AN EVALUATION OF THE USE OF COMPUTERS IN A SOUTH AFRICAN PRIMARY SCHOOL

by

Orla Mostert

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ABSTRACT

The introduction of the computer into the educational arena is unique as pressure for its inclusion has come not from educationalists, but from public demand based on the conviction that exposure to computers is an essential ingredient of modern education. This has resulted in computers being added to school curricula before there has been careful research into its educational implications, making huge demands on teachers involved in the innovation.

South African primary schools involved in computer education have followed international trends in their adoption of computers, initially perceiving computer education as a separate subject added on to the present curriculum. However, changing trends in computer use internationally are now beginning to reflect educators' changing perceptions of the nature of primary education, and educators are calling for the use of computers to be integrated into the curriculum rather than being seen as an area of study in themselves.

This investigation attempts to outline general trends and perceptions of computer use in a South African primary school. Despite a high level of computer usage at the observed school, the computer was seen by teachers, in the main, as an extra subject, and has not yet led to any significant changes in teaching styles and methods. The research suggests that two main issues need to be resolved before computer education in primary schools reflects the present paradigm shift towards learner-centered educational practices. Firstly, there is a need to rethink the delivery of the curriculum towards one which promotes a greater degree of problem solving and decision making on the part of the learner. Secondly, it would appear that teachers need to be made more aware of this trend.

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Chapter One

1. The context of computer use in Primary education

This chapter will cover 1. a brief outline of the situation in South Africa, 2. an identification of the trends of computer use in primary education, 3. perceptions of the nature of primary education, 4. perceptions of the role of computers in primary education, and 5. reasons for the choice of the research topic.

1.1 The situation in South Africa at the time of the research

The advent of computers[1] in the educational arena is unique in that the pressure for its inclusion has come primarily not from educationalists, but from public demand based on the conviction that exposure to computers is an essential ingredient of modern education (Fritz 1985). The result of this grassroots approach has been the inclusion of computers in schools before educators have been convinced about their place in education or have been prepared to handle the subject adequately and in a coordinated fashion.

Computers have been in use in South African schools for more than two decades. Despite this, there is still no firm policy on the use of computers in the primary classroom, and at this stage, each Department of Education has developed its own general outline on use. (Fallick & Pistorius 1989.) This is potentially one of the major problems hindering the effective integration of computers in education in South African Schools, where educators are being deluged in a rapidly changing technology with limited knowledge of how to make effective use of it. The rapid introduction of

[1] The term computer will be used to denote microcomputers or Personal Computers (PCs).

technologies into schools has been a piecemeal affair, and many different schools, departments, subject areas and teachers are at vastly different stages in their use of computers.

In a written communication from the Cape Education Department (Appendix A), the following policies were identified:

- to encourage the effective use of computers in all aspects of education;
- to encourage the integration of computers into the curriculum;
- to promote computer literacy[2] among teachers as a first step towards achieving the above.

Within the primary curriculum the Department has identified three aims:

- to provide pupils with an appropriate degree of computer literacy;
- to use the computer as a learning aid whenever appropriate and effective; and,
- to provide a tool for teachers when appropriate.

Despite the Department's encouragement however, they have taken no steps to issue guidelines on computer use in the classroom. The given reasons are that many schools do not have computers and do not have the funds to purchase them; those schools that do have computers have an insufficient number; and few teachers have any formal training on using

[2] Computer Literacy refers to the acquisition of knowledge, attitudes and skills necessary for a person to function effectively in an information-based society. The interpretation of Computer Literacy usually reflects the aims of a specific school or education policy, but generally involves a knowledge of how computers work, computer applications and computer programming.

computers in primary education. The Department's commitment at this stage is limited to the development of a comprehensive training syllabus for college students.

At the time of the research the use and incorporation of computers into the primary school had been left to the individual schools.

> Only when there are sufficient computers in our schools and (an) adequate number of computer literate teachers, will (we) be able to integrate the Computer into the curriculum as a matter of policy. At present it is an option left to individual schools and teachers. (Communication from C.E.D. May 1990, Appendix A).

Hawkridge (1990), however, argues that developing countries need a strong national policy on computers whether or not departments or ministries have sufficient funds to supply the necessary hardware to the schools. He points out that

> ...the computers arrive anyway ... Without a policy, computers, some of them obsolete, arrive in uncoordinated fashion. Teachers are not trained. Software is scarce ... Spares, repairs and maintenance hardly exist. ... Ministries of Education ... with a policy, ... may still lack the money to do all they want to ... but at least they are able to take important decisions, within the policy. (Hawkridge, 1990:6)

Charp (1988) has identified a growing pressure for technological change in schools from both inside and outside of education. These pressures are due to technology's penetration of all spheres of society, the evolution of the technologies themselves and the concern that the educational systems at present are not coping with the issues of unemployment and productivity. This has led to researchers

and educators becoming increasingly concerned about the proper role of technology in education.

For most teachers, however, the nature of the role is uncertain. Many schools have gone ahead and purchased computers and software without a clear plan as to how they will be used, and very little knowledge on the variety of ways in which they can be used. South Africa has followed a typical path in its road to computers in education, and has led Benn (1989) to comment that:

> The expectations of such schools are often unrealistic because technology is simply thrown into the education arena before adequate preparation of the environment has taken place. (Benn, K. 1989:613)

In addition, it is essential that educators in South Africa evaluate the applicability of computer education within the South African context. Stoker and Robertson (1989) suggest that in addition to examining the surface potential of computers in education, educators must decide whether computers are at present the most appropriate area of expenditure in South African education.

In international terms, the impact of the computer on existing curricula is still quite limited despite the increase of computer hardware both in the home and at school. Experimentation, basic computer awareness and literacy are still the most likely path being followed in education circles world wide (Harper, 1987). Even in advanced industrial societies, educators are only now beginning to perceive something of the potential that the new technology has for learning and teaching. The debate as to what exactly the computer should, can and will do for education continues - have computers really improved education, and can they really serve to improve education in

the future? Despite a great deal of research done in this area, little is really known about the effects of computer education or information technology[3] on the learner and teacher. (Chan, 1989)

Trends of computer usage reflect educators' changing perceptions on the nature of primary education. In turn, this has impacted upon their perception of the role of the computer in primary education. In order to place the use of computers in a South African primary school in perspective, the researcher has chosen to examine general trends and perceptions as indicated in the literature available on computer education.

> To know what has already been accomplished is the first step, whether one merely wishes to find out what the field is like, or whether one wishes to determine the points from which to begin one's own work. (Taylor, 1980:2)

1.2 Trends of computer use in Primary schools

In order to better understand the computer innovation it is first necessary to examine the various ways computers have been used in primary education. For purposes of clarity the researcher has made use of Robert P. Taylor's (1980) functional scheme of Tutor, Tool and Tutee as a framework for discussion about the different ways computers are used in classrooms.

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[3] Information Technology encapsulates a variety of applications related to new technologies, one of which is the computer. The study involves the acquisition, production, transformation, storage and transmission of data by electronic means such as to facilitate the interaction between people and between people and machines. It also includes applications and implications (social, economic, cultural) of these processes.

For the purpose of this discussion these terms have been defined as follows (Adams 1988, Chan 1989, Kansky 1982):

The computer as Tutor:
As a tutor, the computer teaches the student some "knowledge". Essentially, the computer presents subject material to which the student responds. This mode is exemplified by software such as drill and practice, tutorials, simulations and adventure games.

Drill and Practice: Such programs usually assume that the student has had some previous instruction in the concept or process to be addressed. Usually the student will receive immediate feedback on their performance.

Tutorials: Teaching takes place through a dialogue between the student and computer. The computer presents the lesson in the form of text and questions.

Simulations: The computer models complex systems which cannot be brought into the classroom, for example river ecology. (Chan 1989) It creates a "world" based on a set of real circumstances in which the learner engages in considering problems and outcomes.

Instructional or Adventure Games: The computer establishes an environment which includes
- the adoption of specific rules of operation;
- the establishment of competition or cooperation;
- the need to develop a winning strategy;
- the element of chance introduced by random events which force revision of strategies.
(Kansky 1982:19)

The computer as Tool:

As a tool the computer assists but does not direct the learning process. The computer takes on routine tasks, allowing time saving and creativity on the part of the student. Of the tool type or generic software, word processors and data bases are most commonly used in schools. These programs are often called "content free"[4] because the child or teacher will determine the content of the exercise.

The computer as Tutee:

As a tutee the learner "teaches" the computer. The student programs the computer to perform a certain function, for example to draw a triangle. This type of software provides an environment for general problem solving. The most common program in this form found in primary schools is LOGO. Software in this mode is also called "learner based" or "learner centred" software.

Traditionally, most computer software used in the primary school is of the tutor model. Of that model drill and practice has the highest incidence of use. This type of software is the one most criticised by educationalists because it uses methods that do not fit into the cognitive theorists view of how the primary child learns best (Kelly, 1984). This kind of usage has also been condemned because it does not fully exploit the power of the computer and, as computers are a scarce resource for most schools, it has been argued that they should be used for activities which would otherwise be difficult to provide. Alessi and Trollip (1991) claim that there are just not enough good drills capitalising on the computer's power. Whatever the

[4] Content free software refers to programs which contain no content in themselves, but which provide a framework within which the user may structure material.

arguments, the incidence of drill materials in still high despite the wide variety of software available to primary schools (D'Arcy & Gardiner, 1988) and the research which indicates that retention is lower over the long term than with traditional drill and practice methods (Chan 1989).

The computer in the tutee mode has been in use in many South African primary classrooms for a number of years. The software most used in this mode is LOGO. Studies both abroad (Papert 1980, Howe et al 1979) and local (Stoker 1983) have been conducted on the effects of LOGO usage in the classroom, and the following is merely an outline of its use.

The power of LOGO is such that once the children are able to formulate simple words on paper and have some concepts of numbers, they can control a sophisticated piece of technology and create relatively complex graphic patterns. Most schools tend to use LOGO to teach programming, problem-solving, concepts of mathematics and geometry. The most easily accomplished of these is that of teaching geometric concepts using 'turtle' geometry (Stoker, 1983).

Research literature reflects that there has been a noticeable change of emphasis in computer usage recently. What was initially perceived as an addition to the curriculum, is now being seen as something that can easily be integrated into the syllabus as a teaching tool. These perceptions, however, are usually limited to those intensely involved with computers in education, and most teachers are

unaware of the concept of content free software, and how it can be used in the classroom.

> ... Few (educators) are aware of the wide range of general-purpose tools that are available and have not considered their educational potential nor have they considered how the general availability of such powerful tools will alter the world of the students they are educating. (Olds in Adams 1988:3)

Although the research in this area of computer usage is still in the initial stages, it would appear that the computer when used as a tool creates a "functional learning environment", which leads to a more positive learning process (Riel 1989). Such programs, it is argued, have the potential to allow students to play a more intellectually active role in the learning process, and place a higher cognitive demand on pupils. (Bennett 1987, Underwood 1988)

> Application software also seems likely to serve current educational needs because it is generic and therefore, maximally flexible. For example, a word processor can be used as a tool for teaching writing, but it does not actually do the teaching or practice any particular teaching approach. (Bennett 1987:227)

An area of usage not often found in South African schools is that of Control Technology. Jones (1984:76) defines control technology as "the modification of the operation of a device or system by observation of its action followed by adjustment of the subsequent action." Essentially control technology makes use of the computer output ports[5] to control another device (such as a light) which then performs an action (such as switching on and off in predetermined sequences), while the learner observes the action and makes

[5] A port is an entry or exit point to or from a computer for an external device such as a printer.

any necessary adjustments to the action. The aim of control technology is to provide for the learner a practical learning situation in which he can develop perceptual skills and understanding.

Primary schools in South Africa making use of this technology are generally limited to using a LOGO turtle. Although published research is limited in the field of control technology, it has already made a significant impact on the British curriculum in the form of craft and design technology, and will probably in due course be used more extensively here.

1.3 Changing perceptions of the nature of Primary education

As early as 1931 Hadow (Hadow Report 1931) indicated that education should involve itself in "activity and experience rather than knowledge to be acquired and facts to be stored", which could best be achieved by providing opportunities for active forms of learning (Blenkin and Kelly 1983:12). Although slow in making an impact on the South African primary curriculum, there has been a steady change in perception about the nature of primary education. Despite this, an essentially product-oriented curriculum has left schools in a position where they still tend to concern themselves with subject content, goals and assessment.

