, or to do other writing-related activities, resulting on average in both longer documents and better-quality writing."

Word processing allows writers to revise in an almost stress-free learning environment. Grabe and Grabe (1996:69) state that learners can pursue an idea, see where it takes them, and worry about fixing syntax and spelling later, enabling even less competent learners to produce acceptable work and improves their self-esteem. The capacity to save and load text on disks makes it possible to revise earlier drafts with minimal effort. Positive attitudes towards reading, increased volumes of writing, extensive revisions and fewer errors were noted in classrooms where educators replaced pencil and paper with computers. Learners who wrote on computers on a daily basis shared more of their ideas, thoughts and feelings in print. Computers provide learners with a more non-judgemental and risk-free experience than educators, whose words or body language might convey a message when it is not safe to write or say what one really feels (Casey 1997:91, 114).

Learners are empowered when they have been taught to use the keyboard, with which they can almost effortlessly produce a professional-looking word, sentence, story or letter (Karger 1988:39, 40). However, the computer keyboard has an unusual arrangement of the alphabet, causing novices to spend time looking for the letters they want. Moreover, the keys are labelled

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with the upper case whereas young children are used to working in the lower case, often resulting in more confusion. A concept keyboard can be used to assist those who really struggle. This is a pressure-sensitive board, with individual keys that represent words, phrases or actions. The computer recognises which area of the keyboard has been pressed, and the correct response is shown on the monitor. The writing skills of young learners develop faster, for they can now write without having to concentrate on holding the pencil, shaping letters or having to search around the keyboard to find the letters they need (Hopkins 1989:141). Concept keyboards can help with literacy until a learner has acquired a higher level of proficiency on the normal keyboard.

The storage facility of computers makes the uninhibited development of work in the foundation phase possible. The end of a period or school day does not imply the end of the work, for learners can return later and carry on from where they left off. Their own stories, even if only one sentence long, can be added to daily, either at home or school, or saved for alterations to be made at a later stage. The more expert children become, the more they want to write and the longer their stories become. A decent final product with a drawing that is professionally printed out is eagerly read over and over again. The printout is proof of authorship, it is motivating, can increase learner output, and provides them with new learning powers and new paths to thought. Learners will be motivated and willing to attempt new ideas and projects, which will lead to better literacy efforts (Casey 1997:1, 107; Grabe & Grabe 1996:169).

When children learn to write, they delight in writing letters by hand, but this enthusiasm wanes gradually and soon becomes a time-consuming chore with a long return-rate. Learners can now use e-mail to write letters and exchange ideas and stories with other children from all over the world at a faster return-rate. The Internet gives quick responses and thus provides another opportunity for educators to facilitate children's literacy development (Stonier & Conlin 1985:77). Word-processing and hypermedia software programs are ideal for use with young children, because besides writing stories, learners can draw, paint, be exposed to music, links and connections, while having fun (Liang & Johnson 1999:58). An appreciative audience helps

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to increase young learners' writing ventures. Parents that model writing and reading, and praise their children's early writing and reading efforts, form a critical component of early literacy development. The enthusiasm and interest in their learning as well as patience in answering their learning-related questions are motivational for learners and can inspire them to write more and more regularly (Royle 1989:174; Stonier & Conlin 1985:67). Literacy improves with practice. CAI motivates learners to try and improve their creativity with every attempt.

4.3.3.4 Collaborative writing and computers

CAI offers tools and assistants to both groups and individual learners in foundation-phase classrooms. Birch (1995:48) states that:

> "Some children prefer to work alone, others in a group: as IT continues to proliferate there will be a need to manage opportunities for learners to learn in as many ways as possible, both through and from the medium."

The computer can support many different modes of teaching and learning, but the learners are more likely to work collaboratively on computer-based tasks than on standard classroom tasks (Light & Littleton 1999:11).

Researchers discovered that the educational benefits of computers were as strong when two or three students shared a computer, as when it was used by a single learner. Traditionally schools regarded sharing of work as a form of cheating. This attitude can turn writing into a lonely process. However, the purpose of writing is the sharing of ideas. Conference writing, where two or three learners work together at a task to create and revise stories on a computer can improve the quality and quantity of written expression for learners who find it time-consuming to use a pencil. Learners need not spend their time sitting alone, struggling and provoking criticism from educators instead of producing original stories (Hall & Brown 1986:231; Schwartz &

Beichner 1999:43). Foundation-phase learners enjoy the unique opportunities for playful stimulation and collaboration in terms of thinking and writing that CAI provides in the classroom.

The computer screen or monitor creates opportunities for teaching writing strategies, because it forms neutral ground where learners and educators can brainstorm together. Learners working in groups are more inclined to enter into discussions about the work in progress. Everyone in the group sees the work on the screen simultaneously. Critical cognitive activities develop readily, because children begin to take the responsibility for their own learning (Morocco & Neumann 1986:245; Royle 1989:173). Work displayed on a monitor also provides openness to the learners' work, while exercise books tend to hide matters and problems. The educator can see what strategy the learner is using at a particular moment and can immediately prompt, organise ideas, manage spelling, stimulate re-reading or observe revision processes, if learners are having problems with their work. CAI can thus help in reinforcing young learners' self-image as authors, because mistakes are rectified before they turn into real problems (Jonassen 1996:263). This openness of the work displayed on the computer monitor promotes accuracy and therefore scaffolds learners who use CAI.

## 4.4 Computers and numeracy as a learning area in the foundation phase

Mathematics becomes part of the learning experiences of foundation-phase learners through the learning area known as numeracy. Numeracy implies the construction of knowledge that deals with qualitative and quantitative patterns and relationships in space and time. Mathematics encourages problem solving and logical thinking and teaches learners analytical skills that will help them to make critical decisions. It has its own, exact language, with unique mathematical terms and symbols (Department of Education 1997a: MLMMS-2; Department of Education 1997b:14; Robertson 1998:35).

Computers are often regarded as "mathematical instruments". They are however, merely machines, which can depending, on the software, be used to enhance numeracy in the classroom. Using computers as tools in the classroom is a skill that today's children have a need for, while their parents never did. These developing skills should be assessed in order to determine whether or not modern schools are still effective in their aim of providing learners with relevant knowledge and skills (Schwartz & Beichner 1999:157, 160). The teaching of numeracy, even in the foundation phase, should also correspond with modern mathematical needs, including the proper use of the available technology.

## 4.4.1 Numeracy in the foundation phase

Numeracy is an early years learning programme that focuses on the accumulation of knowledge and ability in number and space work. Foundation-phase learners need to learn to work with numerical aspects in different ways and on a concrete level, both independently and in groups, to become acquainted with mathematical concepts, terminology, facts and theories (The Department of Education 1997a:MLMMS-4).

Foundation-phase learners should develop their own approaches to working with numbers. They have to learn to understand and perform basic operations in number work, measurement and the correct use of mathematical terminology and symbols. Numeracy in the foundation phase should concentrate on specific mathematical aspects such as problem solving, the use of money and simple economic principles to develop entrepreneurial skills. Additional features should also be cultivated such as independence and joy and confidence in mathematical abilities (Department of Education 1997a:22; Wilkens 1998:46).

## 4.4.2 Computers and numeracy

Computers can complement the mathematical development of young learners when they are properly used as teaching and learning tools in the classroom. Papert (1992:197) envisioned a culture evolving through interactions with computers that would extend the learning environment and empower children as learners and problem solvers. He says educators should think about how to get children to like mathematics, to enjoy programming and to use higher-order thinking skills. Griffin and Bash (1995:43) say modern learners should be able to use CAI to

- communicate and handle information
- design, develop, explore and evaluate models of real or imaginary situations
- measure and control physical variables and movement
- make informed judgements.

Computers have been credited with assisting learners in problem solving, critical thinking, natural learning, information retrieval, language and cognitive development (Schwartz & Beichner 1999:155). CAI can also provide activities that include elements of fun, variety, learner control, interactivity and speed (Pokay & Tayeh 1997:117). The computer can ask questions and give feedback to the learner. However, a computer often takes little from the learner's response to each question, other than whether it is correct or not. Some software developed for school use relies only on reward, repetition and incrementing difficulty levels to impart various skills. This is especially true in elementary arithmetic, where rote learning has always been valued. There are thus concerns that although computer programs can dispense information, they do not encourage learners in the same way as human educators can (Light & Littleton 1999:1; Newby et al 2000:170). CAI can help foundation-phase learners to develop higher-order reasoning and problem solving skills if appropriate software is used.

4.4.2.1 Computers and the development of higher-order reasoning skills

Numeracy as a learning area provides opportunities for the learners to develop and employ their reasoning skills through varied experiences, including the use of computers. Papert (1992:142)

reasons that the developmental differences in learners might be attributed to workable materials missing from the child's environment. He maintains that computer systems could be developed as "objects to think with", so that learning can take place as a natural process for all the learners. Certain mathematical aspects, like the number concept, cannot easily be taught, because learners need individual experience to develop a cognitive awareness thereof. CAI can support the development of number concepts. Research showed that changes in cognitive development occurred when learners make progress in mathematical knowledge structuring, when they question rules and start looking for answers (Department of Education 1997a: MLMMS-18). When successfully applied, CAI can provide foundation phase learners with more opportunities to develop their reasoning and other numeracy-related skills.

CAI is capable of improving learner cognition, because computers in the classroom can assist the learners in finding answers to mathematical questions (Bright 1988:51). In mathematics how someone reasons, both on the verbal and the non-verbal level, is as significant as how they find correct answers. Original and critical thinking, as well as finding and testing concrete solutions to problems, are pre-conditions for effective mathematical practices and higher-order thinking. Even foundation-phase learners must know what learning objectives they are to focus on in numeracy development (Craig 1989:39). Appropriate experiences with CAI can thus help to develop higher-order reasoning skills in foundation-phase classrooms.

4.4.2.2  Learning and problem solving through play

Play is an important activity through which foundation-phase learners learn. Education systems will improve and be less necessary, if learners can freely use aspects of interesting micro-worlds in classrooms to discover facts through play (Papert 1992:140). CAI is mostly justified in terms of the development of problem solving skills, increased understanding of mathematical and linguistic concepts and general computer awareness, but it also provides a lot of fun in the numeracy class. Careful selection of software, proper planning and the successful implementation of CAI by educators can enhance the cognitive abilities of learners and can

assist them in gaining self-confidence and enjoyment in numeracy (Robertson 1998:33). Numeracy in the foundation phase develops better when fun and exploration go hand in hand and learners can discover facts in a practical way using CAI.

Computer games can simplify the teaching of recognition of colour and shape, vocabulary, number facts and they offer opportunities to explore aspects like money, time, space, shape, puzzles, direction, estimation, measuring, tables and graphs, formation of patterns, number relationships, mental arithmetic, problem solving and symmetry in the primary grades. They also provide fast and reliable "back-up systems" which allow learners to reason and experiment more freely than was possible before. Foundation-phase learners enjoy the way in which computer programs urge them to find new solutions on higher levels. Games should, should however, not be too competitive, since winning may become more important than learning the content (Bright 1987:45; Hoot 1986:76). Computers can thus provide fun and at the same time contribute to the quality of numeracy in classrooms.

