South African Elementary School Learners' Perceptions of Computers as a Technology; with Particular Reference to Learners from Economically Disadvantaged and Historically Disenfranchised Backgrounds

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Dissertation submitted in compliance with the requirements for the Master of Technology (Education) degree in the Department of Education, Faculty of Arts at the Durban Institute of Technology

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Reference declaration in respect of a Master's Dissertation

I, Hintsa Zwelinzima Mhlane
(full name of student)

and, Julia Judith Prosser
(full name of supervisor)

do hereby declare in respect of the following dissertation:

SOUTH AFRICAN ELEMENTARY SCHOOL LEARNERS' PERCEPTIONS OF COMPUTERS AS A TECHNOLOGY; WITH PARTICULAR REFERENCE TO LEARNERS FROM ECONOMICALLY DISADVANTAGED AND HISTORICALLY DISENFRANCHISED BACKGROUNDS.

(1) as far as we know and can ascertain:

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ABSTRACT

The purpose of this research study was to establish firstly, whether elementary school learners from previously disadvantaged communities do have negative perceptions towards computer technology and if these perceptions exist, to what they may be attributed. Secondly, there is a need to provide research-based approaches to the use of computers in education, particularly in the delivery and support of the curriculum. The international education community considers computer technology as a panacea for solving most of the epistemological and operational problems currently beleaguering the education enterprise.

The development of learner perception should not be viewed in isolation but rather in the context of the two environments that the elementary school learner is exposed to; home and classroom. These environments are determined, largely, by socio-economic conditions, societal values, educational ideology and classroom praxis. The above determinants are fundamental in shaping the elementary school learner's perception of the learning process in general and the use of computer technology in the learning process in particular.

Since the early 1970s, a myriad of teaching and learning programmes known as computer-assisted instruction (CAI) and computer-assisted education (CAE) have been developed. Furthermore, computer technology has been used extensively as a pedagogical tool in a number of numeracy and literacy programmes. As a result of these developments it has become necessary to initiate serious research into Technology Education, in general, and the use of computers in education, in particular.

As an educational field, Technology Education[1] is relatively new (no more than forty years) and thus lacks well-grounded research and knowledge. Firstly, Technology Education needs to develop both a distinct body of knowledge and a unique pedagogy and this includes the scientific study of computer technology. Secondly, the appropriate use of computers as a pedagogical tool has continuously eluded the education community.

Computers are a critical component of the Technology Education academic discourse, in terms of their use as a teaching and learning resource and in terms of teaching and learning about how they function, yet very little is known about how learners' perceptions and attitudes towards them are both shaped and influenced. It is hoped that this research study will contribute towards an answer to this question and further contribute to the provision of a quality education that will lead to social development and a better life for all the citizens of the country

[1] Technology Education is the teaching and learning of Technology or an educational field aiming to cultivate technological thinking and doing. This implies the enhancement of cognitive, affective and practical capabilities involved with the various aspects of technological problem-solving, including needs assessment, planning, implementation, measurement and improvement.

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ACKNOWLEDGEMENTS

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GLOSSARY

The following list provides meanings and definitions of some of the words and concepts that have been used in the dissertation. Beyond this, the glossary is intended to eliminate ambiguities in respect of the context in which such words or terms have been used, and/or referred to.

African ⇒ defines that group of South African citizens who are indigenous/native to the African continent

Black ⇒ refers to ethnic minorities in the United States, these are usually people of African and Hispanic origin
or
a heterogeneous group of South African people who are either African, Coloured or Indian, as defined by the South African Population Registration Act 81 of 1996

deficit theory ⇒ a belief or tenet that a person's lack of intellectual development (real or perceived) is due to either of the following factors: language, culture, racial or ethnic origin or the socio-economic background from which the person comes

elementary school ⇒ a phase of formal schooling which includes educare, pre-primary and primary education; in South African education these are referred to as Early Childhood Development, Foundation Phase and Intermediate Phase

independent school ⇒ a South African school that is established and funded privately; it is usually set up by a private organisation but is subject to the same education acts that regulate state schools