"Good primary practice" has been identified as teaching which concerns itself with improving the intellectual development and cognitive functioning of the individual child. In order to achieve this ideal, Stenhouse (1975) identified the need to develop a "process-oriented curriculum" which, unlike the product curriculum, does not define the curriculum in terms of subject content and goals, but rather concerns itself with a consideration of the processes which need to be promoted in education. Such

processes involve growth of understanding as well as acquisition of knowledge, and attempt to develop in pupils the ability to critically review knowledge and understanding (Kelly, 1984). Kelly (1984) stresses that these processes can only be promoted if the learner is actively engaged in the learning process through genuine interaction and interplay between the learner and the activities in which he is engaged. A process-oriented curriculum would, therefore, lead to a shift in emphasis away from teacher-dominated, transmission type teaching towards that of child-centred learning where the learners' construct their own reality based on their experiences and social interactions.

The general trends identified in computer usage seem to reflect the contrast between product and process type education. The product based curriculum identifies education as instrumental in achieving goals based on the subject content or bodies of knowledge felt to be useful to society. Consequently, it tends to promote education as transmission. The use of tutorial and drill and practice type software, therefore, suggests a reliance upon a more product oriented framework where goals and objectives can be more readily defined.

In contrast, the process based curriculum reflects a shift towards understanding of processes rather than the transmission of subject content. Such a curriculum aims to respond to the developing experiences of the individual pupils and his needs (Blenkin & Kelly, 1983). Proponents of process type curricula reject the idea that a division can be made between the learning of basic skills and other more sophisticated forms of learning (Blenkin and Kelly, 1983). Tool and tutee software, therefore, seems more readily applicable to child-centred activities and process learning. This would seem to suggest that technology in the classroom

can, under certain conditions, be used to complement the perceptions underlying good primary practice.

1.4 Changing perceptions of the role of computers in Primary education

The movement away from identifying the computer as a teaching machine or an extra subject in the curriculum reflects the changing perception of educators about the role the computer should play in primary education.

The computer is a device with many uses, some of which are still in the process of being discovered. As with any innovation, it was first used to carry out existing tasks in a different manner. However, once experience was gained with the tool, educators began to recognise its potential (Woodhouse and Jones, 1988:386). From these perceptions a number of issues arose. Educators identified a need to teach pupils the skills necessary to cope in the "Information Age"[6]. Such skills would need to be integrated into the curriculum in order to ensure their transfer to the pupil's normal activities. In addition, there developed the realisation that the teacher played a pivotal role in achieving the above.

1.4.1 Skills for the Information Age

Educators generally accept that we have entered a technological era, the Information Age, which requires new skills. Educators point out that the 'explosion in information', created by the use of extremely sophisticated computing devices, questions the validity of teaching

[6]The information age refers to the impact of current techological development on society based on the computer. These developments have led to an emphasis on information retrieval and processing.

children facts as opposed to source of fact (Hubbard 1988, Evans 1986 and Jones 1984).

> Given the information storage and retrieval capability of the microcomputer, the only reason why human beings should be required to store information is as a basis for the development of understanding. (Kelly, 1984:6)

The new technology can serve to complement the concept of good primary education which emphasises the need to move away from promoting subject content. It is now generally accepted that there is a need to change the present teaching emphasis away from the acquisition of facts towards an understanding of information, its use and manipulation.

> In the Information Society, he who has information and can handle it will have power. It is the task of schools to heed that message. (Longworth as quoted in Jones, 1984:4)

Educators, therefore, began to identify the needs and skills of the information age in order to incorporate them into the learning process. The most obvious skill required in the Information Age is the ability to operate a computer. This skill was easily identified and led to the emergence of a new subject "Computer Literacy". However, as the use of the computer became more prolific, researchers and educators began to question the need to formally teach Computer Literacy. The rate of technological change made redundant an understanding of specific technology, rather, pupils needed to be taught the ability to assimilate and gain an understanding of new technology as it appeared (Galpin 1988). As software improved and became easier to use, the information required for pupils to become computer literate no longer required extensive training and could more easily be integrated into other classroom activities. Researchers identified that the computer could, in many cases, be used

not only to develop specific technological skills, but also to support and supplement good primary teaching (Jones 1984, Bennet 1987, Chan 1989, Grabe & Dosmann 1988).

Good primary education emphasises the need to encourage children to work from their own experiences. Children learn from doing things, not by being taught about things (Ross 1984:27). One way this process is encouraged is through the skill of 'information handling'. Teachers have long used libraries and other sources to retrieve information on a variety of topics. However, the computer, with its ability to store vast quantities of information and allow quick access to information, has opened a new perspective on this skill. Information handling skills necessary in the information era require that pupils not only retrieve information, but also manipulate it. The pupil therefore needs to be able to capture, interpret, communicate, measure and control information in order to find patterns and relationships.

Pupils using computers are now able not only to retrieve information, but also to build up databases of facts and figures and to analyze this information and in so doing create information (Evans 1986). This can be done with a speed that makes more time available for pupils to examine the significance of what they have found. In addition, the computer can respond to information with a degree of sophistication no teacher could ever hope to match, and thus gives access to kinds and levels of understanding which would otherwise remain inaccessible (Kelly 1984).

These skills are not only those which can be learned with a computer, but those where the computer can act as the best known aid at present to facilitate such skill acquisition (Ross 1984). The computer allows the learner to do more

than just practice skills, it allows the child to use these skills in a meaningful situation. Underwood (1988) claims that the use of the computer, specifically its use as a tool, encourages the pupils to apply skills and knowledge, to make judgements and to draw disparate information into a whole in order to solve problems. Kelly (1984) supports this claim and states that the processing of information in order to enhance understanding is a major part of becoming educated. The computer is a highly sophisticated device for doing that, provided that it is used properly.

Educationalists such as these argue that unless the use of the computer is integrated into the curriculum, skills learned may remain separate from their potential application in the child's life.

1.4.2 Integrating the computer into the Primary curriculum

As Educators recognise the need to change the primary curriculum to suit good primary practice, they perceive the need to change the emphasis of schooling across subject boundaries towards an integrated curriculum. Evans (1986) points out that

> ... one must recognise that the growing intrusion of technology in our society needs to be reflected in the way we teach and the way in which children learn. (Evans, 1986:64)

Information technology is having a growing effect on primary pupils whose adult lives will be in the twenty-first century, and as such it is necessary that information skills become part of the pupil's learning experience. In terms of 'good primary practice' Kelly (1984) argues that it is essential that these skills are not taught in isolation, as that would merely serve to make subsequent use of them more inefficient, and possibly cause rejection of them due to the

boredom of repetition and irrelevant exercises. Consequently, educators have recognised the need to find a place for technology in all subjects which are able to promote information skills.

Charp (1988) has identified computer education as a technology concerned with the integration of computers into the teaching and learning process. The nature of a primary curriculum, which revolves around group work and self-discovery, supports this concept of integration into the curriculum.

Straker (1989) suggests that activities with computers will permeate and stimulate many different aspects of teaching and learning in school, rather than the computer becoming an object of study in itself. Straker (1989:6) identifies the purpose of integrating computer use into the curriculum in this way as threefold:

- it allows teachers to extend and enhance the education of the children in their care;
- it allows children to acquire skills in the use of a computer as a tool for their own purpose; and,
- it gives children a better understanding of the range of ways in which their own lives will be affected by information technology.

The integration of the computer across the curriculum, could, if planned correctly, aid primary schools towards achieving the goal of a more process oriented curriculum. North (1991) in a study of Information Technology (IT) in Northern Ireland identified a number of areas where the use of technology challenges the present object oriented or

product curriculum and can act as a catalyst for curriculum and learning style change:

> (i) The integration of IT will challenge the content and structure of a curriculum that is represented by 'defined knowledge'...and... 'bounded subjects' through promoting a theory of knowledge that is based upon transferable key cross-curricular processes.
>
> (ii) IT challenges approaches which direct passive competitive student learning ... by supporting a theory of learning designed to increase the active and collaborative involvement of students working cooperatively in problem-solving ventures.
>
> (iii) Cross-curricular IT promotes a theory of teaching which conceptualises the teacher's role as a partner in exploration and investigation and which values the student's contribution to these activities. It is, in fact, a theory more concerned with processes than outcomes...
>
> (iv) IT will challenge many of the spatial settings now found in schools ... and methods of classroom management through supporting ... learning environments which require effective arrangements to be devised for both group and individualised learning.
>
> (v) Cross-curricular IT utilises a theory of assessment ... emphasising creativity, independent learning, discovery and experience ...
>
> (vi) The integration of IT will challenge current practices of IT resource deployment in schools (and) ..will ensure ... students will have immediate easy access to IT equipment in support of independent learning.
> (North, 1991:14)

However, Kelly (1984) has cautioned educators that the use of computers in schools will not in itself guarantee the existence of a satisfactory educational curriculum.

1.4.3 The role of the teacher

Initially computers were seen as the answer to much of the educational backlog. They could replace the teacher, were cost effective, and were better teachers. Experience and

research reveal that these 'advantages' of the computer are far from possible at present, and that, in fact, effective computer education is dependent upon the teachers perception and use of the medium.

Benn (1989) has pointed out that schools in South Africa have tended to place great emphasis on acquiring the hardware and little attention to the manpower required to operate it effectively. Researchers such as Chan (1989), Cox et.al. (1988) and Kahn (1989) support this and suggest that the teacher will be the deciding factor in effective computer usage.

> The computer can help students to learn faster, maintain longer attention spans, and become more interested in learning, but the quality of what students learn ultimately rests with the teacher. (Chan 1989:275)

As the trend towards the computer's integration into the teacher's educational programme becomes more desirable, so the need to educate teachers in its use in these areas becomes more obvious. Riel's (1989) research led her to conclude that computer usage would only have a positive effect on the students' learning if teachers had the knowledge and experience to integrate the computer into the 'functional learning environment'. Consequently, the extent to which software is utilised within the curriculum is limited only by the expertise of the individual teacher.

The computer, therefore, is not effective as an educational tool unless teachers are able to make informed decisions on whether or not to use them to provide a particular learning experience (Woodhouse and Jones 1988). According to research, teachers tend to be intimidated by the machine and find it difficult to master, but with hands-on practice this fear is usually overcome (Chan 1989, Harper 1987, Cox et al

1988). Many teachers also tend to be satisfied with their present methods and without adequate information and training these feelings can prevent them from seeing any reason to adopt the new technology. In addition, Bennett (1987) warns that without proper guidance and a knowledge of how to integrate computers into curriculum areas, enthusiasts can become over eager and see a use for computers in almost all situations no matter how tenuous. "When the only tool you have is a hammer, everything looks like a nail" (Mark Twain in Bennett 1987:227). It is evident, therefore, that without the training of teachers, computers can never achieve their potential use in education.

1.5 Selection of study area

The question of how schools have tackled the computer innovation in the primary classroom and its outcomes has been a topic of much research internationally (Kelly 1984, Naymark & Plaisant 1986, Cox et al 1988, D'arcy & Gardiner 1988, Chan 1989, Kahn 1989, etc.) and indicates that it is an area worthy of study.

Evans (1986) has pointed out that the use of computers in schools has developed more rapidly than any other aspect of the education system, and has made huge demands on those teachers who have been involved in the innovation. Many South African schools have been involved in computer education, and many more are contemplating such a step. However, there are few published articles on the impact of computers in South African education, and many teachers have been left to their own devices when attempting to use the innovation. If South African Schools are to obtain value from the computer in education, it is necessary that educators examine the present situation both internationally and at home and develop an awareness of the possibilities

which are emerging as the innovation has become better understood.

Due to the nature of the computer innovation, in that it is a predominately grassroots development both in South Africa and abroad and due to its rate of technological advancement, it is difficult to establish clearly where computers are moving in education. As such any analysis of computer use in education or the implications of such use must be general.

The researcher chose to limit the study to a small private school primarily because the school in question exhibited a high profile of computer use, and had implemented an extended programme of computer education. The intention of the study has been to present a general framework of computer usage in the observed primary school, and an analysis of the factors which had influenced the way the innovation was used and perceived by staff and pupils.

Thus, the research, though limited in scope, is intended to stimulate some discussion on the present utilisation of computer technology in a South African setting, and its potential for the future.