Learning how to use a particular problem solving strategy is more important than finding the solution to the problems. Learners need to ask mathematical questions in order to explore "mathematical truths". "What will happen if?" is one of the most common questions a mathematician asks, but it is also one of the most common responses to an interactive computer program (Boltman 1998:21). CAI could thus help to improve numeracy in the foundation phase, but it depends on the ability of the software and the educators to comply with curricular demands. The best programs have been found to be the ones where the technology asks and motivates the users to do things. A computer can present a variety of problems, give learners practice in solving a large number of problems in a short time, and help learners to generalise their problem solving skills or focus on specific skills, like spatial ability and logic (Newby et al, 2000:170).

CAI permits the easy checking of the reasonableness of results, for it focuses on the analysis of the situation. It frees learners from re-performing lengthy calculations, thus allowing them to

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concentrate on problem solving. Numeracy requires learners to explore, guess, and make and correct errors, in order to gain confidence in their own problem solving abilities (Parker & Widmer 1992:48). This type of experimentation and discovery allows learners to explore and control computers and become active builders of their own thinking processes and intellectual structures. Both groups and individual learners can benefit from using computers in numeracy in this way. Working with a partner helps minimise lapses in mathematical thought and also exposes learners to a richer variety of strategies in the foundation phase (Craig 1989:39).

Most foundation-phase learners are bound to concrete work in numeracy. Computers can provide these young learners with mathematical experiences they would not normally have, because CAI opens up new possibilities for symbol manipulation and exploration at their level. Papert (1992:143) believes that computers can allow the shifting of the boundary separating the concrete and the formal and that knowledge that was traditionally accessible only through formal processes can now be approached concretely through CAI. He maintains that children can learn to use computers in a masterful way and that learning to use computers can change the way children learn.

## 4.5  Computers and life skills as a learning area in the foundation phase

Life skills as a learning programme in the foundation phase involves experiences over and above academic work. Life skills include the building of self-esteem, survival skills and a healthy lifestyle to empower learners and to develop their personal potential; to participate in the activities within their environment and accomplish scientific and technological skills; to eventually become lifelong learners and empowered citizens in the world of work (Department of Education 1997a:23; 1997b:15).

In this learning programme the learner is seen as a developing adult in the modern world. Moursund (1997:51) states that:

> "Knowledge is a form of wealth, a form of power, and it is of ever growing importance. .... (F)ormal education credentials are not the only measure of the person's education. "Street smarts" - practical, down to earth people, knowing how to get things done - is increasingly important. Human ingenuity, computers and communications - together they are a powerful combination for solving problems and accomplishing tasks."

Educators should thus assist foundation-phase learners to handle real-life experiences and cope with the challenges of rapidly changing societies. CAI has the potential to provide the learners with these skills and relevant experience to develop each learner's full potential, but educators need to plan and integrate the use of computers in the classroom.

Lawler (1997:13) says education is about how to improve attitudes and skills, instil a respect for learning and teaching children how to apply what they have learned outside the school. The learners of today are the adults of tomorrow and even foundation-phase learners need to be guided on their way to adulthood by reinforcing and developing life skills that are applicable beyond the classroom. CAI could provide all learners with the knowledge and capabilities required by today's employers and society. Stonier and Conlin (1985:140) maintain that:

> "Working with a computer should be treated as a life-skill situation. Not only is a specific problem being solved but the children are learning to argue, work, discuss, and tolerate each other's point of view. The excitement of winning and working through a program unaided, is an experience a child will not forget easily. This will not happen if an adult is constantly interfering. On the other hand a child also needs an appreciative audience."

Using CAI to facilitate the teaching of life skills can lead to positive learning results over a wide spectrum. Jenkins (1990:114) lists some effects of success with modern technology that can be applied to intellectual and life skills

- it increases social interaction and cooperative learning
- it increases self-esteem and self-mastery
- it increases thinking, reasoning, and problem solving skills
- it facilitates language development and language usage
- it facilitates concept development
- it stimulates young children's symbolic play.

These effects can be realised in different ways. An educatorr could, for instance, start off by showing a video tape on a topic like the environment to supply background and arouse learner interest and start discussions. Specific pictures can then be shown on the computer to support the main theme and generate more learner interaction, for instance through discussions in small groups or a class debate. Headlines, articles or photographs from newspapers or other sources could be scanned in to set the tone for a student-centred exploration of relevant issues. Groups can later investigate related problems from programs on CD-Rom, from their textbooks or school library materials, or physical visits to relevant sites could be made. Thereafter, groups might undertake surveys like measuring some household disposal, for instance paper, in a week and compile a spreadsheet and create a graph of all the data they gathered. The groups could then present the results in the class through play, discussions and reasoning, using aids like multimedia, videos and posters. Letters could eventually be written to various members of the community on word processors, to report findings or to file complaints, in which the learners can make use of a dictionary on CD-Rom that contains definitions, translations and even the pronunciation of words. The computer can be used to record and analyse learner responses typed on the keyboard and to provide periodic review questions and feedback on the learners' progress (Newby et al 2000:42, 43, 102). This example shows the versatility of the computer as one of the tools in foundation-phase classrooms, when CAI is well managed and applied.

The foundation-phase learner is a complex person who enjoys challenges at all levels. Learners' progress in improving their life skills depends on their emotional development and well-being. Foundation-phase learners' cognition, affective and physical development can be supported by using computers in the classroom. Success achieved through the effective use of CAI can build young learners' self-esteem and motivate them to concentrate on the world around them, thus extending their life skills.

## 4.6  Summary

Foundation-phase learners and their educators are linked by the learning matter that has to be shared in the classrooms. The learners want to accumulate knowledge and learn more about the world they live in. They need scaffolding in their endeavours to probe and manage their life-world at their level. Using computers as tools and assistants in the classroom can simplify and support these activities. Foundation-phase learners participate in various activities as outlined in the curricula, including CAI, to develop relevant skills over a wide spectrum through

- literacy
- numeracy
- life skills.

Making use of CAI in the learning environment can assist the affective and cognitive development of learners. Foundation-phase learners need to learn to read, write, listen, socialise, communicate and become worthy members of their school and society. They interact with other learners when they take part in group work, which helps them to better understand themselves, other people, and their world. CAI can assist learners to attain successful and constructive learning through the challenges set by the software. Learners can thus experience cognitive development in relation to their unique learning rate and potential. Success in learning builds their confidence and gives the learners greater courage to attempt new challenges, both

inside and out of the classroom. However, learners have to be computer literate at their level, to be able to properly use the computer as a tool in the didactic situation.

CAI can help individual learners to experience success. They can also gain knowledge in all three learning programmes, to ensure that they become more independent in their learning, at home and at school. Computers do not get tired and are thus excellent tools and assistants when repetition is needed until certain learning matter is fully absorbed by the learners. CAI offers variation that minimises the boredom that would result with the usual repetitive activities. Education must help learners to make sense of the information age. They could experience modern life as overflowing with masses of disorganised and unrelated information. CAI has the potential to improve learning and develop individualised characteristics and personal traits of foundation-phase learners, while they think that they are playing. Enjoyment and success are thus linked to form a winning combination to enhance learning in foundation-phase classes.

# CHAPTER 5: GUIDELINES FOR THE USE OF COMPUTERS IN THE FOUNDATION PHASE

## 5.1 Introduction

Inexperienced educators who want to make use of computers as tools in the didactic situation require guidelines. The need to compile such guidelines becomes more obvious in the light of claims from researchers like Bonk and King (1998:209) that educators and instructional designers are seeking to learn how to integrate the use of computers in instruction in effective and efficient ways, and Newby, Stepich, Lehman & Russell (2000:61) that teachers are still struggling to make the best use of these "wonderful tools". Scrutinising the school-related qualities of computers, the role of the educator and the curriculum in relation to CAI in the foundation phase, and how the learners can utilise the computer in learning has led to the question: "How should educators go about teaching and learning to equip foundation-phase learners for successful CAI?".

Guidelines are rules that determine a course of action. They should be followed to reach a specific goal. Didactic guidelines could thus indicate the way forward for educators who want to use CAI in the foundation phase. Newby et al (2000:25, 38) say in this regard that the theoretic foundations for teaching need to be translated into practical guidelines for educators to reach didactic destinations and create solutions to their unique problems. Whether computers will become tools for liberation or agents for repression will depend on how CAI is introduced and applied in classrooms. Sewell (1990:12) draws the attention to the same fact:

> "To date, the dominant role for computers in the classroom has been as an aid to traditional teaching and traditional curricula. ....(However) computers can play a cognitive role; can influence our perceptions of what constitutes intelligence, and our conceptions of what children can and cannot do."

The real usefulness of CAI is determined by the attitudes of educators and learners and how they exploit the properties of computers as tools and assistants. Guidelines could direct and support educators who have difficulties incorporating CAI into foundation-phase classrooms.

The following guidelines were selected from the consulted literature to assist less experienced educators in particular, to successfully introduce and establish the use of CAI through literacy, numeracy and life skills as learning areas of the foundation phase. These guidelines refer to the technological skills of both educators and learners, teaching methods and the subjects being taught, the selection of software and the involvement of parents in CAI.

## 5.2 Guidelines for CAI in foundation-phase classrooms

Guidelines based on using computers in classroom activities could promote successful CAI in the foundation phase. Haugland and Wright (1997:80) state that there is no single and correct way to use CAI. Educators should take the initiative in CAI and use various teaching methods to present learning matter in an integrated way. This would enable learning activities from low-level routine jobs, such as rote learning, up to and including higher-order and logical thinking activities, like problem solving and application that best fit the needs of their learners and the didactic setting at that moment.

It will thus be shown in this chapter that the most effective and enduring uses of CAI have proved to be those in which learners use the computer as a tool on their own, as well as in collaborative projects. Educators should become the models, guides and collaborators, and they should aim to improve the skills and knowledge of the young learners (Newby et al 2000:30, 187, 256). This implies that both educators and learners should have the skills and confidence to use the computer as a tool at their level.

Planning the didactic situation well, involves educators selecting software with care and continuously evaluating its applicability. The learners usually view the computer as a "toy". Educators thus have to ensure that every learner has fair access to it, for the learners to share in the "fun". Careful planning and the use of relevant methods and software could motivate the learners to gather knowledge and skills in a practical way with CAI in the foundation phase. Independent exploration of new learning matter could result when the learners feel safe and confident in the learning environment. They might even attempt activities they were initially hesitant to try. Parents and other educators could support activities related to CAI to extend learners' joy and motivation and assist their working and learning efforts in the classroom. The guidelines for successful CAI in the foundation phase were derived from the consulted literature. The guidelines are thus neither rigid nor complete, but could help inexperienced educators in particular to initiate and establish the use of computers as tools and assistants in the didactic situation.