ICT ⇒ an acronym used for information and communication technologies

information technology ⇒ the study or use of especially computer and/or telecommunication systems for storing, processing, retrieving and transmitting information

NEPAD ⇒ New Partnership for Africa's Development

science ⇒ the intellectual and practical activity encompassing the systematic study of the structure of the physical and natural world through observation and experiment

Science Education ⇒ the teaching and learning of science

scientific method ⇒ a method of procedure that has characterized natural science since the 17th century, consisting of systematic observation, measurement, and experiment and the formulation, testing and modification of hypotheses

state school ⇒ a school that is established, funded and administered by the government's education authority

technology(ies) ⇒ all the ways people use knowledge (scientific or lay), inventions and discoveries to satisfy their needs, desires; systems, contraptions or artefacts developed from such knowledge; or a form of knowledge dealing with engineering or applied science.

Technology ⇒ a learning area in the South African system of education as defined in terms of the South African Qualifications Authority Act 58 of 1995

Technology Education ⇒ the teaching and learning of Technology or an educational field aiming to cultivate technological thinking and doing. This implies the enhancement of cognitive, affective and practical capabilities involved with the various aspects of technological problem-solving, including needs assessment, planning, implementation, measurement, improvement etc.

technological literacy ⇒ a concept used to characterise the extent to which an individual understands, and is capable of using technology. It is a characteristic that can be manifested along a continuum, ranging from non-discernible to exceptionally proficient.

technophobia ⇒ fear of, dislike of or avoidance of the use of new and/or unfamiliar technology(ies).

township ⇒ defines a settlement that apartheid South Africa designated particularly for Africans to live in around a city; these settlements served as labour dormitories for industry

Vocational/Technical Education ⇒ an upper-secondary or tertiary educational frame aiming to prepare well-educated workers at the middle level for employment in industry and other occupational fields.

White ⇒ refers to people of Caucasian extraction in the United States
or
a group of South Africans who are of European or Caucasian descent

CHAPTER 1

THE PURPOSE OF THE STUDY

1.1 Introduction

Technophobia is a major contributor to the fact that large sections of most communities are unable to access information and services. In developed societies, certain technologies are the means by which people access information and services. Examples of such technologies are, among others, information and communication technologies (ICTs) such as computer networks, radio, television, cellular and landline telephones, electronic voice-messaging systems, the internet's world-wide web, vending machines, remote sensors such as satellites and automatic teller machines. Nonetheless, many people are still fearful of some of these technologies.

People's fear of technology creates anxiety, i.e. many people become uncomfortable and anxious when confronted by an unfamiliar technology. This is particularly true for computers. Anxiety negatively affects the manner in which the individual performs during the time when they are using the technology. Evidence of this anxiety in respect of computer technology is confirmed by an article that was published by the Mail & Guardian towards the end of the last century.

> **Researchers in the United States have recently reported that people who spend even a few hours online become more depressed and withdrawn, while investigators into British attitudes to computer use believe up to 25% of the population may be suffering from techno-anxiety.**

The article continues...

> **Psychologist Dr Mark Brosman of the University of Greenwich, who has been studying technophobia in Britain, Hong Kong and Japan, says the buzz and hype that surround the possibilities of the 'connected' world are obscuring the fact that people of all ages have real anxieties using the [computer[2]] technology.**
>
> *Mail & Guardian, February 19 to 25 1999, p.35*

Over the last two decades, computer technology has come to play a major role in people's daily lives. The global reliance on computer technology manifested itself most clearly in what became a very serious international anxiety towards the turn of the millennium. The anxiety was over whether some of the computer systems that were currently being used would, in fact, be able to function properly after midnight of the 31st December 1999. This phenomenon was colloquially referred to as **Y2K**. Research on, and the management of, the Year 2000 compliance of computer systems became the world over a huge and lucrative industry. It was reported that the South African government invested **R1,2-billion** into making computer systems compliant countrywide, while an estimated **R4000-billion** was spent by banks, municipalities, airports and other major service providers world-wide to eradicate the date-related Y2K computer bug (Sunday Times, 2 January 2000). This shows beyond any doubt that computer technology is of enormous social and economic significance and thus cannot be ignored by the country's education system. Nevertheless, the same technology has potential to adversely affect those who use it, as indicated by both the report on the research study on technophobia and the Y2K phenomenon, to which reference was made above.