> From sand is the silicon microcircuit created, from sand the optical fibre. The most common and worthless material about us, available in inexhaustible quantities, suddenly is transformed to be the key to all our futures, in a world so different from the one we know that merely to turn our minds to it strains our imaginations. The task of education in helping our kind to make the transition to a new life style is one that will demand our skills, insight and flexibility. Yet the role of education is central, for it is in the mind of man that the revolution to come will be fought. In the kingdom of sand, all things become possible, and only imagination rules. (Prof. Gosling in R. Jones 1984:8)

Chapter Two

2. Research Methodology

This chapter will cover 1. the choice of a research method for evaluating and discussing the innovation at the school, and, 2. the data collection methods.

2.1 Research Methods

Within the context of educational research, choice of methods and techniques of evaluation are determined to some extent by two conflicting paradigms: the traditional, scientific or normative paradigm and the anthropological or interpretive paradigm.

The interpretive paradigm arose out of evaluators' dissatisfaction about the limitations of the traditional paradigm. Evaluators such as Parlett and Hamilton (1976) expressed the need for a new approach which would not be rooted in contrived experiments using control groups, and would allow for a diversity of opinions and unintended outcomes.

Some discussion of these two paradigms is necessary in order to clarify the researchers approach to this evaluation.

2.1.1 Evaluation Paradigms

The two traditions which dominate educational research and evaluation are known under a variety of names. For the purpose of this preliminary investigation the researcher intends to use the terms "normative" and "interpretive" as defined by Cohen and Manion (1989).

2.1.1.1 The Normative Paradigm

The normative paradigm (or agricultural - botany approach as defined by Parlett and Hamilton, 1976) is modelled on the

natural sciences and has its basis in experimental testing in psychology. Research methods evolving out of this paradigm are used in the attempt to obtain fully objective evaluations. The emphasis, therefore, tends to be on empirical quantifiable observations that can be analysed using mathematical tools. (Husen 1988)

Cohen and Manion (1989:38) explain the normative paradigm as one consisting of "two major orientating ideas". The first is that human behaviour is "rule governed" and the second, deriving from the first, that it can be investigated by natural scientific methods. The effectiveness of an educational innovation would, therefore, be assessed by examining its performance against pre-specified criteria.

2.1.1.2 The Interpretive Paradigm

In contrast, the interpretive paradigm (or social anthropological approach as defined by Parlett and Hamilton 1976) derives from the humanities with an emphasis on holistic and qualitative information. This paradigm has been identified as one characterised by a "concern for the individual", and a desire to "... understand the subjective world of human experience". (Cohen & Manion 1989:38).

Research methods influenced by this approach are directed towards an understanding of the individual and his interpretations of the world. As such, the evaluator looks for patterns and significant events as they appear naturally, without control or modification by the researcher. Evaluation and research falling within this paradigm tends to be oriented more toward programme activities than programme intents, and research methods which utilise meaningful description and interpretation.

2.1.2 Illuminative Evaluation

Illuminative evaluation falls within the social anthropoligical or intrepretive paradigm. This strategy arose out of dissatisfaction expressed by "non-traditional" evaluators with the normative process. Evaluators, such as Parlett and Hamilton (1976) argue that "scientific inflexibility" does not allow for the complexity of the educational milieu:

> So many random, unpredicted and human factors intervene that neat experimental designs cannot contain them all. For this reason, results from such studies merely carry conviction: they present an emanciated and artificial picture of real-world educational life. (Parlett and Hamilton in Dachs 1976:34)

In contrast to the "scientific" model, illuminative evaluation makes no attempt to measure educational products, but rather to "open out" or illuminate the innovation holistically, not as a product in isolation, but as part of a wider educational experience.

Essentially Parlett and Hamilton (1976) summarise the aim of Illuminative Evaluation as one which strives to

> ... study the innovatory project: how it operates; how it is influenced by the various school situations in which it is applied; what those directly concerned regard as its advantages and dissadvantages; and how student's intellectual tasks and academic experiences are most affected. It aims to discover and document what it is like to be participating in the scheme, whether as teacher or pupil, and, in addition, to discern and discuss the innovation's most significant features, recurring concomitants, and critical processes. (Parlett & Hamilton, 1976:89)

2.1.3 The research strategy of Illuminative Evaluation

Parlett and Hamilton (1976) define illuminative evaluation as a strategy for research rather than a systematic methodology. The researcher does not begin with a theory and pre-determined research methods, but rather immerses herself within the situation and allows the theory to emerge from this. The methods used, therefore, are defined by the situation itself, and allow the researcher to respond to emerging issues, not just preconceived problems. In addition, different methods are used in order to assess the problem or innovation from a number of angles, and to cross-check initial findings.

The three interrelated stages the researcher goes through in the illuminative evaluation process are observation, further inquiry and explanation. (Parlett and Hamilton, 1976)

The researcher begins by observing and absorbing the broad characteristics of the "learning millieu."[1] As the observations progress common incidents and trends become obvious to which the observer gives more attention. Observations then tend to become more focussed and systematic. The third stage consists of the researcher's

[1] "Learning Milieu" is a term used by Parlett & Hamilton (1976) to encompass the social-psychological and material environment in which students and teachers work together. This milieu represents cultural, social, institutional and psychological variables which interact in complicated ways to produce a unique pattern of circumstances, pressures, customs, opinions and work styles within the learning experience.

attempts to explain and clarify the general principles and trends underlying the innovation.

> Beginning with an extensive data base, the researchers systematically reduce the breadth of their inquiry to give more concentrated attention to the emerging issues. This 'progressive focusing' permits unique and unprecedented phenomena to be given due weight. (Parlett & Hamilton, 1976:93)

2.1.4 The choice of research method

Robert Stake (1983) in his report on Programme Evaluation has summarised diagramatically the different approaches to evaluation.

An edited section dealing with Illuminative Evaluation is depicted in table 1.

Approach	Purpose	Key Element	Risks	Payoffs
Transaction Observation	Provide understanding of activities and values	Educational Issues; classroom observation	over-rely on subjective perceptions; ignore causes.	Produce broad picture of program; see conflict in values.

Table 1. Modified version of Stake's Approaches to Evaluation.

Although a simplification of this evaluation approach, it helps to explain the researcher's choice of evaluation method. Illuminative evaluation seeks to discover what happens when an innovation is introduced, to "provide understanding of activities and values". It was within this context that the reasearch at the school took place.

The aim of the research has been to examine the computer innovation within the school, its use and impact, and to analyse emerging trends observed.

It was felt by the researcher that the scope of the investigation, being so broad, required a 'descriptive' method which is seen to be more useful when examining a broad base of educational issues. Gay (1987) identifies a descriptive method of research as being one which "determines and reports the way things are." In addition, the researcher did not want to evaluate specific problems that prior research literature had exposed, but rather to describe what was occurring within the context of local education. "...the descriptive researcher has no control over what *is*, and can only measure what already exists". (Gay, 1987:189)

Illuminative evaluation, as an interpretive and descriptive method of research suited the nature of the research required in setting a strategy for the researcher within which she could identify some of the 'complex realities' of this school. As there are no guidelines set by the Cape Education Department (Appendix A) regarding computers in primary education, it was the responsibility of the teacher-in-charge of computers to implement his own programme. The programme was flexible in that changes could easily be made by the teachers as circumstances and their own needs demanded. The research strategy, therefore, needed to be sufficiently flexible to take into account this dynamic environment.

The decision not to use formal 'paper and pencil' techniques of questionnaires was taken in light of the small scale nature of the research. The investigation was confined to a private school, whose policy was directed to a large extent internally rather than through an external education body. Use of large-scale techniques were considered inappropriate in terms of the goals of the research.

2.2 Data collection methods

As is suggested by Parlett and Hamilton (1976), the methods used should be defined by the situation itself, and different methods should be used in order to assess the innovation from a number of angles. The choice of methods should allow the evaluator to collect sufficient information to build up an 'information profile'. The researcher approached the evaluation with the intention of observing the situation, and from there to make a decision as the observation progressed as to what further methods (if any) should be used. This use of multiple data collection techniques is referred to as "Triangulation", and is a recognised research technique (Cohen & Manion 1989).

2.2.1 Triangulation

Triagulation requires the use of two or more methods of data collection. Cohen and Manion (1989) argue that single methods of investigation provide only a limited view of the complexity of human nature and may bias the researcher's interpretation.

In addition, theorists argue that this bias or subjectivity can be increased when using the open-ended qualitative data collection techniques of illuminative evaluation. Parlett and Hamilton (1976) note this concern about the "subjective nature" of these techniques, and suggest that a way to overcome the risk of "gross partiality" would be through using a number of collection methods to establish the validity of the data.

A further reason for using multiple methods is submitted by

Cohen & Manion (1989) who argue that triangulation can help to overcome the problem of "method-boundedness".

> Methodologists often push particular pet methods either because those are the only ones they have familiarity with, or because they believe their method is superior to all others. (Cohen & Manion 1989:270).

Using alternative methods when investigating an innovation can help validate the data. As such the researcher chose to use two methods of evaluation, namely observation and informal interviews.

2.2.2 Observation

In illuminative evaluation, observation plays a central role as a method of data collection. Within the context of this research it was felt that non-participant 'naturalistic' observation was required. In this form of observation the observer is not directly involved in the situation. Gay (1987) describes the observer's role as one where

> .. the observer is on the outside looking in and does not intentionally interact with, or affect, the object of the observation. (Gay, 1987:206)

Although it was not the intention of the researcher to intentionally alter the situation through interaction, much of the observation did lead to some involvement. This was confined to discussions or conversations with teachers and, to a more limited extent, with pupils. Parlett and Hamilton (1976) allow for this development, and argue that this type of interaction may well provide additional information not otherwise apparent.

In an observational study, the intention is usually to assess the status of an innovation through observing, not asking.

However, conversation with teachers and pupils tended to flow naturally into discussions around their involvement with the innovation. It was out of these conversations that many issues were raised, some of which were further investigated in the informal interviews.

2.2.3 Interviews

2.2.3.1 Purpose

In order to discover in more detail the views of the participants in the innovation, the decision was taken to return to the school and hold informal interviews with as many of the teaching staff as was possible. The aim was to discover the teachers' perceptions of the innovation, its value and use, and whether it had had an impact on their teaching.

As the study was a preliminary investigation, it was thought best to limit these interviews to the teachers as they were central to the innovation process. In addition, the innovation was still at an experimental stage, and it would have been difficult to adequately select and question pupils to determine the effect of computer usage except in the most general of terms.

2.2.3.2 The interviewing technique

In keeping with the research strategy adopted, it was felt that the 'informal' or 'semi-structured' interview using mostly open-ended questions would be most suitable.
It was necessary that the the research purpose governed the questions asked, and supplied a frame of reference for the respondent's answers. This would allow the respondent the freedom to give his own answer as fully as he chose without constraint.

It was felt that such a technique would allow for:

i) Flexiblility - the interviewer could shorten, adapt or change the question relevant to the respondent and the conversation;

ii) Cooperation - an establishment of rapport could develop in that the interview would proceed in a more 'conversational' form; and,

iii) It would allow for unanticipated answers.

2.2.3.3 Limitations associated with the interview technique

In any interview situation problems of bias and respondent constraint arise. Cicourel (as quoted in Cohen & Manion, 1983, pg 311-312) lists five unavoidable features of the interview situation:

i) There are many factors which inevitably differ from one interview to another, such as mutual trust, social distance and the interviewer's control.

ii) The respondent may well feel uneasy and adopt avoidance tactics if the questioning is too deep.

iii) Both interviewer and respondent are bound to hold back part of what it is in their power to state.

iv) Many of the meanings which are clear to one will be relatively opaque to the other, even when the intention is genuine communication.

v) It is impossible, just as in everyday life, to bring every aspect of the encounter within rational control.

The techniques applied in this methodology can lead critics to question the validity of such research. However, Parlett and Hamilton (1976) question the evaluators' demand for scientific reliability when dealing with a human situation. They argue that in any interaction involving people the very

concept of validity becomes a redundant notion. Kitwood (1989) supports this argument and claims that

> ...every interpersonal situation may be said to be valid, as such, whether or not it conforms to expectation (and) whether or not it involves a high degree of communication... (Kitwood in Cohen & Manion 1983:319).