## 5.2.1  Subjects should be integrated

It is evident from the literature consulted that subjects should be integrated when teaching with CAI in the foundation phase. For example, Haugland and Wright (1997:116) encourage educators to use the holistic approach to enable young learners to progress with CAI. They reason that the integration of learning programmes widens the abilities of the concrete-bound learners to understand their world through the progressive mastering of bigger units of knowledge. The integration of subjects in the classroom gives learners multiple exposures to the learning matter. The learners are thus continuously involved with the learning matter, presented through different approaches. This assists understanding and breeds familiarity that supports learning in the foundation phase.

Educators should look for opportunities, and devise ways to teach subject matter like English, mathematics or social studies in integrated units, for a combination of strategies, drawn from

different subject areas, is required to solve most problems (Haugland & Wright 1997:118). Birch (1995:46) reports in the same vein that a teacher commented:

> "I try to fit something we are doing on the computer to the topic we are doing. I try to use it to supplement maths work or language as appropriate, for example, constructing graphs, bar charts, or word processing."

Attitudes like this promote integration and are valuable when attempting teaching with CAI in the foundation phase.

## 5.2.2  Combine teaching methods

Combining teaching methods and media in classrooms can be powerful because the simultaneous input of the visual, aural and tactile from different sources can create better learning experiences and help make problems more realistic for young learners. Combinations of methods like discussion, cooperative learning, presentation, demonstration, discovery, drill-and-practice, problem solving, simulation, tutorials and games on the computer can also result in the educator reaching more learners in the classroom. The variation brought about by combined teaching methods can support foundation phase-learners to achieve the learning objectives (Newby et al 2000:38, 91, 100). Educators should therefore choose and combine appropriate teaching methods, resources and strategies to bring the learning matter to the learners in a realistic way.

Sewell (1990:86) writes that good educators call upon experience and intuition when dealing with everyday learning in the classroom. He continues that these educators vary their teaching style in accordance with the perceived requirements and objectives for that class. Educators should therefore be open-minded and adaptive to be able to attend to the didactic needs of all the learners. Educators could combine other media with presentation software to engage learner attention in modern learning environments (Haugland & Wright 1997:101, 120). To

ensure that computers serve, rather than dictate the didactic needs of every learner involved in CAI, educators should present work in multiple ways. They should strive to match the learners' unique needs, learning styles and preferences through combinations of teaching methods, especially in the learning areas of the foundation phase.

## 5.2.3 Experiment with technological applications

Educators do not always have the necessary skills to introduce the use of more complicated technological applications into classrooms (Haugland & Wright 1997:3). Educators' ingenuity, expertise and input are linked to their skills and self-confidence when initiating CAI. Those who are confident with computers will motivate the learners to participate in projects and thus ensure the success of CAI in the classroom. Educators thus have to explore and use the available technological tools to produce the expected results with the curriculum and the relevant learning areas in foundation-phase classrooms. They should experiment with technological applications to build personal confidence as they progress with CAI.

Better skills develop when educators experiment with technological equipment, like computers. For instance, according to Haugland and Wright (1997:82, 85), a teacher revealed that she initially used only a variety of drill-and-practice exercises in language teaching with which she was comfortable. She then enrolled for a computer class which enabled her to experiment with word-processing in the classroom. At first the learners only typed words and sentences and wrote papers, but they soon began illustrating their work with clip art and graphics. After some time she introduced hypermedia. The learners then used set databases and investigated virtual encyclopaedias and relevant reference software. In addition, learners could also record the sights of a field trip and convert their pictures into computer images with a scanner, or use a digital camera to establish a database and create their own micro-world (Newby et al 2000:148). This example confirms that teacher confidence with the computer and its applications is important for the successful implementation of CAI in foundation-phase classrooms.

Haugland and Wright (1997:73) advise inexperienced educators to visit classrooms where computers are well established as tools. They say that when educators observe the ease with which more experienced educators manage the classes, their own confidence with technology will improve. Technological skills could be extended by means of in-service training. Teacher confidence is thus best acquired in time and through personal experience with experimenting and using the computer as a tool, both inside and outside the classroom.

## 5.2.4 Gradually acquaint learners with technological skills

Educators understand how children develop and learn and should thus know to gradually introduce and facilitate learning with CAI. Sewell (1990:63) states in this regard that successful computer integration requires a classroom environment in which all the learners are encouraged to take learning-related risks. CAI is structured on a 'bit-by-bit' basis, so that learners can take one small step at a time towards the goals. Progression is dependent on the mastery of each of those steps.

Learners are familiar with educators slowly introducing new learning matter to them, and will thus also accept the gradual incorporation of this new tool into classrooms. Educators should offer rewards like certificates, good grades, praise and extra time spent on enjoyable activities, after success with specific tasks at the computer, to reinforce skills and motivate learners to want to make progress with CAI (Newby et al 2000:25, 187). Learners' learning rate and abilities have to be taken into consideration to ensure that every individual gets the opportunity to gradually become familiar with the qualities of the computer as a tool in the foundation phase.

Learners need basic computer literacy skills to be able to progress with CAI and should over a period of time at least be taught to boot up, select programs and save and print work. Hall & Brown (1986:232, 235), for instance, observed a teacher working at computer skills with a junior class. He reports that during the first two weeks, learners in groups of two or three

retrieved material that the educator had written, completed error-correcting exercises like inserting capital letters and punctuation, identified and changed poor setting in short paragraphs. After managing this well, they started to write stories to enhance their keyboard skills and emphasise the word-processor's capabilities while composing, editing and printing. Numeracy soon followed. Peer teaching was part of the process, so the educator responded with questions when the learners asked for help, to encourage them to learn not only from her but also from their classmates.

Young learners can master basic language skills through drill-and-practice to enhance basic computer-related skills. They will gradually learn to use word-processing to compile classroom newspapers and databases on specific content areas. CAI can also motivate them to communicate and collaborate with global peers on projects via the Internet (Newby et al 2000:164). Educators and learners will find more ways in which computers can be used in the classroom as their skills improve. However, Newby et al (2000:38) warn that computer-technology requires thoughtful integration into the curriculum or it may fall short of its promise. The curriculum has to be extended to complement and support the learning of required skills as well as the technological development of every learner at different times and with various activities. This has become necessary because, for instance, the language skills that learners are using today go beyond merely reading, writing, listening and speaking (Newby et al 2000:30).

Learners need to work on computers, develop relevant skills and, in time, become actively involved in their own learning. The final objective should be for learners to naturally reach for the computer when they want to search for information or write, display or present learning and other matter (Newby et al 2000:61). Teaching and learning with CAI should progress gradually and naturally, as the educators manage to expand on what has been successful before, and learners start to develop the skills and confidence to experiment with and use computers and their applications in different ways at their level.

## 5.2.5  Plan and assess activities

Educators should be able to guide and assist the learners in accordance with the curriculum to be successful with CAI.  Haugland and Wright (1997:73) state in this regard that leaving learners in classrooms with computers in the hope that suitable technological skills and knowledge will be acquired by chance, is not a viable option for the successful implementation of CAI.  Detailed prior planning and critical and objective assessment of the outcomes of all computer-related activities in the classroom are vital (Schwartz & Beichner 1999:155).  Extensive and meticulous planning by educators can result in interesting and challenging tasks for every learner at their own level of development.  Diversity among learners in terms of motivation, intelligence, learning styles, gender, culture, socio-economic status, special needs and skills and knowledge complicates the educator's planning, but has to be acknowledged in the didactic situation (Newby et al 2000:67, 265).  Educators should thus continually monitor and ascribe values to their own efforts, as well as to the progress of the learners when using CAI.  Continuous assessment and reflection can lead to the improvement of the learning process.

To encourage learners to plan and structure their own efforts from the start, educators should provide multiple materials and orderly storage facilities when the learners use CAI (Casey 1997:95).  Educators should ensure beforehand that all relevant components are tested and in place, and that the adjunct materials, like printed matter, are ready.  It is also important that the users should be acquainted with using the relevant applications at their level (Newby et al 2000:187).  Learners become enthusiastic when they can activate systems to respond positively.  Haugland and Wright (1997:13) state in this regard that the successful manipulation of computers should result in self-motivating learning, for learners experience a sense of control when they press buttons and the screen responds to their intentions.  However, learners should also acquire the skill of reflection to understand their own learning experiences, and eventually learn from their mistakes as well as from their triumphs at CAI.

Educators have to guide young learners to ensure that they develop a solid base from which to attempt CAI. Volunteers, like parents or older students can also assist the educator in the classroom. This would ensure individualised support for and motivate reluctant learners to accept the challenges and use computers as tools in the classroom (Haugland & Wright 1997:4). Progress with CAI in the foundation phase can be accelerated when educators plan well, and continuously assess teaching and learning activities with a view to improving their learners' computer-related skills.

## 5.2.6  Software selection and record keeping

Educators should take special care when they select software for use in foundation-phase classes. Haugland and Wright (1997:28) state that finding quality software with accurate content suitable for specific academic levels is challenging, especially for inexperienced educators. Vast amounts of software are available. However, the goal is to find developmentally appropriate software that will be supportive in promoting learner progress. Educational and software magazines as well as the World Wide Web can help educators keep up with relevant software releases while other educators may also recommend software that they found useful (Haugland & Wright 1997:80).

Educators should keep in mind that software should be appropriate to the specific age group and easy to use, with clear instructions and child control. Software should also have features such as expanding complexity, independence, process orientation, a reliable real world model, non-violence, and technical features like animation, saving and printing, anti-bias deduction and transformation. Quality software gives learners a correct, broad perspective on the world, representing diverse cultures and races, family styles as well as gender roles, thus meeting the "challenges of diversity" in every classroom. Open-ended programs offer children the opportunity to create their own learning matter, solve problems, build skills and develop self-esteem (Haugland & Wright 1997:67; Stonier & Conlin 1985:23).

Educators should develop systems that indicate the applicability of software, for their future reference. Haugland and Wright (1997:59, 93) state that each educator should keep a record of the content of specific software, successes with its implementation or any other tips, through rubrics, checklists or other rating scales. Adequate record-keeping saves time, and helps to improve the quality of CAI in foundation phase classrooms. It could prevent the re-occurrence of problems or mishaps with software. The careful selection of software, supported by good record-keeping will save time and assist educators to ensure that CAI has a higher success-rate in foundation-phase classrooms.

## 5.2.7  Access to computers

All learners should have fair access to computers in the classroom. Different situations exist as regards the availability of computers in classrooms, but access has to be managed on the basis of fairness. Schwartz and Beichner (1999:13) say "one-computer-classrooms" can produce good results when well managed, but a computer area in a pre-school would usually operate better with two or three computers and a printer. They go on to say that primary phase learners who use word-processors and encyclopaedias on CD-Rom more extensively, could benefit more from four or five computers. One of these could be mobile to be relocated for group presentations or demonstrations.