2.2.4 Recording and collection of data

The researcher collected data in the following ways:

i) All initial conversations regarding the process of the research were recorded on cassette and transcribed to a daily journal.

ii) Classroom Observation:
   - Impressions were written in a journal
   - Some parts of the lessons were taped on cassette

iii) General conversations with teachers were recorded on cassette and transcribed.

iv) A daily journal was kept to record observations and impressions and for transcribed notes.

v) The researcher attended Staff tea-breaks and observed some classes not related to computer use in order to gain a general picture of the school.

vi) Background documentation supplied by the headmaster and teaching staff useful in building a general information profile about the ethos of the school was collected.

vii) Informal interviews with as many teachers as possible, including both those who made use of and those who did not make use of the computer were recorded and transcribed.

2.2.5 Choice of research method.

Despite the limitations inherent in this kind of research strategy there are compelling reasons for choosing it above more scientific methods, especially in the educational context. McNeill (1990) argues that the greatest strength of such a technique lies in its aim to provide a description faithful to the participants own view and within their own social context. Researchers applying this technique, therefore, attempt not to impose prior assumptions on the subject matter. This reflected the aim of this researcher, which was not to seek causes and explanations, but rather to allow any theories on the innovation to emerge from what had been observed and recorded.

Chapter Three

3. The setting of the research

This chapter will cover 1. a brief description of the observed school, and 2. description of the location and use of computers.

3.1 The observed school

The primary school chosen for observation is an independent (private) integrated school catering for approximately two hundred and fifty pupils from pre-primary to standard five. The school has been in existance since 1885, though most of the buildings it uses at present were only built or purchased in the early part of this century.

The school consists of three sections:

- the pre-primary school which is located some distance from the main school;
- the Junior primary which consists of sub A, sub B, standard 1 and an enrichment class located close to the pre-primary; and,
- the Senior primary school catering from standards two to six located in the main buildings.

The classes are co-educational until standard one after which the boys and girls are taught at separate schools for the rest of their primary schooling. Boarding facilities are provided for boys from sub A to standard six. Pupils enter the school on a non-selective basis and are taught through the medium of English. An Enrichment class has been introduced to help black children integrate more effectively into the English medium school.

According to the school's policy statement, the main curriculum emphasis is placed on co-operative learning,

problem solving and the acquisition of skills. No formal examinations are written until standard five when the pupils are tested and prepared for entry into the high school by writing the Common Entrance Examination. Pupils are assessed on a continuous basis with symbols replacing marks and no use is made of class positions. The school aims to 'encourage pupils to recognise their own strengths and weaknesses, strive for self-improvement and not to compare themselves unduly with others'.

3.2 Location and use of computers

3.2.1 Hardware location

The school has twelve BBC computers joined on an Econet[1] Network with one file server[2]. The computer classroom is located opposite the computer teacher's standard three classroom. It is a large room and the computers are situated in the second half. They are positioned in four rows. Two rows of computers face the outside walls and the two centre rows have computers placed back to back. Long tables have been made for the computers and the pupils sit on high stools. There are usually two to three pupils seated at each computer. There is a white board in the front of the classroom. The back wall and one side wall contain posters and charts related to various software packages in use.

In addition, three teachers each have one BBC computer in their classrooms.

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[1] The econet network is the Acorn Network system for linking computers to a single file server.

[2] A file server is a computer which, in a network, 'serves' information from a central disc or memory store to other computers on the network.

3.2.2 Allocation of the resource

The allocation of computers in schools is, to a large extent, dependent upon how the school intends to use them, the number of machines that can be purchased with available funds, the staff available to run the innovation, and security. These factors were decisive in the observed school's choice of a computer room in favour of that of computers in each classroom.

The computer teacher, teacher A, explained that the school's decision to house the computers in one classroom is essentially related to their primary intention of regular exposure and the need for computer literacy.

The emphasis on computer literacy was mentioned frequently by the teachers as a factor underlying their support for computers in education. Teachers interviewed stated that computers were essential for the children's future. They stressed the pupils need to be aware of computers and be taught the basic computer skills fundamental to their ability to cope in a technological society. Teacher A summed up this concern stating that "computer awareness among children is vital as modern society is becoming increasingly computer orientated and thus (one) cannot afford to be apprehensive about using them".

The choice of a central facility also solved a number of potential problems inherent in introducing computers into the school. A computer room requires only one instructor capable of using and managing the computer. This solved the problem of intensive and time consuming staff training. Teacher A stated that on his arrival no other member of staff had experience in the use of computers in education and only one other member of staff had been confident about using them. He pointed out that the school had had four

computers prior to his arrival, but they had not been used to any great extent. The staff admitted that they had ignored the computers and stated that it was due to their lack of understanding about the computer's potential in education.

In addition, he pointed out that teachers who were unaware of how to make use of the software often made poor choices that could be detrimental to both the pupil's and teacher's acceptance and use of the facility.

Teacher A stated that the decision to keep the computers in one room had also been taken because teachers unfamiliar with the technology could be resistant to using it if it had initially been placed in their classrooms. He felt that the most effective way to allow teachers to develop an interest in the innovation would be at their own pace and that this could be most easily achieved by introducing a centralised facility to which teachers would have access. Periods not allocated to computer literacy are available to other teachers who wish to make use of the computer room, and teacher A has held introductory sessions with teachers to familiarise them with the use of the computer.

Teacher A agreed that introducing computers into each classroom could, under certain conditions, allow more teachers access to the computer and more easily allow for their integration into the syllabus, but he felt that this would not have been successful as an initial policy. He argued that as teacher's were not trained in the methods necessary to make full use of the computer in an integrated fashion, in most situations the computer would probably have been used as a motivation by teachers for children to complete their work. This would be detrimental to a slower child who needed the practice in skills which were available

on the computer, but would not easily gain access to the machine.

Further factors influencing this decision were those of finance and security. As a private school all purchases come from school funds. One room equipped with all available computers and software resources can be kept under direct supervision of the computer teacher cutting down security problems and allowing greater numbers of users easy access to software.

3.3 Access to the computer room

Access to the computers is scheduled during school hours with free access under supervision in the afternoons. Computer lessons are formally incorporated into the time table with one period per week for computer literacy. Remaining periods are allocated to teachers who wish to make use of the facility (Appendix B).

3.4 Computer Literacy

As has been mentioned, Computer Literacy has been formally incorporated into the school syllabus. The content and structure of these lessons had been left to the discretion of teacher A.

At the start of the year, a revised syllabus (Appendix C) was drawn up which consisted of three broad components:

- technical knowledge and operation;
- programming; and,
- controlled access to a variety of educational and generic software packages.

These components have been combined in an attempt to foster the integration of computers across the curriculum.

3.5 Software in predominate use in the school.

All the software packages in use during the observation period are part of the original collection of the computer teacher. All the BBC software in use was produced in Britain.

The different types of software packages in use have been classified by the researcher as follows:

3.5.1 Reinforcement or drill and practice

The concept or topic is first introduced by the teacher in the normal classroom. This software is then used to further illustrate or give additional practice in the same concept. The majority of packages seen were for practice in language skills and mathematics.

3.5.2 Adventure games and simulations

The games were used to stimulate language reinforcement by reading and talking, logical deduction and planning. They were also used by the teachers as a motivation and form of reward for class work. Simulations were used to develop business skills and experience activities usually difficult to perform in a normal classroom situation. The only simulation used during the observation period was a business simulation of the stock exchange by a standard five group.

3.5.3 Generic or "tool" type software.

The only generic application in use by the pupils during the observed period was the word processor. The use of the word processor was only observed in one classroom, and at this stage it was only being used to copy work originally written by hand.

3.6 Application to begin research

The request to research the use of computers in the school was positively received by both the headmaster and teacher A. As the researcher is not a member of staff at the school all dates for observation were first discussed with the teacher A, and research was conducted on two week long periods in the second and third school term.

Chapter Four

4. The Application of the Research Strategy and Analysis.

This chapter will cover 1. an outline of the application of the research strategy, and 2. emerging issues which the researcher observed during this period.

4.1 The Four Stages of the Research.

Following the strategy as outlined by Parlett and Hamilton (1976) the researcher broke her task into separate but associated stages:

- establishing a research strategy;
- observation;
- interviews and triangulation; and
- ordering the data.

4.1.1 Establishing a strategy

The researcher established initial contact through the Headmaster with the teacher-in-charge of computers, teacher A. Through informal interviews with teacher A a general understanding of computer usage at the school was gained.

According the teacher A, the school's primary intention with computer education is to ensure that as many pupils as possible had access to, familiarity with, and an understanding of the computer and its uses. Accordingly, computer education has been formally incorporated into the timetable, and teacher A has been employed to establish and manage the computer facility and conduct lessons with the emphasis being on computer literacy.

At the time of the initial interview, the computer room had been in use for two years. The emphasis on computer literacy remained, though one other teacher was using the computer consistently in her remedial lessons. Teacher A

had rejected at this stage the possibility of integrating computers across the curriculum, and stated that the software he had access to did not allow for integration. He also felt that the teachers were not yet ready for this step as they were still familiarising themselves with the new technology.

Toward the end of the year teacher A decided that he would attempt a programme of integration starting the following year. The aim of the research now became twofold: to examine the use of the computer in the primary school, and to investigate the intended incorporation of computers across the curriculum.

At the following meeting with teacher A it became obvious that the programme to integrate computers across the curriculum had met with some problems. Teacher A had accepted a teaching post in Botswana for the start of the third term, and was doubtful that the programme would be completed as planned, though he was determined to get it started. The researcher felt that it was unlikely that the syllabus as drawn up by teacher A would have made sufficient impact on the school to ensure its longevity, and the result was the decision to concentrate the research on the use of computers in this primary school.

4.1.2 Observation, interviews and triangulation

The second stage began with a week's study of the day-to-day realities of the innovation at the school. Most observation occurred within the computer classroom, though time was spent observing other lessons and meeting with teachers in the staff and tea rooms. Data collection was done through observations and written notes, taped conversations with staff, pupils and between pupils and staff. These

observations were recorded and transcribed into a daily journal at the end of the school day.

The lessons were observed from the front of the classroom as the pupils seldom faced that way directly. The researcher also moved around the classroom at times though tended to be ignored by the pupils. As no formal introduction had been given to the staff they were mostly unaware of the researcher's purpose and initially assumed that the researcher was a student teacher. The staff did not seem concerned by the researcher's presence in the classroom. The researcher felt that this was possibly because most of the teachers did not formally present a lesson during their computer period and as such did not feel that their teaching ability was being assessed.

On completion of this stage of the research a short informal set of interview questions was drawn up to allow for cross reference and to add extra depth to the observations. The researcher returned to the school and conducted taped interviews informally with as many staff members as possible. These interviews were later transcribed.

4.2 Emerging issues

4.2.1 Observations of issues related to the choice of a centralised computer facility

4.2.1.1 The teachers' use and perception of the innovation

Observation of the computer classroom indicated that the staff's attitude towards, understanding of and use of the computers was influenced by their placement in a separate classroom.

It was noticeable that the predominant use of the computer classroom was at the junior preparatory level. Two of the three teachers who were not making use of the facility taught the higher standards. The reasons given by these teachers were:

- the lack of available software;
- the distance of the computer classroom from their own classrooms; and
- its unavailability due to the inflexibility of their own schedules.

Though it seemed to be the exception, on two occasions during the observation period teachers of the higher standards took pupils to the computer room to "keep them busy". One teacher stated that although this was a scheduled computer period for the pupils he did not formally plan a lesson for them as he felt that most of the pupils were more familiar with the computer than he was. He stated that he made no use of the facility outside of the scheduled time and did not involve himself in structuring the lesson within the curriculum.

Teacher A commented that there was a great deal of available software for the higher standards, but he felt that the teachers were not prepared to examine and make use of it. It would seem that the teachers, who all have a heavy workload and limited time were constrained by the lack of immediate access to the computers upon which they could examine the software.

The problem of distance was mentioned on more than one occasion in explaining why the teachers did not make consistent use of the facility. An example being the pre-primary school which is situated two blocks away from the main building. Getting the pupils to the classroom and

settled took at least twenty minutes. The teachers in the more senior classes also commented that distance to the room tended to disrupt the flow of their lessons.