Educators should ensure that all the learners get a fair chance at using the technology that is available. If schools have limited hardware, computers could be established as one of a number of learning centres, to be used by individuals or small groups of learners in rotation. Newby et al (2000:170) advise educators who find themselves in this situation to assign half the class to work in pairs at computers, while working directly with the other half, rotating after a period of time, to make optimal use of human and electronic resources. This practice also ensures that all the learners are continuously productively engaged in educational activities. Turn-taking boards could be created to indicate the names of learners who are waiting, to arrange fair access to

computers and to avoid conflicts. Computer placement and utilising practices will gradually develop for individual educators, as their teaching experience with CAI increases, similar to other practical aspects of teaching like furniture arrangement or group work (Haugland & Wright 1997:71, 73). However, it remains the responsibility of the educators to ensure that every learner has a fair opportunity to explore the technology in the classroom, and to eventually develop the necessary skills to become a competent user of CAI.

## 5.2.8 Cater for fun and the development of learner confidence

Fun at the computers encourages learners to explore the qualities of the machines. Successful exploration could result in the development of more confidence with CAI. Casey (1997:95) consequently advises educators to be encouraging, friendly and patient when the learners use CAI. He adds that educators should give specific praise, and accept quiet talking from the learners at the computers. Computers are fun and these pleasant experiences could help to improve learner-confidence with CAI.

Haugland and Wright (1997:73) claim that CAI offers relief to learners who struggle with schoolwork. These learners can begin to experience enjoyment and escape from real, hard learning situations while learning naturally and in a challenging way if educators couple education with challenging computer-assisted games. Games keep learners interested in didactic activities through common features like setting the players a series of challenges to overcome. Games also provide a fantasy environment, resulting in elements of fun and mystery that are fascinating to young learners. Haugland and Wright continue that computers are interactive, unlike passive teaching aids like books, tapes, films, radio and television. CAI allows learners to experience a sense of control as well as freedom of choice, because the learner determines what happens next through active, motor and cognitive involvement in the activities. A computer can furthermore be programmed to explain concepts in interesting ways, while no amount of talking, writing, or providing diagrams can compare with making learning matter come alive on the screen like colourful animated material accompanied by a happy tune. Computers have infinite

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patience, they do not tire and they can ensure privacy for every user. Negative elements, like ignorance, lack of skill, slow comprehension or poor coordination, can thus be overcome with CAI in the classroom. Computers can provide every learner with interesting opportunities and applications to make learning fun, especially in the foundation phase.

## 5.2.9  Involve parents and other educators in CAI

CAI has the potential to enhance all teaching and learning, but there is no single correct way to use CAI. However, it appears that parents sometimes expect educators to take all the responsibility in supporting the learners in their didactic endeavours especially with CAI, which parents often regard as a specialist area. Parents should also carry the responsibility for the education of their children and should be involved in their successes and progress with CAI. Reimann (1986:343) suggests that educators could, on a regular basis, keep parents updated on and involved in the use of CAI by means of a newsletter. The educators could include learner products, and allow the learners to suggest topics for discussions to personalise the newsletters.

Parents could engage the learners in additional computer-based learning programs for remedial or extended work, or just for fun. They could also make contact with other parents to share experiences on CAI. Such efforts would assist their children to develop into successful learners (Knight & Knight 1995:144). Educators should thus involve parents in CAI, to gain their support in the endeavours to establish positive learning attitudes in the learners.

## 5.3    Consolidation

Computers in the classroom are as effective in enhancing literacy and numeracy as they are in assisting learners to gain life skills. Using CAI in classrooms can provide learners with fun as well as a challenge. Learning should be based on didactic theory and should aim at the construction of knowledge, the integration of skills and the expansion of learner independence.

Children have individual learning preferences, but Dahlberg (1990:13) states that they will follow objectives and learn, if educators teach so that

- knowledge is relevant and constructed
- skilled performance is integrated and goal directed
- students become independent learners who can relate, combine, communicate, change and learn on the job.

These learning preferences also become distinct when educators attempt to introduce CAI to the learners. Some learners can easily reach the goals related to CAI. Others approach computers with greater hesitation, but usually benefit from teacher assistance and support. Still others do not approach the computer at all, and might never become involved in CAI without abundant encouragement and support (Haugland & Wright 1997:101). Learning is an active search for knowledge, skills and independence, seated in each individual learner. Learning benefits when learners manage to organise new information and link it to their existing expertise.

CAI has the potential to enhance all teaching and learning, but there is no single correct way to use CAI. However, educators can assist and equip learners to become successful at reading, writing and mathematics, as well as to make the most of life and its experiences, on their way to adulthood and life-long learning. CAI can assist foundation-phase learners to easily write stories at their level, which could even be published on the Internet. Computers allow learners the opportunity to use the spell-checker to refine their spelling abilities, to write letters to pen pals at a fast return rate, to teach mathematics, also through graphs and spreadsheets, and even to expand their view of the world and the ways of its people. Inexperienced educators could make use of the guidelines for CAI to ensure foundation-phase learners experience fun and success in tandem with learning. The full potential of each learner in the learning areas of literacy, numeracy and life skills can be exploited when CAI is used in foundation-phase classrooms.

## 5.3.1   Literacy and CAI

How computers are applied as tools and assistants in literacy will depend first and foremost on the attitudes and skills of the educators responsible towards computers.  Mann (1989:49) says the following about literacy teaching with CAI:

> "A linguistically rich environment should be colourful, stimulating, challenging and fun. The classroom-based computer can offer just such opportunities to enhance the language environment…limited only by the expertise of the individual teacher."

It will be shown that CAI can enhance the development of young learners' writing and reading skills and assist them in becoming competent  writers at their level.   CAI offers various opportunities for the improvement of reading and writing through appropriate software. Software can provide words, pictures and sounds for individuals or groups of learners to experiment with, and produce stories and poems that could even be posted on the Internet. Spell-checkers can be used to improve learners' general language attentiveness skills.  It could result in improved reading skills and assist proper pronunciation through books on CD-Rom. CAI can thus assist learners in producing neat products that encourage creative literacy in the foundation phase.

### 5.3.1.1  Writing and CAI

CAI supports writing-related activities.  Newby et al (2000:46, 55) say young learners can use word processors to perform pre-writing activities like brainstorming, or to take notes and collect ideas, and to do written work or to revise earlier writing attempts.  Learners can also type handwritten notes to reinforce learning.  Activities like these are difficult with pencil and paper writing, but can develop easily and naturally when using a word processor (Schwartz & Beichner 1999:161, 162).

Foundation-phase learners should be taught to use the keyboard to avoid confusion because of the unusual arrangement of the alphabet on it, as well as the use of the upper case, because young learners are used to working in the lower case (Hopkins 1989:141). Learners can then use computers to produce unique stories and become competent authors. A story, even one sentence long, printed out with a picture, will eagerly be read over and over again by its author, and can be added to or edited on a daily basis, at home or at school (Stonier & Conlin 1985:67). Independent authors could thus also develop into independent readers in a natural way when using CAI in the classroom.

Educators can print copies of slides or other relevant matter for the learners to use, because interesting pictures enhance ordinary notes and writing and can help to promote literacy. Certain software supply learners with multimedia to assemble stories using less words and lots of pictures and sounds (Schwartz & Beichner 1999:75, 164, 170). Learners can use the software to experiment with features like colour, form, design and balance. The tools are fun and easy to use to make tidy, colourful illustrations and decorations for stories, greeting cards, invitations, mini-books, journals, reports, writing rebus stories and creating graphic representations or to produce school newspapers or yearbooks (Newby et al 2000:49, 193).

Educators should provide opportunities for learners to read and share their efforts. They should ask leading questions to extend stories and keep the focus on the flow of ideas, while learners could use the computer to direct or change stories on the computers, especially mystery stories and adventures. Learners could be taught to be creative when writing their own stories rather than copying existing material. This practice is best avoided in foundation-phase classes. Stories and poems can be posted on the Internet for the world to read, and to show learners that educators value their writing efforts (Casey 1997:95). Such proof of successful writing and reading using a computer will lead even young learners to believe that they are effective learners and capable authors, motivating them to improve on previous attempts.

- Group work

Group work on computers is popular in foundation-phase classrooms. Underhay (1989:94) recommends that children work in groups of not more than three or four so they are able to sit comfortably around a computer, and that every learner should be allocated a specific job: operating the keyboard, reading the screen display, or recording information and decisions taken, to make a real contribution to the final product and to be part of the writing process. Problem solving and higher-order thinking skills develop when learners define, organise, edit, sort and search the fields well. Group members often work in isolation to locate information from prepared databases in relation to their levels in the early phases of research, but learners working in groups can motivate, teach and assist one another with writing and other skills, to create attractive products for display in the classroom by using colour and large fonts. The learner in each group with the least amount of material opens the writing centre with his or her information. The others read what has been entered, and add their unique material, one by one. Grabe and Grabe (1996:27) advise educators to insist on organised products so the unstructured report is then printed, cut into different parts with scissors and rearranged in different ways to improve its format. Thereafter the educator demonstrates the use of the cut and paste features on the computer, and the final version is printed for display. Computers can support the writing activities not only of individuals, but also of groups of learners in the foundation phase and motivate them to become competent, creative authors.

- Spelling and computers

Spelling-checkers on computers are easy to use and can improve spelling awareness in the foundation phase. Spelling is an important skill that foundation-phase learners should learn to master. Educators should provide guidance in hearing phonemes and helping learners to edit their own work for phonemic consistency (Casey 1997:95). A spell-checker can save teaching time and energy and allow the educator to get on with other, more important tasks in the classroom.

Learners enjoy using a spell-checker to practice their spelling words for the week. Grabe and Grabe (1996:36) suggest that learners work in groups of two, one dictating the spelling list, while the other one types the words. The spell checker is used to search for errors when the list has been completed. If a learner has difficulty with a particular word, the spell-checker will repeatedly provide corrections, serving as on-time and as-needed drill-and-practice. Schwartz and Beichner (1999:163) support the use of this practice, but state that learners must respond cautiously to the spell-checker. If they simply replace every flagged word with its first suggestion, their writing may contain strange words and sentences, because the computer cannot suggest correct words based on meaning and context, or distinguish between homophones. Looking up each alternative in an on-line dictionary, until the word with the correct meaning is found, improves spelling skills in game-like fashion. Language attentiveness and reading skills can thus develop more easily for most learners when spell-checking becomes part of their computer- and learning experiences from an early age.

- The Internet and writing in the foundation phase

Newby et al (2000:193) regard the Internet as an excellent communication and information-orientated development. The Internet has become available for public use, including schools, in recent years, through e-mail, discussion groups and information publishing and retrieval. The Internet allows large volumes of communication to take place immediately (Schwartz & Beichner 1999:180). It can allow even foundation-phase learners to relocate vast amounts of information over long distances in a very short period of time. Learners can now access a wealth of knowledge, including libraries, museums and data banks fast and effectively through the Internet. They are no longer limited to boring textbooks and library-resources because lots of information can easily be found for projects, although not unconditionally so (Haugland & Wright 1997:15).

Newby et al (2000:61, 205) say material on the Internet is mostly up to date, free of charge and quickly accessible but educators should have realistic expectations for not all of it is useful for lessons. This material should be previewed by the educator in the same way as a videotape or

textbook, to ensure that it relates well to the objectives and the content of the lesson, especially in the foundation phase. Supervision is essential to ensure that learners do not wander off to inappropriate sites. Learners should also be aware and understand that they share this public medium with other people of different ages and countries and they need to be considerate towards fellow users. Learners have to be taught to carefully evaluate information and to judge what is relevant and should show pride in what they publish and retrieve (Newby et al 2000:208). The objectives of the lesson have to be discussed with the learners and the educator should give learners written guidelines on the specific activities that they have to undertake. Learners need to be reminded of copyright guidelines and the school policies for acceptable Internet use. The activities should be discussed after using the Internet, to discover how successful the learners were and how to enhance such experiences with future projects (Newby et al 2000:60, 198). The Internet has the potential to assist learners in their research and subsequent writing activities, but good judgement and control are vital.

Learners of all ages enjoy having pen pals. Stonier and Conlin (1985:77) state that learners could use e-mail for pen pal exchanges and to learn more about other places and cultures or to practice a foreign language or exchange ideas, written work and data. Educators should coordinate pen pal projects in the classroom by taking grade levels, ages, as well as location and the purpose of the contacts into account. Learners could even e-mail educators for information or to submit work. Also, science experiments as well as the latest news can be retrieved and research conducted while the results of classroom projects could be published on the Web (Schwartz & Beichner 1999:175). Web sites with children's literature allow them to read, and even to write and publish reviews of their favourite books, correspond with authors and list their e-mail addresses so they can be notified when new books by their favourite authors or books on specific topics are published. Publishing information on the WWW provides practice in reading and writing, and promotes a sense of audience in both (Schwartz & Beichner 1999:174, 177, 178). The Internet thus provides another opportunity to improve literacy. It can be of help in improving the writing, reading, thinking and learning skills of learners when they post and find information on the Web.

5.3.1.2  Reading and CAI

Teaching reading is a major task of the foundation phase.  Beginner readers are often eager until they realise that learning to read is a slow process which involves a lot of hard work.  Difficulty with reading can result in a lack of self-confidence as well as learners starting to believe that they cannot read.  Calvert (1994:142) found that books on CD used by a skilful educator can be helpful for such readers.  These books not only help to improve memory strategies when learners have to name objects, but also allow learners to have the names of objects elicited on the computer screen by presenting a picture of that object.  Programs like these are often repeated by the learners, especially when they contain colour, movement and sound.  Learners believe they are playing, and rehearsal activities increase in a natural way through CAI in the foundation phase.

The computer does not tire or get grumpy when it has to repeat words or stories, and the learner can turn it on or off whenever it pleases him or her.  Schwartz and Beichner (1999:179) believe that books on CD can provide all learners as well as those who feel inhibited when they have to take part in groups, with the opportunity to repeatedly hear unknown words correctly pronounced by the computer, until they feel confident enough to read them to the educator or to the group.  Computers can be set to follow the learner's pace and are thus ideal for promoting skills such as reading for a purpose and learning to make evaluative judgements about text. CAI offers independence to readers at all levels because they are able to choose their learning matter as well as their reading and learning speed.

According to Liang and Johnson (1999:58), the use of talking-book software gives feedback that provides learners with cross-checking information, a decoding strategy that fosters independence through interesting reading and talking activities, and the use of colour, illustrations and animations.  These all help to motivate the learner.  The user may turn the pages, "find" hidden qualities through exploration and gain the rewards of animation or sound by clicking on

objects on the screen.  Books on CD offer features such as choice of voice, colourful games, lively animation, catchy music, open-ended questions, access to background information, as well as a variety of activities in which the attention is focused on the beginning, middle, or end letters and word matches (Evans-Andris 1996:103; Robertson 1998:37; Schwartz & Beichner 1999:173).  Reading skills can thus improve in a natural way when foundation phase learners explore the different options provided by books on CD in an effort to enhance literacy through CAI in foundation-phase classrooms.

## 5.3.2   Numeracy and CAI

Computers are merely machines which skilful educators and learners can use as tools. However, they are often referred to as "mathematical applications" and expected to work wonders for learners trying to master numeracy.  Individual educators use different methods to introduce foundation-phase learners to CAI, in order to build and support skills related to numeracy.  For instance, primary-age learners working on basic arithmetic skills might rotate through several related learning stations featuring concrete manipulatives, traditional flash cards and a computer drill-and-practice game in the classroom (Newby et al 2000:171).  Teaching numeracy needs to correspond with global mathematic needs, including CAI.  However, the methods used will depend on the learning matter as well as on those skills learners need at a specific stage.

There is more than one way to solve a problem.  Mistakes should be viewed as steps on the path to correct solutions.  Learners will soon understand that better planning leads to better results (Newby et al 2000:182).  CAI can help young learners to construct a foundation for algebraic thinking through the pre-planned instructions that they give the computer.  The computer's immediate feedback allows learners to refine their thinking and attend to the visual and symbolic representations and properties of mathematical shapes as well (Schwartz & Beichner 1999:148, 149; 151).  This concept becomes clear in Haugland and Wright

(1997:118), who describe an incident where children explored coloured shapes moving in "complex intertwining paths" to create visual effects on two computers. Some used the animated shapes to tell stories, others to choreograph a dance. The computer provided these learners with opportunities to stretch, shrink, bend and combine shapes into new forms. They thus learned mathematical concepts such as angles, coordinates, lines, measurement, degrees and speed, in a concrete, real-life environment.

Learners also build language and social skills when they give and follow directions and take turns to use CAI. Learners manipulate computers and experience a feeling of "being in control" when they press buttons and the screen responds positively to their instructions. CAI serves as enrichment and extends activities with physical manipulatives, while learners merely lectured on angles, and completing work-sheets, follow an educator's agenda, and do not experience such high and intrinsic motivation (Haugland & Wright 1997:13). CAI provides valuable opportunities for drill-and-practice exercises, especially in mathematics, because it can give learners immediate feedback which is particularly motivational.

Spreadsheets can be put to good use when teaching numeracy in the primary grades, since teaching at this level involves counting and the charting of information. Spreadsheets make it possible for learners to create graphs to set up and maintain personal or organisational records and budgets, and to enter and analyse data (Newby et al 2000:56). Spreadsheets are easy to create and they simplify recordkeeping. Even the creation of basic illustrations can be extremely motivational for these young learners. Grabe and Grabe (1996:181) suggest that learners could carry out surveys on topics like favourite sports, foods, hobbies and pets, graph the frequency with which popular alternatives were recorded, keep track of money earned from class projects, keep personal grade records or plan a budget.

Skip-counting, which means that learners are given a number that becomes the starting number in a counting sequence, is a common activity in the primary grades and can be enhanced by the use of spreadsheets. The intellectual challenge with oral skip-counting is only to think of the

next number, while skip-counting on spreadsheets allows them to see patterns and explore numbers in a different way. Educators could also ask the learners questions to lead them to explore occurrences of odd and even numbers or other distinct number patterns (Schwartz & Beichner 1999:140,141). When abstract activities are made concrete, like skip-counting on spreadsheets, it opens new lines of manipulation and thought especially for the younger, more concrete-bound foundation-phase learners in particular. CAI thus helps learners to refine their thinking processes by assisting in visualising abstract processes. Reflective thinking in the foundation phase is promoted when learners have to find alternative options or solutions to problems in numeracy.

### 5.3.3 Life skills and CAI

Life skills as a learning programme should equip learners with skills necessary to cope with life, especially in the twenty-first century. Schwartz and Beichner (1999:102, 103) maintain that the computer has moved into the forefront as one of the most powerful influences on today's society. They go on to say that teaching life skills involves subjects such as environmental or social studies, and that social studies teaching today look a lot like social studies teaching of the past. However, CAI makes the teaching of life skills more accessible than it was in the past, because relevant sights and sounds are only mouse-clicks away. CAI thus supports the teaching of life skills in foundation-phase classrooms.

In order for the schools to relay these skills to the learners, they have to prepare them to form their own opinion about pollution, recycling or other relevant issues. Educators can use multimedia software to retrieve information or create their own basic databases with relevant information. Inappropriate materials should be omitted to avoid the chance of learners becoming bored or losing interest in the presentation. Groups or individual learners can then explore the data, select relevant information and print reports on the results of their surveys. Educators can also select short video clips to tell a story, or put a few relevant clips together in

an interesting way to use as resource materials and to promote reflective thinking in learners. Excellent video discs, colour photographs and movie clips on topics like oceans, deserts, astronomy and dinosaurs are available and can be used to enhance the teaching of science and social studies (Schwartz & Beichner 1999:102, 116, 117). Group work benefits individual learners, for it enables them to learn from their peers, while it also teaches them the skill of working together as members of a team. A third-grade teacher reported that she uses games on computers in groups to get learners to stretch their minds, for the responsibility of being a valued member of a group encourages learners to constantly think of alternative solutions (Evans-Andris 1996:102). Life skills as a learning area, thus implies that learners gain knowledge and skills to assist them with the ability to develop into balanced and better citizens and human beings.

Computers can be used to introduce learners to research, like exploring and interpreting historical questions and to compiling comparative graphs on historic and other relevant data. To illustrate this Schwartz and Beichner (1999:104, 105) say a laptop with database software could be used to set up and store information found on gravestones, which could then be used to explore historical questions on, for instance battles and wars. Comparative graphs on male/female deaths could be compiled, and possible reasons for the results discussed. Personal family histories could be researched and organised in a database. "Dead" historical data could thus be gathered and quite easily organised in manageable form, for learners to explore and interpret (Schwartz & Beichner 1999:120). Computers become part of the teaching of life skills in schools when, for instance, history becomes an interesting and understandable subject to which even the foundation-phase learner of today can relate.

The WWW possibly has more to offer social studies teachers than to educators of any other subject (Schwartz & Beichner 1999:118). It makes the kinds of global connections and interactions that were difficult and impractical in the past, a quick and easy option. For instance, browsing the Internet may not only unveil useful learning materials and opportunities, but also allow collaboration and communication that would not have been possible otherwise (Newby et

al 2000:43). Learners can communicate with individuals from diverse backgrounds and cultures through the Internet, and thus expand their view of the world, discovering how people are alike, and how they are different (Haugland & Wright 1997:17). Educators and learners should make use of these communication opportunities to improve teaching and learning and to gather knowledge and skills that could also benefit their personal lives. The successful application of CAI can open up the possibilities of enhancing skills like creative and analytical thinking, problem solving, research, exploring and effective communication in life skills as a learning area in the foundation phase, while the learners are having fun.