In addition, the housing of the computers in a separate classroom may have been responsible for some teachers perceiving the use of the computers as an extra subject, not directly related to their own required syllabus. Teacher A commented that many teachers felt constrained by the syllabus and thus did not make use of the computer as they did not have time to 'play games'. Those who did make use of it commented on the computer's ability to 'lighten' their lessons which concentrated on basic skills such as spelling and tables. In discussions they tended to refer to the use of the computer as 'playing' and in this way actively separated it from the normal classroom activity.

The teachers could only make use of the facility for a scheduled period. This could, to some extent, explain the predominant perception of the role of the computer in primary education as one for consolidation, reinforcement and some enrichment for the more advanced pupils. The teachers made almost exclusive use of drill and practice software, and the use of the adventure game software was not seen to be structured within the rest of the curriculum. Many commented that the computer allowed "another approach" or a way of doing the same thing using a different medium.

When asked about the computer and skill development most teachers found it difficult to answer and tended to identify basic skills such as hand-eye coordination, fluency, reading and careful following of instructions. Mathematics teachers also felt that the computer could be used effectively for logical development and problem solving. Only one teacher

other than teacher A commented on the computer's potential in developing information handling skills. Teachers who had a computer in their classrooms did make use of the software in a more integrated way, though only one was beginning to use generic "tool" type software. One teacher commented that the time it took to print work at a centralised facility, and the fact that they would have to do all the printing in one scheduled period made use of the word processor inefficient.

Keeping the computers in a separate room under the guardianship of an "expert" could also have influenced the teacher's perception of "ownership". This could have been responsible for their resistance to experiment with and take control of the technology, their feeling that the computers were an "extra" rather than integral part of their teaching, and their reliance upon teacher A with regard to choice of materials.

In contrast to this the pupils showed consistent confidence in the use of the machines and often successfully came to the aid of the teacher when hardware problems occurred. They also tended to explore all the lessons available on the menu. This is possibly a reflection of the school's choice of a computer classroom which enabled a broad spectrum of computer awareness amongst pupils.

4.2.1.2 Reliance upon teacher A

A noticeable feature of the choice of a centralised facility, was the reliance of the staff on the knowledge of teacher A. On four separately observed occasions, staff members called teacher A out of his standard three classroom to fix minor problems such as the resetting of the machines or choosing an alternate lesson when a disk was misplaced.

This reliance related, however, not only to the maintenance of the hardware, but also to their choice of software.

Teacher A has set up disks for each subject and ability group for which he has suitable material. As such the teachers needed only to load the disk on the network for that class and allow the pupils to select the lesson required from the menu. The procedure to load disks onto the network was clearly presented on a chart next to the file server, and many teachers still read the instructions while applying them. It was noticeable that many of the teachers used only those lessons which teacher A had presented to them, and had not examined the other lessons available on the menus.

Teacher A pointed this out and considered their resistance as "not normal". He felt that the teachers still did not feel confident enough to explore what was available and experiment with the different kinds of software. He admitted that the teachers would only really make use of the material if they had more immediate access to the computers, that is by having them in their classrooms.

All the teachers consulted stated that there was a need to allow pupils to develop specific computer skills in order to form links between their present experiences and anticipated future computer use. However, there was no observed situation where the teachers, other than teacher A, actively pursued this strategy. It was felt by the researcher that teachers assumed that this skill development would be taken care of by the computer specialist in his specific lessons. This reliance upon teacher A could have prevented the teachers from assimilating computer skills in their own lessons which as a result, consisted predominately of the use of drill and practice software.

4.2.1.3 Integration across the curriculum

As has been mentioned, it was the intention of teacher A to begin a formal programme of computer integration across the curriculum. A number of problems hindered his progress in this development, many of which, the researcher felt, were related to the particular policy for locating computers in the school.

In addition to managing the computer room and teaching all the computer literacy classes, teacher A was the standard three class teacher. He was also a house master and was involved in a number of extra-mural activities not related to the computer. Due to this heavy commitment he was unable to acquaint teachers with the concept of computers across the curriculum, and this was one of the reasons they had not been involved in the design process. Both he and other teachers commented on the problem they had in making consistent use of the computer facility. The researcher felt that under these circumstances teachers would find it difficult to introduce the computer in a flexible manner across the curriculum.

Despite this, teacher A had managed to prepare a preliminary syllabus (Appendix C) which he had already begun to put into effect.

As the only teacher with dedicated computer periods he used these periods to test this innovation. He devised a syllabus for each class which documented the available software useful for skills development at the various levels.

Due to the fragmented nature of this approach, the emphasis in the preliminary syllabus seems directed towards integrated skill development rather than that of integrated

use across the curriculum. Under these circumstances the transfer of skills gained in the computer classroom to their other learning experiences could be haphazard. As such, although many activities with computers are taking place at the observed school, there is no real integration of computers in the school's curriculum.

The general nature of the observed school's primary classroom, which aims to develop group work and self-discovery, lends itself towards the integration of the computer across the curriculum. However, this research suggests that successful integration is dependent to a large extent upon the computer environment. Housing computers in a separate classroom means that an entire class is moved when they want to make use of the computer. The teacher who wishes to integrate the use of the computer would, therefore, find this move disruptive. The computer room is "alien" to the usual classroom where examples of the work being done are on display, and therefore easily referred to. As such, the attempt to integrate the computer is not always encouraged by the movement between classrooms. That the teacher's were becoming aware of this is evident in their statements that they would, ideally, prefer to have the computer in their own classroom, even if they have access only to one.

4.2.1.4 Growth of staff awareness

Despite the resistance of the staff to exploring the medium on their own, the growth of teacher awareness towards the innovation was obvious. The number of teachers using the computers had increased each year. In addition, many staff members expressed a desire to have a computer in their classroom. There seemed to be a change in perception in that teacher's now felt that it was not really necessary to have one computer per child, though they all felt that the

computer room should remain and was an important part of the pupil's day. This reflected the school's initial policy of computer literacy and the need for a central facility.

Teacher A expressed his satisfaction with the progress that had been made in this direction. He stated that by having a computer room and knowledgable teacher the initial resistance had dissipated and teachers were slowly becoming aware that the computers were an available resource which they could use. He felt that teachers responded best to change if they were allowed to partake of it at their own time, and this could only be done with the combination of a central resource for wider access and a computer specialist who could introduce them to the facility. The staff who had initially been resistant to the innovation stated that their feelings of inadequacy in acquiring expertise in an area where many pupils were more proficient had dissapeared. Teachers expressed the process as follows:

> We did have one or two computers before he (teacher A) came, but there wasn't an awful lot of interest, certainly not from my point because I'm so uneducated in that area anyway. But, the minute he came and explained to us exactly how it worked, what fun the kids would get out of it and what an advantage it would be for the children who are educated that way, well then we grasped at it.
>
> Initially I was terrified of the computers because the kids actually knew more about it than me. ... I've gradually become computer literate, (and now) I enjoy them.

Teacher A stated further that it was essential that the resource was seen to be used in a positive way, with something other than just programming taking place. Most teachers related the positive attitude of the school to the computers to the effective and well run computer centre.

The consistant use of the facility had impressed on the staff its fuctionality and viability in the school.

The allocation of computers in the school showed a tendency to inhibit the diversity of use available in this powerful resource. The more formal organisation, however, had been effective in encouraging teachers to initiate some computer usage in their teaching. The researcher felt that the initial aim of computer education at the school had been met, but felt that its continuation in its present form could be detremental to its use in a more integrated way.

4.2.2 Need for a computer specialist

On numerous occasions both teacher A and other staff commented on the need for a specialist to coordinate the use of the computers. Although the researcher felt that this need was related to some extent to the school's choice of a centralised facility, it seems evident that a coordinator offering some form of technical assistance, software management and cross-curricular computer knowledge is an essential requirement of any school making extensive use of this technology.

The lack of ownership felt by the teachers with regards to the computers may have lessened their willingness to take responsibility for their own usage. Many teachers commented about their initial insecurity and some still considered themselves as beginners. They fely the need for an "expert" to give them support when needed. Most teachers agreed that they would probably not have made use of the computer room if teacher A had not actively promoted its use, and had been available to rectify hardware and software problems.

As there was a staff member who was noticeably in charge of the computer room staff tended to rely on him to supply

materials and support. Teacher A commented that he felt the teachers should by this stage be making more independent choices but were not.

It would seem that having a computer expert readily at hand could deter teachers from taking control of the medium, and strategies would have to be developed to allow the computer expert to "share" his knowledge amongst staff.

Teacher A commented that there was a definite need for a full-time coordinator to evaluate software and assist in training teachers in new concepts and methods of computer use. He felt that the resistance had changed from a fear of computers to one related to a lack of knowledge about what was available and how to exploit it adequately. He stated specifically that he did not have the time to evaluate the software, and much of what was available was not being used. In support of this he also mentioned that teachers faced a problem in keeping up to date with the vast growth of computing in terms of new research developments, methodologies and evaluation techniques.

4.2.3 Implications relating to the choice of hardware

Teacher A stated that the decision to purchase the BBC computer was because they had been developed for use in the primary school, and the software was appropriate for the needs of the primary pupil. The software was designed by educationalists rather than programmers and lesson design had been grounded in good primary learning theory. Due to their extensive use at primary level in the United Kingdom,

an abundance of software had already been produced allowing teachers a wide choice of robust[1], good quality software.

A feature of the BBC computer and its software commented upon by many of the teachers was its ease of use. Thus it was non-threatening both to inexperienced teachers and to pupils. Teacher A felt that this feature had been instrumental in overcoming some of the initial reservations many staff had in using the computers.

The uncomplicated use of the keyboard which did not require complex combinations of key presses was also commented upon. The pupils observed did not seem hindered by the keyboard.

In terms of software design teachers also commented on the large font, simple graphic displays, colour monitors and lack of complex information as important factors when choosing hardware and software for use in the primary environment.

Teacher A commented that the choice of hardware was of primary consideration when implimenting computers in schools because that choice would determine the quality of software available to the school.

4.2.4 The choice of a network

The school chose to make use of a file server and a number of computers connected by a network. The network option allowed teachers to load one disk onto a file server which could then be quickly accessed by a number of machines. This cut down the time taken by teachers to start up a

[1] Robustness refers to the lack of programming problems that could cause lesson interference should an unanticipated key press or response be used.

lesson who would otherwise have had to load the lesson onto all the machines individually.

In terms of finance the choice of a network eliminates the need to buy separate disk drives for each machine. Housing the machines in one room controlled by a network also decreases cost in that only one software package needs to be bought for the room rather than a number of the same packages for each individual classroom.

The limitation of this option is its inflexibility for the following reasons:

1. The network used by the school ran on a dual disk drive system which required that the software had to be set up on disks specifically for the system. This procedure together with the maintenance of the network is sufficiently complex to require the services of a specialist. This again raises the issue of the success of the innovation being reliant upon the skills of one teacher which could be threatened should he leave.

2. There are no stand alone machines in the computer room. Due to the hardware configuration, only one disk can be loaded onto the network requiring all the students to work only on the material available on that disk. Although this did not present a problem at the school because of the use of mainly short drill and practice programs, the researcher felt it could prevent a more flexible use of the machine and limit the teachers perceptions of other ways of using the software. It must be noted that this limitation is not because of the network per se, but rather to the limited resources, that is the use of disk drives rather than a hard drive.

3. The purchase of machines without their own drives would prevent staff from being able to move a machine into their classrooms and in order for this to occur additonal hardware purchases would be necessary.

Watson (1990) has pointed out that the use of a network encourages the perception of computer allocation being a single-classroom fixed resource.

4.2.5 Implications relating to the available software

4.2.5.1 "Foreign" software

As had been mentioned all the software in use was developed in the United Kingdom. Although the staff did not consider this a major problem, the mathematics teachers pointed out that some of the material could not be used for this reason. They pointed out that in some areas methods of teaching differed and these methods tended to be reflected in the programs. An example given was the method of multiplication in the United Kingdom which required that students multiplied the "tens" number before the "unit" number, exactly opposite to South African methods. Some teachers felt that staff not trained in software evaluation might make use of these programs leading to confusion especially among pupils at the junior primary level.

In terms of text-based software teachers did not feel that British-centered software was a problem, as they felt exposure to this would extend the pupil's general knowledge. The danger the researcher felt in the exclusive use of software not developed in an African context was that unless teachers took time preparing for the use of the software, unnecessary interference in the learning process could occur, espcially in terms of children having first to interpret information not related to their own experiences.

Without active teacher intervention pupils could resort to guesswork in their responses, effectively undermining the intention of the lesson at hand.

The use of such software also raises the question of the kinds of values transmitted by the software. Kelly (1984) warns that although most forms of educational material presented to pupils expose them to a particular set of values, this aspect is most problematic in computer software when the software is not being directly mediated by the teachers as most other forms of presentation are.
Hebenstreit (1990) comments that

> Willingly or not, the educational software designed in a country carries with it, in many subtle ways, the social and moral values of the culture of that country and, therefore, the massive use of educational software designed in a foreign country will slowly but inevitably lead to a transforamtion and eventually to a decline of the originality and specificity of the national culture and traditions. (Hebenstreit in Hawkridge et.al, 1990:49)

Under these circumstances the researcher felt that such software would best be used in a more integrated fashion, through teachers incorporating the program into their normal classroom activities. There seemed to be a greater need on the part of the teachers to build on the stimulus of the programme through active integration.

4.2.5.2 The use of drill and practice software

During the observed period most lessons conducted by teachers other than teacher A involved the drill and practice lesson "Table Mountain". From available records on software usage, drill and practice software which could be related directly to the syllabus was used extensively. The

predominant software related most easily to English and Mathematics consolidation.

Most teachers identified their main use of the computer as complementary to their present syllabus as it offered an addition to their methods of reinforcement and extension. Some comments included:

> ...it all ties in because of consolidation.
>
> The method of teaching the subject still remains pretty much the same, but the extension is different.
>
> It wouldn't really (change my methods) because if you do a normal maths lessons you're going to have a game at the end just for consolidation, and it's just taking the place of a game really.

Chan (1989) has pointed out that drill and practice software has been in predominant use because it can be incorporated more easily into the teacher's existing syllabus. In addition, this type of software requires very little expertise on the part of the teacher. Both these factors were evident in the school observed. Many teachers, despite having made use of the computer room consistently for over a year, still showed little knowledge of the diversification of the computing medium.

In interviews teachers, especially those at senior primary level, stressed a need for more software specific to their curriculum. This perception is not unique to the school in question and according to Chan (1989) could relate to the teachers reliance upon drill and practice software in which

the skills developed are most easily identified as part of the requirements of the lower standards.

> Teachers reported that it was easier to isolate skills in the lower than in the higher grades and consequently, matching software were more readily identified. (Chan 1989:111)

Most of the teachers observed were using just one type of computer application, drill and practice, and usually for just one instructional function, consolidation. The researcher felt that the extensive library of drill and practice software available to the teachers resulted in their perception of the computer as an aid primarily for consolidation. Papert (1987) noted that teacher complaints about insufficient or inadequate software related to this perception of the computer. He identified a need to change this perception through teachers making use of software which presented the computer as a powerful tool rather than only a teaching aid.

Extensive use of drill and practice software requires very little change in the teacher's methods. In interviews, teachers stated that although the computer could have some impact on teaching methods as it became more widely used, at present it had had no immediate impact on their methods. The only change identified was the use of a different medium for reinforcement and extension. Consequently the researcher felt that the availablility and predominant use of drill and practice software had to some extent prevented teachers from experimenting more extensively with the use of the computer and gaining a wider perspective of its possible uses in the curriculum. As this type of software is not easily adapted to more integrated use across the curriculum the use of the computer would at this stage have had little impact upon the curriculum and its presentation.

Teacher A commented that the computer's "novelty factor" was sufficient initially to motivate the pupils, but that as they became more familiar with the medium they would soon become bored with the repetitive nature of the drill and practice software. Naymark and Plaisant (1986) expressed the same concern, and suggested that the solution would rely upon integration.

> The computer activity rapidly becomes tedious and cut off from the child's daily activity if the teacher does not provide for its linkage to other activities. (Naymark and Plaisant, 1986:171)

However, although there is a danger that such use of the computer may reinforce existing practices, Mathinos and Woodward (1988) have pointed out that it can represent a bridge encouraging teachers to move towards more "process-oriented" uses. This tends to reflect a trend emerging at the school in that some teachers commented that they felt the innovation could be used in a more extended fashion but were not sure how to go about it.

4.2.5.3 The use of adventure game software

Although Computer Literacy was still a set period for teacher A, he had introduced his new syllabus which included a wider interpretation of the topic. During the period of observation, most of the computer literacy classes were involved in an adventure game[2] "Crown Jewels". Some of the other classes also made use of this game during their reserved lessons.

[2] A traditional adventure game such as the one discussed here uses text or graphics or a combination of both to present a series of related situations through which a player must pass in order to achieve a goal. The players have to plan and take action according to the situation in order to master the initial task(s) of the game.

In discussions the teachers identified a number of ways the computer game developed learning skills. Many components particular to an adventure game were felt to have instructional value not always easy to foster in the normal classroom. The skills identified by the teachers and researcher can be summarise as follows:

Text Processing: The pupils are required by the game to read the text (graphics were not an integral part of the game in use) to find the information or locate objects needed to solve a series of problems.

Problem Solving: These skills are developed through the pupils having to formulate what the problems to be solved are while they are reading, and then deciding what action is necessary.

Interaction: (Not identified by the teachers but observed by the researcher). Unlike any other medium, the computer requires input in order to proceed. In the game situation, the pupils are forced to take an active role. The role taken will determine the outcome of the game in that until the material is understood and the problems imposed by the game are identified and resolved, the game cannot be completed.

A noticable feature of the lessons observed was the cooperation between the pupils. Although each group indicated that they wanted to complete the game first, they were always prepared to help other groups identify and resolve problems. The teachers made no attempt to prevent this cooperation, and in fact actively encouraged what might have been considered "cheating" in a normal classroom activity.

The limited number of computers available required that groups of up to three pupils worked together at each machine. This tended to increase verbal interaction in the computer classroom, but it was noticable that this type of interaction was more highly developed in adventure game situations. The adventure game allowed students the opportunity to discuss, justify and explain choices to each other. Reil (1989) suggests that such verbal interaction and cooperative learning is an important outcome of group work at the computer, and noted that

> The act of verbalizing material led to cognitive restructuring on the part of the students who were attempting to explain. Verbal interaction was also important because it led students to hear different points of view, which, in turn, led to cognitive conflicts. (Reil, 1989:183)

Although many of the processes identified by the teachers were occurring the researcher felt it was due more to the inherent nature of the software than through active teacher planning. There was no indication that these worthwhile learning skills were being structured within the learning process. The researcher felt that there was a possibility that the skills learned would only be transferred in a haphazard fashion to other areas of the curriculum, and that this type of software would be more effectivly used as an integral part of the normal curriculum.

It was interesting to observe that the pupil's use of problem solving techniques and cooperation was not limited to the use of adventure game software, though it was more obvious in that context. The drill and practice lesson "Table Mountain" presented a problem to slower typists. In order to challenge and motivate the pupils, they were awarded stars according to the speed with which they completed a table. Pupils whose key boarding skills were

less developed than others were often seen cooperating to increase their speed while cutting down their time by one pupil typing the response called out by the other pupil. Again the teachers did not consider this kind of aid cheating, and in fact encouraged pupils to work together to help each other achieve the required time.

4.2.6 Remedial uses

All the teachers involved in remedial and extension classes made use of the computer facility. One of the remedial teachers had a computer in her classroom, but all the others brought their classes to the centre.

Although the remedial teachers made use of the drill and practice software, there was a move towards non-content specific software such as the Cloze lesson. One remedial teacher commented on the flexibility of the program in that it allowed her to type in passages of her own choice. As such she had been able to incorporate the computer into normal classroom activities.

The most consistent users of the computer centre other than teacher A were the remedial and extension teachers. In the observed lessons, there was a greater tendency to actively incorporate the use of the computer with other classroom activities. The quiz software was used to stimulate vocabulary development rather than general knowledge, though it had led to the pupils and teacher searching for additional information on a variety of topics in the library.

As the remedial groups observed tended to be smaller than normal classes the use of the computer allowed for a higher level of interaction and cooperation between teacher and

pupil. One of the remedial teachers was the only teacher who identified any change in her teaching methods:

> It has helped me to talk more with the children, talk around the subject.... My interaction with the medium, the seating, that has changed quite a lot.

She also indicated that the computer had broken down the normal teacher-pupil relationship that she was used to. She now sat next to the pupils, there was no desk separating them, she openly relied on the pupils who were more computer literate than she, and she stated that she had noticed an increased level of cooperation between the pupils working together, and between teacher and pupil.
Evans (1986) has termed this a "triangular" relationship which is generated between teacher, pupil and computer where the teacher and pupil unite against the computer to solve the problem that is set.

4.2.7 Teacher commitment as a factor facilitating the acceptance of the innovation

A study done by Cox et.al. (1988) concluded that the successful implementation of an innovation in schools is dependent upon gaining the acceptance of teachers, and on teachers being motivated and commited to the value of computers in education.

In the school a variety of commitment levels were observed, but all the staff interviewed (both users and non-users) indicated that computers should play an important part in the educational process. The researcher felt that there were two main reasons for this perception: the headmaster's support of the innovation, and the commitment of teacher A to promoting computer use throughout the primary school.

4.2.7.1 Support of the Headmaster

Cox et. al. (1988) concluded from research done at a number of primary schools that

> The attitude of the headteacher is critical in encouraging a positive attitude amongst staff which is essential if computer assisted learning is to become an integral part of the primary curriculum. (Cox et al 1988:178)

The headmaster of the school had been involved in the implementation of the innovation from the start. He had involved himself in the steps required to introduce the technology and the decision to appoint a knowledgeable staff member to manage the resource. His support for teacher A's scheme of implementation was seen to place a value on the new technology which was transmitted through to the staff.

Although he had left the progress of the innovation up to teacher A, it was felt by the researcher that his support was integral to the continued acceptance of the innovation by the teachers.

4.2.7.2 Teacher A's commitment to and promotion of computers in education

It was felt by both the teachers and the researcher that the dedication of teacher A, his enthusiasm, his willingness to aid staff, and his promotion of the new technology had resulted to a large extent in the school's positive perception of computers in education.

Teachers, however, will not make use of an innovation which threatens their self-confidence, and the researcher felt that the programme to increase staff awareness as developed by teacher A was the foundation upon which this acceptance rested.

From discussion and observation the researcher concluded that teacher awareness of the technology rested to a large extent on two levels of training: firstly training which developed teacher confidence in the technical use of the equipment, and secondly, teachers being made aware of the educational value and uses of the innovation.

Teacher A, with the support of the headmaster, had held compulsory training sessions when the computer facility was first established. The initial session had been to give teachers the opportunity to learn the basic operation of the computer, view some of the software available, and discuss various applications of the software for classroom use. The second session, held a year later, was directed towards an understanding of the potential in primary education of the programming language LOGO. Additional training was given by teacher A on an individual and ongoing basis with teachers who had expressed an interest in the medium. Teacher A had limited the number of formal training session because he felt that acceptance of the innovation would rely upon teachers being allowed to develop interest at their own pace.

The success of the training procedure as implemented by teacher A was reflected in the extensive staff use of the medium. The researcher felt, however, that the school had reached a stage in the innovation process where additional exposure to extended computer usage was necessary if the use of the innovation was to continue progressing.

4.2.8 The need for increased teacher education and instruction

Many teachers indicated that they were unable to make more use of the medium because of lack of time. As had been suggested, this perception may have rested upon the location

of the computers in one classroom, and the teacher's lack of immediate access to hardware and software.

Mathinos and Woodward (1988) suggest that teachers tend to perceive the computer as an extra subject, as something they will be held accountable for. Senior primary staff at the school tended to perceive the computer as useful for games and therefore not related to their curriculum needs. The researcher's perception is that teachers need to be educated in the potential of the computer at all levels in the primary school, and that they need guidance on how and when it can be most effectively used.

The researcher felt that many teachers were not participating sufficiently while pupils were using computers, and there seemed to be a need for greater teacher awareness on how the computer fitted into the context of primary education.

Cox et al (1988) stress that a factor behind using computers to the benefit of the pupils requires a greater deal of teacher participation than is usually present. They state that

> teacher participation needs to be at a level where .. it can ensure that the software is being used correctly or in ways which are of greater educational value to the children. (Cox et al, 1988:177)

Observation indicated that the teachers had successfully implemented computer education in terms of reinforcement and consolidation, but lacked knowledge of new trends emerging in computer education and the use of more current tool type software. Computers had been added to the curriculum in such a way that their was a tendency to view them as an

optional extra or as a departure from the normal educational practice.