## 5.4  Web-sites of particular interest

Educators could explore web-sites like

- The KIDLINK organisation, (http://www.kidlink.org), aims to promote global dialogue among young people (Schwartz & Beichner 1999:119).

- The National Geographic Society (http://www.nationalgeographic.com/kids) offers a well-designed Kids Network unit, with on-line curriculum projects (like *Hello!)* that support science as well as social studies learning. Learners can participate by gathering and recording data on weather, acid rain, trash, water, etc., and sending it to a central computer. They then receive an analysis of all the data from the team schools and can compile and view the data as tables, charts and graphs (Schwartz & Beichner 1999:121).

- The JASON project (http://www.jasonproject.org) offers various different expeditions to the world's oceans or Iceland.

- Zoos and aquaria (http://www.zooweb.net) offer information, pictures, stories and virtual field trips.

- The National Wildlife Federation (http://www.nwf.org/kids) and the World Wildlife Fund (http://www.wwf.org) provide interesting learning materials as well (Schwartz & Beichner 1999:134).

## 5.5    Summary

Literature on CAI was consulted because of practical problems experienced by educators when using CAI in foundation-phase classrooms. Some useful suggestions were found according to which guidelines were formulated.

The guidelines suggest that educators should combine various teaching methods in foundation-phase classrooms. They should present learning matter in an integrated way to promote learning that ranges from low-level routine jobs, like rote learning, to higher-order and logical thinking activities, like problem solving, to accommodate the needs of the learners. Every learner should have fair access to computers. The educator has to evaluate and select the software, and plan the didactic situation well, to initiate the development of learner skills in a practical way. Learners will explore information and participate in activities when they feel confident that they have acquired the skills to use the computer in accordance with their learning needs. Educators might feel inadequately equipped to initiate CAI, as they would with introducing any other new phenomenon. They should, however, evaluate and use the computer as a teaching and learning tool in foundation-phase classrooms in the same way as they would use any other tool in the didactic situation.

CAI benefits teaching and learning. Educators can equip learners to become successful at literacy, numeracy and life skills. Foundation-phase learners can write their own stories on computer and use the spell-checker as well as multi-media to turn out excellent products. Learning with the aid of computers assists cognitive development, because the learners are allowed to reason and experiment freely and they can explore and question mathematical truths. The learners develop life skills when they try to solve the problems that they encounter in the world. Their self-esteem develops when they experience success at different levels and become aware of their own potential, abilities and strengths.

The guidelines have resulted from information found in this study and should provide some assistance for educators of foundation-phase learners who want to equip learners for successful CAI. These guidelines were compiled from the consulted literature. They are thus not complete sets of rigid rules, but should rather be regarded as a starting point from which CAI can be initiated in foundation-phase classrooms. The guidelines will not be applicable to all situations and have to be adjusted according to the personal needs of the individual educator and learner.

# CHAPTER 6:  FINDINGS AND RECOMMENDATIONS

## 6.1  Findings and recommendations

The research resulted in guidelines for the use of computers in teaching and learning.  These were compiled and noted in chapter 5.  Findings on the use of CAI in the classroom and recommendations in this regard were also noted.  These findings and recommendations focus on computers and teaching, computers and learning as well as on the guidelines for using CAI.  The proper implementation of these recommendations could have a positive influence on the learning environment of foundation-phase learners.

## 6.1.1   Findings and recommendations regarding the computer and teaching

Finding 1:  Although computers are available in classrooms, they are often not used to their full capacity.  (See 1.1; 2.2; 3.1)

Computers in the classroom complement modern education in terms of realistic future orientated challenges in teaching and learning.  However, computers as teaching aids in South African schools, is not a general phenomenon.  The high cost of buying, installing and maintaining them, as well as the fact that educators often lack computer-related skills have a thwarting effect on implementing CAI in the didactic situation.

Recommendation: Educators need to be trained to use computers as tools and assistants, particularly in foundation phase classrooms.  Practical guidelines could help them to use CAI more confidently in the classrooms.

<u>Finding 2</u>:   The software determines the applicability of every computer-based activity in the classroom.  (See 2.2; 2.3; 3.2)

Computers are merely machines which can provide assistance to learners in the foundation phase.  The software used in conjunction with computers has the potential to enhance skills related to literacy, numeracy and coping with life, in general.  The implementation of the computer as a tool in the didactic situation, like with any other tool in teaching and learning, determines its didactic value.  Educators have to exploit the potential of the different programs, because negative traits rather than learning could result when inappropriate software is selected.  Depending on the software, computers could be used in foundation-phase classrooms to complement traditional ways of teaching when used as a tutor, a demonstrator or an assistant to present and mark drill-and-practice and problem solving exercises.   Software needs to be didactic, open-ended, suitable, accurate, flexible, motivating, current, involving, playful and easy to operate, to support independent learning at the learner's individual level and pace.

<u>Recommendation</u>:   Educational software should enhance teaching and learning in the classroom.  Guidelines could assist educators with selecting didactically applicable software for CAI in foundation-phase classes.

<u>Finding 3</u>:  Access to the Internet has become a valuable resource to find information and to connect people worldwide via e-mail or discussion groups.  (See 2.3.6; 3.2.1.4; 4.3.3.3; 4.5)

The use of applications, like the Internet, supports foundation-phase learners in their quest to accumulate knowledge in the learning areas of literacy, numeracy and life skills in an enjoyable way.   Schools should sort out technical inadequacies, like access to telephone lines and modems in advance to realise this goal.  By using the Internet educators and learners could have

instant access to large volumes of information from all over the world. However, learners have to be guided when selecting information or contacting other users. Finding appropriate and useful sites on the Internet can become a burden if learners do not follow clear objectives.

Recommendation: Learners should use the Internet in the classroom to save time. They should be taught to use the Internet to find and retrieve relevant information and manage contact with other people. The guidelines for CAI could assist educators to guide learners in performing this task.

Finding 4: CAI can assist learners to acquire first hand learning experiences by testing alternatives and comparing results, while working either independently or in groups at the computers. (See 2.4.2; 3.1.2; 3.3; 4.2; 4.3; 4.4; 4.5)

Educators need to help foundation-phase learners to take up the responsibility for their own learning. CAI can assist with the development of learner cognition such as problem solving and logical thinking. Developmentally appropriate software can provide the learners with programs that foster interactivity. Interactivity can lure learners into discovery learning, by expecting of them to find information on the databases. Using CAI can enhance learners' thinking and learning patterns in game-like fashion. Working together in groups provides support to less confident learners. They then share the responsibility for their learning, which could encourage them all to exploit the capabilities of CAI. CAI supports teaching and learning, but it should not be the only option for teaching in the foundation-phase classroom.

Recommendation: Educators should make use of computers to help learners test, organise, interpret and use data. Individuals or groups of learners can experience success and improve their learning skills with CAI in the foundation-phase classroom. The guidelines could direct educators to give the necessary support.

<u>Finding 5</u>:  CAI can proliferate in classrooms where educators have the skills and the motivation to use the computer as a tool in their teaching.  (See 2.2; 2.3; 2.4; 3.1.3)

Educators have to take initiative when using computers in the classroom.  They might feel inadequate to perform the task, but cannot afford to sit back and wait for information about teaching with CAI to finally reach them.  They have to take up the challenge and learn more about the qualities of computers and their applicability in the didactic situation while teaching.  The relevant training is not yet freely available in formal education structures.  It has thus become the responsibility of individual educators to improve their qualifications and skills through supplementary reading and by attending relevant courses and workshops.  Such endeavours can put educators in contact with more experienced colleagues and new developments in the field of CAI.

Educators who make use of computers in other areas of their lives should be in a better position to successfully apply CAI to foundation-phase classrooms.  These educators will discuss, rethink and adjust old practices and will try to acquire new skills to be able to benefit their teaching, as well as to create new learning skills for the learners.  Skills in using CAI will improve as educators in the classroom gradually gain more experience.

<u>Recommendation</u>:  Educators need the skills to provide CAI to learners.   Educators should improve their abilities through experimenting with the technology, attending workshops and engaging in additional reading.  The guidelines in chapter 5 could benefit educators of foundation-phase learners and assist them to improve CAI in the classrooms.

<u>Finding 6</u>:  Learners need supervision when they work on the Internet to ensure that they use it according to the school's Internet policy.  (See 2.3.6; 3.2.1.4; 4.3.3.3)

The Internet is part of a public forum and discipline is important when people access it. Learners should be cautioned and made aware of their responsibility in using this tool. They should respect themselves as well as the right of other users to protect both parties.

<u>Recommendation:</u>  Educators should support learners when they use the Internet to retrieve information or communicate with others.  Guidelines are necessary to help educators to ensure learners use the Internet responsibly.

<u>Finding 7:</u>  Better teaching and learning using computers are possible with thorough planning and continuous assessment by the educator.  (See 2.2; 2.3; 2.4; 3.1; 3.2; 3.3)

Educators plan and initiate learning by observing learners.  Planning and assessment go hand in hand and every educator should focus on these aspects when facilitating learning activities. Educators need to focus on the outcomes when planning lessons and deciding on instruction. Educators should assess all their efforts to reach the desired learning outcomes with CAI.  They should also include learner-success in the didactic situation to foster learner-independence. Current learning outcomes include the ideal for learners to acquire some technological knowledge and skills in the foundation phase.  The computer is one more tool in the hand of the educator that can help to ensure active and creative learning in foundation-phase classrooms. CAI should be included in the learning programmes of foundation-phase learners to provide them with technological skills.  The educators thus have to continuously assess all activities relating to learning with computers in the classroom.  They should also give assistance and feedback to learners in order for them to locate relevant information resources and to become more involved and independent in their learning.

Recommendation:  The educator should plan well and observe learner activities with CAI. Educators have to evaluate information in order to improve teaching and learning.  Didactic guidelines, according to which planning and assessment can be done, are thus necessary.

Finding 8:  Teaching and learning benefit the learners in foundation-phase classrooms when CAI is accommodated in the curriculum.  (See 2.3; 2.4; 3.1; 3.2)

The computer could assist educators in providing support to each individual learner on a one-on-one basis.  However, CAI should be properly integrated into the curriculum to suit learners' needs.  The curriculum is a working document which the educator should adapt in order to give learners the necessary opportunities to develop new skills and experiences related to real life.

Recommendation:  The educator, as curriculum designer, has to ensure that activities related to CAI are based on the curriculum in order to enhance teaching and learning.  The curriculum needs to be adjusted and used in accordance with the guidelines for CAI.

## 6.1.2 Findings and recommendations regarding the computer and learning

Finding 9:  Typing and basic computer literacy skills build confidence to explore the capabilities and uses of the computer further.  (See 2.2.4; 2.3; 2.4; 4.2; 4.3)

Learners enjoy using computers in foundation phase classrooms.  The primary purpose of schools is to teach literacy in order to teach learners to read and write.   CAI can provide learners with skills ranging from language development and communication to research, provided that they can use the tool.  Learners have to be able to independently use the

computer as a tool in the classroom at their level. This implies that they have to be able to turn it on, get the program to respond, and close it down again. Proper typing skills support the use of CAI in the foundation phase.