There seems, therefore, to be a definite need to extend teacher knowledge on how to appropriate the technology into their curriculum. As Callister and Burbules (1990) have pointed out,

> It is a mistake to assume that once teachers see the powerful capabilities of computers they will always find them the best means of aiding their instruction..... As teachers understand more about the possibilities of computers, and their effects both good and bad, they will be in a better position to make active and thoughtful decisions about when and how computers can help them achieve their educational purpose. (Callister and Burbules, 1990:7)

Chapter 5

This chapter will cover 1. the researcher's approach to the investigation, 2. a summary of the emerging issues, and 3. suggestions for additional research.

5.1 The researcher's approach to the investigation

The research, analysis and conclusion, are based on a particular view of what is educationally worthwhile, and as such, the educational potential of the computer is analyzed in terms of that particular view. The justification for this approach is found in Kelly (1984) who argues that nothing would ever be written about education if one did not make some kind of assumption about what is or ought to be, and which did not, therefore, base itself on some sort of educational values.

Further justification for this approach rests on the fact that the assumptions made by the researcher are firmly based on a broad spectrum of educational philosophy appropraite for primary education (Stenhouse, 1976, Blenkin & Kelly, 1983, Papert, 1987). This theory of education rests on the belief that education in the fullest sense goes beyond the mere acquisition of certain knowledge or skills and is concerned with personal development beyond the intellectual. Education based on this perspective involves

> the growth of understanding as well as the acquisition of knowledge, it will include the development of a system of values as well as of a cognitive perspective, and it will entail, as a corollary of all this, the ability to make a continuing critical review of one's knowledge, one's undertanding and one's moral and social values. (Kelly, 1984:9)

The perceived success of any innovation in education reflects the theory of education against which it was examined. It was not the intention of this researcher to examine the success of this innovation, and no attempt to measure success or failure was undertaken. The intention of the research was mainly to open up for discussion the use of the computer in a primary school, and attempt to recognise trends reflected in this innovation. As such the conclusion has been limited to areas that the researcher perceived as being noticeable trends that occurred in the implementation of this innovation and may merit further study.

5.2 Summary of the issues

It would seem that the basis for acceptance of any innovation rests ultimately on staff commitment to that innovation (Cox et.al. 1988, Callister & Burbules 1990, Chan, 1989).

In the observed school there were a number of factors which were identified by the researcher as being influential in shaping staff perception and utilisation of the innovation. Despite the limited nature of the research the following factors were seen to be significant.

5.2.1 Top-down commitment

The study conforms with the findings of Cox et al (1988) which indicates that the positive attitude of the head-teacher greatly influences the teachers' acceptance of the innovation.

This acceptance was seen to be further influenced by the commitment of the teacher-in-charge of computers. His enthusiasm, knowledge, commitment and helpfulness were mentioned by staff as being highly influential in changing their perceptions about computers in education. This,

together with his in-service training programmes and his own consistent use of the facility allowed teachers to become progressively aware of the potential of the medium in primary education.

5.2.2 The allocation of the resource

The study supports the research done by Watson (1990) which suggests that the location of the computers is highly influential in the teachers perception and use of the innovation.

The allocation of computers in one room limited staff access to the equipment and made it more difficult for them to find time to familiarise themselves with the hardware and software. In addition there was a tendency for teachers to perceive the innovation as belonging to an expert, and outside of their own experience. As they did not have 'ownership' of the innovation they tended not to experiment with the new technology.

These factors were also seen to be detrimental to teachers pursuing a more integrated use of the innovation as the teachers' perception of the innovation was usually that of an 'extra subject' outside of their own domain. This perception was reinforced by the nature of the room which emphasised the resource itself, and as such did not encourage a sense of integration.

Many teachers, especially those teaching at the top end of the school, explained limited use of the resource as a result of a full syllabus which did not allow them the time to introduce yet another subject into the curriculum. The location of the computer seemed to encourage teacher perception of computers as a separate subject. Watson (1990) argues that locating the computer in the classroom

where the curriculum is being delivered allows the innovation to be incorporated into the whole class framework rather than seen as a special activity.

It was also felt that the location of the computers influenced teachers' perception of the resource as a medium for consolidation rather than integration. If one accepts that the computer should reflect present educational aims then it should be seen as part of the general learning environment. This does not seem to occur easily if the computer is housed in a separate facility.

Although such an allocation was seen to inhibit a more diverse and integrated use of the computer it did allow pupils greater and more regular access. Scheduled periods also allowed for more teachers to become aware of the innovation and as such increase their own exposure to the medium, albeit in a limited fashion. If large-scale teacher training over extended periods is not immediately feasible, then making use of a centralised facility and an 'expert' is possibly the most efficient way of introducing the innovation into the school with least teacher resistance, and is an area that may require further research.

5.2.3 The computer specialist

Discussions with staff indicated that an expert was an essential part of a well run computer programme. As with the school observed it would seem that, in most cases, the responsibility for the management of the innovation falls on a teacher with an already full time table. The teachers at the observed school commented that they had a great advantage in that teacher A was an educationalist knowledgable in computers. However, this is not an ideal situation.

A teacher not specifically employed as a full time computer coordinator does not have the time to ensure the resource is being used to its full potential. As the innovation is constantly changing and its impact on education is just beginning to be felt, the computer specialist/coordinator in schools needs time to become better informed of the educational potential of the computer within the school.

Present utilisation in Australia and the United Kingdom (Quigly 1990, Straker 1989) indicates that schools are employing technicians or coordinators specifically for the purpose of managing computers. Quigley (1990) has stated that the level of computer use in these countries has grown to such an extent that classroom teachers can no longer be expected to cope with managing the resource.

5.2.4 Choice of hardware

Staff at the observed school indicated that the choice of hardware and consequently the software available was a major factor influencing their acceptance of the innovation. The hardware chosen will affect the quality of the software available and this ultimately affects the teacher's attitude and perception of the innovation.

The software available for the observed school was of very high quality, but mostly of the tutorial kind. The researcher felt this had confirmed the teachers' perception of the resource as being one useful for consolidation and remediation, and had prevented teachers from integrating the software into their curriculum.

The need for schools in South Africa to rely on predominately foreign software is also an area of concern (Stoker & Robertson, 1989). Pupils are often left to deal with computer-generated situations to which they cannot

readily relate. The researcher felt that this could lead to unnecessary interference in the learning process. In addition, programs written in other countries carry with them the cultural and social values of that society. The researcher felt that there should be research done not only in the area of local software development, but also in developing staff awareness of these issues.

5.3 Suggestions for additional research

It was felt by the researcher that the following areas require additional research specific to the South African situation.

5.3.1 The need for teacher training

Benn (1989) has pointed out that the computer plus instructional software cannot educate.

> It is the teacher who can use the computer educatively in the classroom who will justify the computer's role in education. (Benn, 1989:614)

Many of the teacher training institutions in South Africa seem aware of the importance of teachers being computer literate (Appendix A). However, teachers need more than this. They need to have access to courses which guide them in the educative use of the computer in the school. Irving (1986) supports this and calls for educators to develop strategies to produce material for teacher education which can subsequently be applied by those teachers for those students.

> Perhaps one of the most critically important issues in need of consideration is the education of the teachers and specialists who will guide the classroom in the use of microcomputers as well as influence, through their articulation of issues, how technology will be used. (Bowers, 1988)

Teacher acceptance of an innovation is the most effective way of ensuring its utilisation in the classroom. Many teachers mentioned that their initial fear of the new technology was the main barrier to their utilising it before teacher A took over the computer facility. It would seem obvious that an obstacle to effective integration of the computer is inadequate in-service training. If teachers are required to integrate computers into their curricula then the emphasis in staff training should move away from the mechanical operation, and concentrate on appropriate learning experiences integrated into specific content areas. In-service training should serve to educate teachers in the use of computers using strategies that relate more to classroom experiences. Callister and Burbules (1990) argue that teachers need to

> approach computers as devices to enhance their own teaching and learning, for their own purposes under their own direction. ... The main advantage of this integrated approach is that it grounds the use of computers in a theory of education related to the aims of personal and intellectual development, and forces us to rethink those aims in light of new possibilities computers may present. (Callister & Burbules 1990:6)

In-service training, therefore, should be directed towards allowing teachers the opportunity to identify appropriate uses of technology in teaching and learning processes within their own fields, and to apply it in a way which will enhance and enrich the quality of their lessons. An increase in the numbers of teachers knowledgeable about technology would allow South African educators, rather than international software houses, to take the leadership role as far as educational computing in this country is concerned.

5.3.2 The need for a National Policy.

Responsibility for the implementation of the innovation in the observed school rested almost entirely upon the ability, motivation and commitment of one person. Although it seemed evident that the teachers in this school had reacted positively to this method of implementation, a number of problems were noted:

- the success of the innovation is determined largely by the character of the teacher responsible for its implementation;
- there is a problem of continuity should the teacher leave;
- one teacher whose commitment is divided between normal teaching activities and the implementation does not have sufficient time to study the impact of the innovation and make recommendations for change and progress;
- such a teacher does not have the time to adequately prepare other staff members in its use; and,
- does not have the time to keep up to date with rapidly changing technology and educational trends.

For such reasons it seems evident that some policy or rationale developed at a national level is necessary if appropriate, adequate and continuous usage of the technology is to occur in schools which have already, or are about to, implement such a costly innovation. It is accepted that not all schools have computers for instruction (Appendix A), but the number of schools investing in technology is steadily increasing. With a national policy this innovation would have a greater impact on South African Education.

Educators both in South Africa and abroad accept that computers have become an integral part of the learning

process. Educators generally accept the notion that computer technology is not going to go away and has a role in education. However, in South Africa, the nature of the role is still being determined. Evans (1984) has pointed out that computer technology has become increasingly sophisticated, and educators are in danger of being 'seduced by bright images and complex calculations'. For these reasons it is vitally important that the use of computers be placed within a sound educational framework. As such, educational authorities at both macro and micro level need to develop a clear rationale for the use of technology in education based on the perceived needs of the children and the resources available.

If one accepts that the main reason for introducing the computer into the classroom should be the enhancement of the learning environment, and that pupils should be given the opportunity to understand and interact with the new technology which forms an integral part of their lives, it is evident that educators should, when developing a rationale for computer use in education, be doing so within the context of a curriculum which best stimulates good primary practice.

5.3.3 The need to 'rethink' the curriculum

Friel (1991) argues that rather than attempt to adapt present technologies to the present curriculum or adding additional subjects onto the curriculum what is needed is a rethinking of the curriculum itself. Consequently, any discussion of the computer in the curriculum should not be restricted to the view of computers as providers of automated programmed instruction. It is important to acknowledge the existence of other important uses of the computer as a tool for learning. Changes should not be made simply for the sake of using the technology, but should

rather reflect the changes in the way people think about and work with technology. This viewpoint is supported by many educationalists (Evans 1984, Kelly 1984, Underwood 1990, etc) who argue that any new curriculum must take into account the future needs of the pupils and utilise those aspects of the technology which reflect good primary practice.

Kelly (1984) has argued that using computers in schools has not in itself guaranteed the existance of good primary educational practice. He points out that educationalists still need to question how computer education is taught and how computers are used and to evaluate this against some agreed educational criteria. The researcher feels that the use of computers in schools should reflect the paradigm shift in primary education away from a product based curriculum dependant upon content, goals and examinations, towards a process or child-centered curriculum. Many educationalists (Kelly (1984), Evans (1984) and Straker (1989) etc.) have shown how the computer can be used as a useful tool for implementing this shift by allowing teachers to concentrate on a process approach employing features available in computer programs such as those of data retrieval, problem solving and decision making.

> The impact of current technological development ... is likely to be far-reaching in its effects on education and it is not too fanciful to speculate that the new thrust may well be .... away from the emphasis on acquiring skills to perform tasks which the microcomputer can do much more easily and readily than we can ourselves and towards a concern for the development of those conceptual 'skills' which people are better at, and for the enrichment of life which now becomes possible. (Kelly, 1984:3)

The observation of the school in question revealed that teachers who used the computer felt that it had the

potential to enhance the quality of their teaching, and, though limited, for some it had prompted changes in teaching style. However, it was obvious that using the computer effectively required more than adapting tutorial/drill and practice-type material available to suit the present curricular needs. Although these are legitimate functions of the computer, such exclusive use could result in many schools becoming disillusioned with the new innovation.