Recommendation: Basic typing and computer literacy skills should become part of the daily routine of learners in the foundation phase, rather than being taught as a separate subject. These skills support learner confidence when using computers as tools. The guidelines can help educators to introduce basic computer-related skills in the foundation phase.

Finding 10: CAI benefits early literacy development when foundation-phase learners make use of computers in reading and writing. (See 2.3; 2.4; 3.3; 4.2.4; 4.3)

Learning to read can be a daunting task for foundation-phase learners. Purposely selected software can make learners sensitive to different sounds, word recognition, differentiating meanings and comprehension. Appropriate software can promote understanding in a pleasant and interesting way suited to the needs of individual learners. Learners are motivated by the constant and individualised feedback from the computer and the educator. Elements of fun help to develop reading skills particularly when integrated with game-playing and repetition. This is especially true when a learner has to learn a second language.

Computers also foster individual and collaborative writing, and can improve the spelling and writing skills of all learners. Writing in small groups allows learners to be creative, as well as to be supportive of one another. Computers should be used to improve concentration and cultivate better spelling skills through the use of spell-checkers. Learners who use word processors can print neat and correct copies of written work and can add pictures. Learners regard such products as their own work and read it repeatedly and with pride. These learners will attempt to do more work on the computer, because they would want to experience success repeatedly.

Recommendation: All learners should make use of CAI with relevant software to acquire literacy skills. Guidelines would assist educators to promote literacy development in the foundation phase.

## 6.1.3 Findings and recommendations regarding guidelines for the use of CAI in the foundation phase

Finding 11: Guidelines for the use of CAI in the foundation phase are necessary to support educators and learners in their endeavours to use computers as tools and assistants in the classrooms. (See 1.1; 5.2)

Didactic guidelines were formulated, from lessons learnt elsewhere in the world, to assist educators in the application of CAI in foundation-phase classrooms. The guidelines for CAI are neither complete nor absolute, but they can provide educators of foundation-phase learners with a starting point, as well as some ideas to make fun and success a part of learning in every classroom through literacy, numeracy and life skills.

Recommendation: Practical guidelines could help inexperienced educators to establish CAI in didactic situations. The guidelines should be changed and adapted to suit the situation and circumstances.

## 6.2 Limitations of this study and ideas for further research

This study focused on the use if CAI in the foundation phase. The use of CAI in other school phases was thus not included. Interesting findings might be uncovered in research regarding continuity in the use of CAI at other levels and in other learning programmes.

The guidelines that were compiled were derived from the literature and validated through personal experience. The guidelines were not verified through a pilot evaluative project for the local school situation. The practical application and testing of the guidelines as part of a scientific study could be beneficial and could serve as confirmation of the results of this research in terms of the current situation in local schools.

It also has to be noted that the field of technology is marked by rapid changes due to the development of new inventions. Many published books and articles were consulted to obtain information for this study but only a limited amount of information was taken from the Internet. Since the Internet contains the most recent information it was not possible to include recent developments and changes in the field of CAI in the literature study.

## 6.3 Conclusions

In this study an attempt was made to highlight aspects about CAI in the foundation phase. The focus is on the computer as a tool and an assistant in foundation-phase classrooms. The roles of the educator and the foundation phase learners in relation to the learning matter and the curriculum were discussed using the didactic triangle as basis. The learners should have educationally appropriate experiences with CAI in literacy, numeracy and life skills. Learners' learning progress depends mainly on the skills, attitudes and ingenuity of the educators in the classrooms, and the software that is used.

The conclusion is that no single and correct way to apply CAI in foundation-phase classrooms exists. It was therefore inferred that didactic guidelines should be compiled to help educators in their attempts to approach and facilitate the use of computers as tools and assistants in

foundation-phase classrooms.  However, these guidelines are based on the literature that was consulted, and are thus neither complete, nor inflexible, as shown in the noted limitations.  It is necessary to keep in mind that the guidelines were not practically tested as a part of this research.

# Bibliography

Ambron, S.  Multimedia composition: Is it similar to writing, painting, and composing music? Or is it something else altogether?  In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education*. Washington: Microsoft Press.

Armstrong, S. 1995. *Telecommunications in the classroom.* Eugene: International Society for Technology in Education.

Berman, P.  The computer environment – ergonomic awareness.  In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.*  Blackburn: Acacia Press.

Bickart, TS & Pierrel, E.  1999.  Technology learning in the k-3 classroom. *Principal.* 78(4), March 1999: 19-24.

Bigum, C.  Logo, some critical reflections.  In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.*  Blackburn: Acacia Press.

Birch, T. 1995. The teacher and the computer: a case study of the everyday issues in one primary school. *School Organisation.* 15(1), 1995: 43-51.

Blanchard, J. 1999. Technology, communication, and literacy: critical issues. *Computers in the Schools.* 15(1), 1999: 1-4.

Blows, M.  1988.  Time for IT. *Junior Education.* 12(8): 20-21.

Boltman, A.  1998.  Two weeks in the life of a technology teacher. *SIGCHI Bulletin.* 30(2), April 1998: 20-22.

Bonk, CJ & King, KS. 1998. *Electronic collaborators.*  London: Lawrence Erlbaum Associates.

Bradsher, M.  The teacher as navigator.  In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education.* Washington: Microsoft Press.

Bright, GW. 1987. *Microcomputer applications in the elementary classroom: a guide for teachers.* Massachusetts: Allyn and Bacon.

Bright, GW. (b) 1988. Teaching mathematics with technology. *Arithmetic Teacher.* 36(4), December 1988: 50-51.

Calvert, SL. 1994. Developmental differences in children's production and recall of information as a function of computer presentational features. *Journal-of-Educational-Computing-Research.* 10 (2), June 1994: 139-151.

Campbell R & Hanlon, P. HyperCard: a new deal in the classroom. In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education*. Washington: Microsoft Press.

Casey, JM. 1997. *Early literacy: the empowerment of technology*. Englewood: Libraries Unlimited.

Chambers, P. 1999. Information handling skills, cognition and new technologies. *British Journal of Educational Technology.* 30(2), 1999: 151-163.

Clyde, L. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave*. Blackburn: Acacia Press.

Craig, J. 1989. Geometry through LOGO. *Mathematics Teaching.* 129, December 1989: 36-39.

Crompton, R. 1989. *Computers and the primary curriculum 3 - 13*. London: The Falmer Press.

Crook, C. Computers in the community of classrooms. In: Littleton, K & Light, P (eds). 1999. *Learning with Computers.* London: Routledge.

Cummings, R. Small group discussions and the microcomputer. In: Jones, A & Scrimshaw, P. 1988 (eds). *Computers in education: 5 - 13*. Philadelphia: Open University Press.

Dahlberg, LA. 1990. Teaching for the information age. *Journal of reading.* 34(1), September 1990: 12-18.

Department of Education. 1997. (a) *Foundation phase (grades Rto3) policy document October 1997.*

Department of Education. 1997. (b) *Curriculum 2005 lifelong learning for the 21$^{st}$ century*. CTP Books.

Dixon, J. 1989. Logo map-making with young children. *Mathematics Teaching*. 37(129), December 1989: 33-35.

Druin, A. 1998. My kid doesn't need a computer .... *SIGCHI Bulletin*. 30(1), January 1998: 15-16.

Du Toit, SJ & Kruger, N. 1991. *The child: an educational perspective.* Durban: Butterworths.

Eastwood, D. In: Paine, N (ed). 1994. *All our learning futures: the role of technology in education.* Glasgow: SCET.

Evans-Andris, M. 1996. *An apple for the teacher: computers and work in elementary schools.* California: Corwin Press.

Firkin, J. Action research and computer education. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Foster-Grundy, B. 1990. Start talking. *Child Education.* 67(7), 1990: 23-24.

Fung, P, Hennessy, S & O'Shea, T. 1998. Pocketbook computing: a paradigm shift? *Computers in the Schools.* 14(3/4): 109-118.

Gillings, H & Griffiths, D. Getting started. In: Crompton, R (ed). 1989. *Computers and the primary curriculum 3 - 13.* London: The Falmer Press.

Gabe, M & C. 1996. *Integrating technology for meaningful learning*. Boston: Houghton Mifflin Company.

Griffen, J & Bash, L. 1995. *Computers in the primary school.* London: Cassell.

Gunderson, L & Anderson, J. 1999. An exploration of internet access for literacy teachers and learners. *Computers in the Schools.* 15(1): 5-11.

Hall, N & Brown, H. Process writing, computers and a confident teacher. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Hardy, JV. 1998. Teacher attitudes toward and knowledge of computer technology. *Computers in the Schools.* 14(3/4): 119-134

Haugland, SW & Wright, JL. 1997. *Young children and technology: a world of discovery.* Massachusetts: Allyn and Bacon.

Henderson-Lancett, L. Dragon world 1: Implementing an adventure game. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Heppel, S. In: Paine, N (ed). 1994. *All our learning futures: the role of technology in education.* Glasgow: SCET.

Hills, G & Hooper, R. In: Paine, N (ed). 1994. *All our learning futures: the role of technology in education*. Glasgow: SCET.

Hooper, C. HyperCard: a key to educational computing. In: Ambron, S & Hooper, K (eds). 1990. *Learning with Interactive multimedia developing and using multimedia tools in education.* Washington: Microsoft Press.

Hoot, JL. 1986. *Computers in early childhood education: issues and practices.* New Jersey: Prentice-Hall.

Hopkins, C. Beyond the QWERTY keyboard. In: Crompton, R (ed). 1989. *Computers and the primary curriculum 3 - 13*. London: The Falmer Press.

James, L. Logo study. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Janse Van Rensburg, J. Outcomes-based teaching and learning: concepts and essentials. In: Pretorius, F (ed). 1998. *Outcomes based education in South Africa*. Hodder & Stoughton: Randburg.

Jenkins, Y. Multimedia technology: tools for early learning. In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education*. Washington: Microsoft Press.

Jonassen, DH. 1996. *Computers in the classroom. Mindtools for critical thinking*. New Jersey: Prentice-Hall.

Kahn, T & Yip, YJ. 1996. Pedagogic principles of case-based CAL. *Journal of Computer Assisted Learning.* 12, 1996: 172-192.

Karger, HJ.  1988.  Children and microcomputers: a critical analysis.  *Education Today.* 38(2), 1988: 39-47.

Kelly, TF.  1992.  Spelling: tyranny of the irrelevant.  *Phi Delta Kappan.* 73(8), April 1992: 638-640.

Kinzer, CK.  1986.  A 5 part categorization for use of microcomputers in reading classrooms. *Journal of Reading.* 30(3), December 1986: 226-232.