If the computer is to become more than a very expensive teaching machine, the curriculum will have to be restructured to reflect areas where the computer can enhance the learning environment rather than simply parallel established classroom practice.

Effective use of the computer can help in this restructuring of the curriculum, and in fact can help to instigate it. Evans (1984) has shown that the computer can promote, enable and motivate good educational practices, and can provide an extra dimension to the pupil's work. However, the present emphasis on content and examinations based on vast amounts of acquired knowledge pose problems for teachers attempting to effectively use technology.

> The sheer rapidity of present-day technological advance makes a nonsense of notions like those of 'vocational education' and 'education in the basic skills',.... 'subject disciplines',(and) 'intrinsically worthwhile activities'. ... We can no longer be dogmatic about the content of pupils' learning without running the risk of offering them experiences which will be of little value to them in the context of the society and the culture they will inherit. (Blenkin & Kelly, 1983:31)

The observed school's attempt to integrate computers across the curriculum had had very limited success due to factors which have already been discussed. A major constraint felt by most teachers in utilising the computer effectively was a perceived lack of adequate software. However, the researcher felt that the software available was not the most pressing issue. What teachers lacked was the knowledge necessary to utilise the available technology successfully, and a curriculum flexible enough to allow for its implementation. Even those who were aware of its added potential were incapable of utilising it beyond normal drill and practice because of the constraints of the syllabus.

5.4 Conclusion

In order then for the computer to be integrated in the South African classroom two major issues need to be resolved. The first is the need for a curriculum which facilitates cross-curricular strategy, that is a "process" oriented curriculum, and the second a strategy to train teachers which reflects international educational trends in primary education.

Computers have invaded many of our schools, but to utilise their potential a change in educational practice is required. The impact of computers on curriculum is only beginning to be felt at the moment, and it is doubtful that the computer alone will be responsible for changing the shape of education. Technology itself cannot solve problems, but rather man making effective use of technology. The computer has allowed some innovative educators the opportunity to extend teaching methods and develop new skills so necessary to the modern world. These innovations should not be lost, but become part of a new perspective on education in this country.

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APPENDIX A

DEPARTEMENT VAN ONDERWYS EN KULTUUR
DEPARTMENT OF EDUCATION AND CULTURE
ADMINISTRASIE: VOLKSRAAD
ADMINISTRATION: HOUSE OF ASSEMBLY

KAAPLANDSE ONDERWYSDEPARTEMENT
CAPE EDUCATION DEPARTMENT

Navrae: P. Waker
Enquiries:
Verw.:
Ref.: L.15/73/7
Tel.: (021) 203-3601

Provinsiale Gebou
Provincial Building
Posbus 13
PO Box 13
Kaapstad 8000
Cape Town 8000

4 May 1990

Mrs V. Mostert
P.O. Box 739
GRAHAMSTOWN
6140

Dear Mrs Mostert

INFORMATION FOR M.ED. THESIS

Your letter dated 4 April 1990 refers.

The topic chosen for your M.Ed. seems a most interesting one. We hope you will send us a copy of the completed thesis in due course.

To answer your questions:

1. The department encourages the effective use of computers in all aspects of education. The primary schools seems to be the ideal phase for the introduction of computers, as pupils are very receptive to new technology at that age. We wish to stress however that the department wishes to see effective and appropriate use.

2. The department encourages the integration of computers into the curriculum. However, many schools do not have computers at all and most schools that have computers have an insufficient number. Few if any teachers have received formal training in the integration of computers in the curriculum. The department therefore has to leave the degree of integration up to the individual schools and teachers.

3. The department has three aims with its computers in education policy.

3.1 To provide pupils with an appropriate degree of computer literacy.

3.2 To use the computer as a learning aid whenever appropriate and effective.

3.3 To provide a tool for teachers when appropriate.

As you are, no doubt, aware, the field of computers in education is one that is developing fast and is constantly being reviewed.

It is common knowledge that the best teachers of computer literacy and the most effective users of computers in the curriculum are teachers who are computer users themselves. The department is therefore promoting computer literacy among teachers as a first step towards achieving (3.1) and (3.2) above.

The new (1989) College Syllabus for Computer literacy applies to all DE I, II and III students. A copy of this syllabus is enclosed. When you study the requirements for the yearmark and the practical examination, it will be clear that this course is intended to create a body of computer literate teachers.

At the beginning of 1990 seven Regional Computer Coordinators were appointed, one at each teachers' centre. Their primary task at present is to provide computer literacy training for serving teachers.

Only when there are sufficient computers in our schools and adequate number of computer literate teachers, will be able to integrate the computer into the curriculum as a matter of policy. At present it is an option left to individual schools and teachers.

We trust that this adequately answers your questions.

for EXECUTIVE DIRECTOR: EDUCATION

End: 1989 Computer Literacy Syllabus for Colleges

APPENDIX B. SCHEDULE FOR COMPUTER CLASSROOM

	1	2	3	4	
	7.30-8.05	8.05-8.40	8.40-9.15	9.15-9.50	9.50-10.10
Monday			Rem. English	Ext. English	B
Tuesday				Std.2 Eng.	R
Wednesday	Std. 4_1	Std 5_2	Std. 2_1	Std5 Ext.Eng	E
Thursday	Std. 2		Remedial	Std. 5	A
Friday		Std. 1	maintenance	Std. 4_2 Eng.	K

5	6	7		8	9
10.10-10.45	10.45-11.20	11.20-11.55	11.55-12.10	12.10-12.45	12.45-13.15
Sub A	Std. 3		B	Std. 6	Std. 5_1
Std.4_2	Std. 4_1	enrichment	R		Std 2_1
Std. 4_1	Std 1_2	Sub B	Sub B	Std. 2_1	Std 4
Std. 2 math	Std. 1_1	Std. 5_2 Eng.	A		
Std. 2_1	Std. 5 Eng.	Std. 2_2 math	K	extra eng.	extra.eng

APPENDIX C

SYLLABUS FOR COMPUTERS IN PRIMARY EDUCATION

This will be based on a spiral approach, using the resources available.

Equipment: 12 BBC B's on an Econet Network.

Approach:
1. Logo
2. Maths Programs
3. English Programs
4. Adventures and Mapping
5. Problem Solving
6. Understanding hardware
7. Basic and related languages
8. Word Processing
9. Computer literacy and jargon
10. The role of computers
11. Hand/eye coordination
12. Enjoyment.

Each of the above approaches should be covered in each year!

CLASS: 1	LOGO	LITERACY	HARDWARE	MATHS	ENGLISH	BASIC
FIRST TERM	Movement FD BK LT 90 RT 90	Keyboard		Addition/ subtraction programs 'Clock' 'Easiadd' 'Ladybird'	'Podd' & exercises 'Letter- grab'	
SECOND TERM	Movement Clean Home PU PD	Keyboard		'Rmaths' 'Numbal' 'Count' 'Ginn' 'Numb + -' 'QBFLY'	'Podd' & exercises 'Facemaker'	
THIRD TERM	Movement Exercises: car boat face sign	Keyboard		'Sub' 'Qbottle' 'Ccar' 'Toyshop' 'Bingo' 'Cakes' 'Compete'	'Podd' & exercises.	

PROBLEM SOLVING	WORD PROCESS.	ROLE OF COMPUTERS	ADVENTURE	HAND/EYE	ENJOYMENT	
'Reverse'	'Pendown'		Beginners Adventure	'Stopbox'	'Navigat'	
	'Pendown'		'Beginners Adventure'	'Stopbox'		
	'Pendown'		'Beginners Adventure'	'Snap'		

CLASS: 2	LOGO	LITERACY	HARDWARE	MATHS	ENGLISH	BASIC
FIRST TERM	CS Repeats	Keyboard Familiarity		Tables & Bonds 'Star' 'Table Mountain' 'Clock' 'Signs'	'Palace' 'Wordpower' -collectives	
SECOND TERM	Repeats	Keyboard Familiarity		'Star' 'Table Mountain' 'Abacus' 'Frac'	'Palace' 'Wordpower' collectives 'Hamgman'	
THIRD TERM	Repeats	Keyboard Familiarity		'Star' Remainder 'Table Mountain'	'Palace' 'Aztec' 'Order' 'Road'	

PROBLEM SOLVING	WORD PROCESS.	ROLE OF COMPUTERS	ADVENTURE	HAND/EYE	ENJOYMENT	
'XOR'	'Pendown'	Databases: 'Tree' 'Animals'	'Granny's Garden'	'Snap'	'Kingdom'	
'XOR'	'Pendown' 'View'	Database: 'Tree'	'Granny's Garden'	'Snap'	'Teasers'	
'XOR'	'View'	Database: 'Tree'	'Granny's Garden'	'Snap'	'4 D line'	

CLASS: 3	LOGO	LITERACY	HARDWARE	MATHS	ENGLISH	BASIC
FIRST TERM	Procedures	Typing: 'Stutor'		'Star' competition Long mult. 'Table Mountain' 'Memory'	'Wordpower' opposites similes 'Story'	line numbers Print A$,A
SECOND TERM	Procedures	'STutor		'Star' competition Fractions/ decimals 'Table Mountain' 'Target'	'Wordpower' synonyms 'Rhymes' 'Sentences'	Input Small quiz Programs
THIRD TERM	Procedures	'STutor'		'Star' Competition 'Jars' 'Mafact' 'Chaser'	'Wordpower' adjectives & nouns 'Word hunt'	use of if...then

PROBLEM SOLVING	WORD PROCESS.	ROLE OF COMPUTERS	ADVENTURE	HAND/EYE	ENJOYMENT	
'XOR'	'View'	Quiz programme	'Circus' & map		'Football Manager'	
'XOR' 'Mallory Towers'	'View'	Quiz programme	'Circus' & map		'Gates'	
'XOR' 'Repton' 'Jars'	'View'	'Where & how we use databases'	'Circus' map & writing		Lab	

CLASS: 4	LOGO	LITERACY	HARDWARE	MATHS	ENGLISH	BASIC
FIRST TERM	Filing systems 'Save' 'Load'	Using function keys		Long mult. method 'Star' 'Wizard' 'Target'	'Bridge'	'Learn Basic' 'Rem statements
SECOND TERM	Filing systems 'Save' 'Load'	Using function keys		'Balloon' 'Ladder' 'Change' 'Conceal' 'Dechunt' 'Rhino'	'Cloze procedure'	'Learn Basic' goto
THIRD TERM	Using the screen editor	Using function keys		Angles - 'Skittle' 'Torpedo' 'Flags' 'Chaser' 'Mtalk1'		'Learn basic' loops - for...next

PROBLEM SOLVING	WORD PROCESS.	ROLE OF COMPUTERS	ADVENTURE	HAND/EYE	ENJOYMENT	
'XOR' 'Repton'	'View'	'Rot. 3.0'	'Castle' & map 'Million'		'Ghouls	
'XOR' 'Repton'	'View'	'Rot. 3.0'	'Castle' & map 'Million'			
'XOR' 'Repton'	'View'	'Rot. 3.0'	'Castle' & map writing 'Million'			

CLASS: 5	LOGO	LITERACY	HARDWARE	MATHS	ENGLISH	BASIC
FIRST TERM	Complex procedures Using variables	Typing tutor		'Connect' 'Cross' 'Poly' '% progs' 'pascal'	Front page	procedure
SECOND TERM	Recursion Using variables	Typing tutor		'Diagonals' 'Magic squares' 'Square' Dis-time graphs		procedure sound
THIRD TERM	Recursion Using variables	Typing tutor		'Lines' 'Mtalk2' 'Tiles' Area		Graphics Re-designing character

PROBLEM SOLVING	WORD PROCESS.	ROLE OF COMPUTERS	ADVENTURE	HAND/EYE	ENJOYMENT	
'XOR' 'Repton'	'View Sheet'	Business simulation 'Stokmark'	'Hitch-hiker'		'Elizabet. Court	
'XOR' 'Repton'	'View Sheet'	Business simulation 'Stokmark' 'Telemark'	'Doom!'			
'XOR' 'Repton'	'View Sheet'	'Flight Simulator' Role of simulators	'Hulk'			