Knight, BA & C.  1995.  Cognitive theory and the use of computers in the primary classroom. *British Journal of Educational Technology.* 26(2), 1995: 141-148.

Kokot, SJ. 1997.  The gifted child - consigned to the demolition heap?  *Educare.* 26(1 & 2), 1997: 15-23.

Koschmann, T.  1996.  *CSCL: Theory and practice of an emerging paradigm.*  New Jersey: Lawrence Erlbaum Associates.

Labbo, LD, Murray, BA & Phillips, M.  1995.  Writing to read: from inheritance to innovation and invitation. *The Reading Teacher.* 49(4), December 1995: 314-321.

Lamb, M.  The computer as a trojan horse: education in the new age.  In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Lawler, RW.  1997.  *Learning with computers.*  Exeter: Intellect Books.

Lewis, R.  1999.  The role of technology in learning: managing to achieve a vision.  *British Journal of Educational Technology.* 30(2), 1999: 141-150.

Liang, P & Johnson, J.  1999.  Using technology to enhance early literacy through play. *Computers in the Schools.*  15 (1), 1999: 55-64.

Light, P & Littleton, K.  Introduction: getting IT together.  In: Littleton, K & Light, P (eds). 1999. *Learning with computers.*  London: Routledge.

Littleton, K.  Productivity through interaction: an overview.  In: Littleton, K & Light, P (eds). 1999. *Learning with computers.* London: Routledge.

MacKay, G.  Computer education experiences at home.  In: Salvas, AD & Dowling, R (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Mann, P. Language. In: Crompton, R (ed). 1989. *Computers and the primary curriculum 3 - 13*. London: The Falmer Press.

Marshall, D. 1989. Core computing 1: science. *Child Education.* 66(9), Sept 1989: 36-38.

McCain, CH. 1996. *Plugged in and turned on.* California: Corwin Press.

McCombs, BL & Whisler, JS. 1997. *The learner-centered classroom and school.* San Fransisco: Jossey-Bass.

McLullich, H. 1989. Learning to listen. *Child Education.* 66(9), Sept 1989: 34-35.

McRae, K. Reflections of a dungeon master. In: Salvas, AD & Dowling, R (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Mercer, N & Wegerif, R. Is "exploratory talk" productive talk? In: Littleton, K & Light, P (eds). 1999. *Learning with computers.* London: Routledge.

Miller, L. 1986. Computers and the language arts. *Curriculum Studies.* 18(3), 1986: 285-297.

Morocco, CM & Neuman, S.B. 1986. Word processors and the acquisition of writing strategies. *Journal of learning disabilities.* 19(1), April 1986: 243-247.

Moursund, D. 1997. *The future of information technology in education*. Eugene: International Society for Technology in Education.

Muente, G. 1989. How listening helps speaking, writing, and reading. *Reading Improvement.* 26(3), Fall 1989: 244-246.

Nanny, M. Interactive images for education. In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education*. Washington: Microsoft Press.

Newby, TJ, Stepich, DA, Lehman, JD & Russell, JD. 2000. *Instructional technology for teaching and learning: designing instruction, integrating computers, and using media.* Ohio: Merrill.

Oliver, R. Effective teaching in computer literacy classrooms. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Olivieri, P.  HyperCard, technology, and education.  In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education.*  Washington: Microsoft Press.

Outhred, L.  Word processing: its impact on children's writing.  In: Salvas, AD & Dowling, C (eds).  1986.  *Computers in education: on the crest of a wave.*  Blackburn: Acacia Press.

Paine, N.  1994.  *All our learning futures: the role of technology in education.*  Glasgow: SCET.

Papert, S.  1980.  *Mindstorms: children, computers, and powerful ideas*.  Brighton: Harvester Press.

Papert, S.  1992.  *The children's machine.*  New York: Basic Books.

Parker, J & Widmer, CC.  1992.  Teaching mathematics with technology. *Arithmetic Teacher.* 40(1), September 1992: 48-51.

Peck, JK & Hughes, SV.  1997.  So much success ... from a first-grade database project! *Computers in the Schools.* 13(1/2), 1997: 106-116.

Phillips, R.  ITMA'S approach to classroom observation.  In: Jones, A & Scrimshaw, P. 1988 (eds). *Computers in education: 5 - 13*. Philadelphia: Open University Press.

Pokay, PA & Tayeh, C.  1997.  Integrating technology in a geometry classroom: issues for teaching.  *Computers in the Schools.* 13(1/2), 1997: 117-123.

Pretorius, F (ed).  1998.  *Outcomes based education in South Africa.*  Hodder & Stoughton: Randburg.

Reimann, J.  What about the girls?  In: Salvas, AD & Dowling, C (eds).  1986.  *Computers in education: on the crest of a wave.*  Blackburn: Acacia Press.

Robertson, J.  1998.  Paradise lost: Children, multimedia and the myth of interactivity.  *Journal of Computer Assisted Learning.* 14, 1998: 31-39.

Rodda, YDJ, Wheeler, A & Muller, A. 1991. *A Productive way of using computers at school: HSRC/ISM computer literacy project.* Pretoria: HSRC.

Ross, J & Schulz, R. 1999. Can computer-aided instruction accommodate all learners equally? *British Journal of Educational Technology.* 30 (1), 1999: 5-24.

Royle, T. Creative activities: art and design. In: Crompton, R (ed). 1989. *Computers and the primary curriculum 3 - 13*. London: The Falmer Press.

Rumsey, EA. 1988. Computer literacy: skills and knowledge a person should possess in order to be considered computer literate. *Education Today.* 38(2), 1988: 29-38.

Säljö, R. Learning as the use of tools: a sociocultural perspective on the human-technology link. In: Littleton, K & Light, P (eds). 1999. *Learning with computers.* London: Routledge.

Scanlon, E, Issroff, K & Murphy, P. Collaborations in a primary classroom: mediating science activities through new technology. In: Littleton, K & Light, P (eds). 1999. *Learning with computers.* London: Routledge.

Schank, RC & Cleary, C. 1995. *Engines for education*. Hillsdale: Lawrence Erlbaum Associates.

Schrum, L & Berenfeld, B. 1997. *Teaching and learning in the information age*. Massachusetts: Allyn and Bacon.

Schug, MC. 1988. What do social studies teachers say about using computers? *Social Studies.* 79(3): 112-115.

Schwartz, JE & Beichner, RJ. 1999. *Essentials of educational technology*. Massachusetts: Allyn and Bacon.

Semper, R. HyperCard and education: Reflections on the hyperboom. In: Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education.* Washington: Microsoft Press.

Sewell, DF. 1990. *New tools for new minds a cognitive perspective on the use of computers with young children*. New York: Harvester Wheatsheaf.

Simmons, K. 1988. Writing with a word processor: what difference does it make? *Support for learning.* 3(4), November 1988: 207-209.

Simonson, MR & Thompson, A. 1990. *Educational computing foundations.* Ohio: Merrill Publishing Company.

Skinner, BF. 1986. Programmed instruction revisited. *The Education Digest.* 52(7), March 1987: 12-16.

Slifer, B. Potential …. unlimited! Micro-computers in special education. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

SchoolNet SA. 1998. Connectivity Survey.
http://ochre.school.za/research/cs98drft.htm

SchoolNet SA report. 1998.
http://ochre.school.za/research/snreports.htm

Snowdon, A. The early years. In Crompton, R (ed). 1989. *Computers and the primary curriculum 3 - 13.* London: The Falmer Press.

Spady, W & Schlebusch, A. 1999. *Curriculum 2000 a guide for parents.* Cape Town: Renaissance.

Spiller, J. 1997. Kids on the Net. *Internet @ccess Africa.* 1(1), Sept 1997: 47-50.

Stebbins, B. Using HyperCard in apple classrooms of tomorrow. In Ambron, S & Hooper, K (eds). 1990. *Learning with interactive multimedia developing and using multimedia tools in education.* Washington: Microsoft Press.

Steinberg, ER. 1991. *Teaching computers to teach.* 2nd edition. East Sussex: Lawrence Erlbaum.

Stimpson, F & Ewing, A. 1988. Content-free software in the primary curriculum. *Education.* 3-13, March 1988:13-17.

Stonier, T & Conlin, C. 1985. *The three cs: children, computers and communication.* Chichester: John Wiley & Sons.

Sunday Times: Business surveys. 17 March 2002. Service with a (virtual) smile.

Taylor, R & McDougall, A. Software development by a classroom teacher. In: Salvas, AD & Dowling, C (eds). 1986. *Computers in education: on the crest of a wave.* Blackburn: Acacia Press.

Thomas, RA & Boysen, JP. 1984. A taxonomy for the instructional use of computers. *AEDS Monitor.* 22(11/12), May/June 1984: 15-26.

Turkle, S. Child programmers: the first generation. In: Jones, A & Scrimshaw, P. (eds). 1988. *Computers in Education: 5 - 13.* Philadelphia: Open University Press.

Underhay, S. Project work: Adventure games. In: Crompton, R (ed). 1989. *Computers and the primary curriculum 3 - 13.* London: The Falmer Press.

Underwood, J & G. Task effects on co-operative and collaborative learning with computers. In: Littleton, K & Light, P (eds). 1999. *Learning with computers.* London: Routledge.

Underwood, J, Cavendish, S, Dowling, S, Fogelman, K & Lawson, T. 1996. Are integrated learning systems effective learning support tools? *Computers and education.* 26(1-3): 33-40.

Van Brummelen, H. 1990. *Towards a Christian approach to curriculum.* Bloemfontein: VCHO.

Van Der Horst, H & McDonald, R. 1997. *OBE Outcomes-based education a teacher's manual.* Cape Town: Kagiso Education.

Wake, B. 1988. Bit by bit. *Child Education.* March 1988: 37.

Ward, AE. 1994. *Multimedia and learning: a school leader's guide.* Alexandria: N.S.B.A.

Wasserman, S. 1985. Growing teachers is there life after Pacman? *Childhood Education.* 61(5), May/June 1985: 331-336.

Wegerif, R & Scrimshaw, P. Computers, talk and learning. In: Wegerif, R & Scrimshaw, P (eds). 1997. *Computers and talk in the primary classroom.* Clevedon: Multilingual Matters.

Wilkens, F. Aspects of classroom management: planning and implementing a learning programme. In: Pretorius, F (ed). 1998. *Outcomes based education in South Africa.* Randburg: Hodder & Stoughton.

Willing, KR. 1988. Computer simulations: activating content reading. *Journal of reading.* 31(5), February 1988: 400-409.

Winkley, D. In: Payne, N (ed). 1994. *All our learning futures: the role of technology in education.* Glasgow: SCET.

Winn, DD.  1988.  Develop listening skills as a part of the curriculum.  *The Reading Teacher.* 42(2), November 1988: 144-146.

Wootton, C.  The isle of what?  The development of a software package.  In: Salvas, AD & Dowling, C (eds).  1986.  *Computers in education: on the crest of a wave.*  Blackburn: Acacia Press.