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[2] Researcher's own addition

1.2 Aims of the Research Study

It is important to remember that the concept of compulsory formal schooling for all, as it currently exists, is a product of the Industrial Revolution. Before the establishment of formal schools, the home was central to the education and development (cognitive, affective and psychomotor) of children. Because industry and commerce fuel the economic development of a society, formal education was made compulsory to serve their needs. The pertinent question is whether the formal school is able to take on the epistemological, philosophical and technological challenges associated with the use of computers in education.

In an attempt to transform and strengthen the education system in post-apartheid South Africa, education authorities introduced a learning area called Technology[3] into the school curriculum. Technology, as both a skills and a knowledge area, is a relatively new entity, not only in the developing world but also in developed countries. In South Africa, very little research has been done on Technology Education which, as an educational field, includes both the study of how computers function and their use in support of the curriculum. This has resulted in a paucity of curriculum support materials such as textbooks, research papers, academic articles and equipment. In an attempt to support the introduction of the learning area, Technology, into the school curriculum, South African education authorities commissioned a number of curriculum research and development projects. Among these was Technology 2005[4], a national Technology Education

[3] This refers to the learning area, Technology, as defined in the National Qualifications Framework within the South African system of education. Technology is broader than Information Technology and computers.

[4] TECHNOLOGY 2005 was commissioned by the national Minister of Education in South Africa, through the Committee of the Heads of Education Departments (HEDCOM), to research the feasibility of introducing Technology Education into the school curriculum.

curriculum development project in which the researcher was involved. The Technology 2005 project was an attempt by the National Department of Education to:

- advocate for and support the introduction and implementation of Technology in the school curriculum;
- create an environment that would be conducive to the construction of both academic and pedagogical knowledge in respect of Technology Education;
- devise strategies for the deployment of curriculum support resources (human, material and financial); and,
- provide a source for learning support material for Technology Education.

Because the researcher was involved with the Technology 2005 process, this research study draws on some of the principles on which that process was based and also attempts to answer some of the questions that Technology 2005 was supposed to address. Among these questions is how computers can be used to enrich the teaching and learning environment. There exists a spectrum of opinion with regard to perspectives on computers and children. At one end of the spectrum, we encounter a rather conservative view that is founded entirely on this most recycled argument that computers are not a panacea to all to the ills of the educational system (Citizens Committee, as cited in Clements, 1985, p.3). Towards the middle of the spectrum is the belief that although computers can do just about anything, they still remain too complicated for the young learner (this would include the elementary school learner) and even teachers. At the other extreme, we encounter optimism that sometimes borders on naivety. Viewpoints become extremely passionate and urgent. The dominant opinion is that the

sooner children are introduced to computers the better. The question becomes where are the majority of our educators and administrators located on the spectrum. Clements (1985) provides a view that aptly describes the situation of elementary school learners:

> **Both the children we teach and the computers we use are so young. They have within them an incredible amount of potential, but to that extent, they are also malleable. Each may scale heights never before reached, or each may fail to do little more than tred** [sic] **tired paths. It is at a precipice that they meet, ready for direction and guidance to fulfil their potential. Those who shall bring them together hold an awesome responsibility, for how they guide one will probably affect the direction and development of the other.**

The philosophy underpinning a good curriculum necessarily takes into account, not only the context within which learners will have to learn, but also both the epistemological and ontological ideologies on which the curriculum will be founded (Mhlane, 1996). The fact that there is no official policy on the deployment of computers in post-apartheid South African schools is very significant. Both the South African national Ministers of Education and Communication jointly launched a "*Strategy for Information and Communication Technology in Education*" only in November 2001, eight years into South Africa's democracy. In the foreword to the document, that was used to launch the ICT strategy, the Ministers wrote:

> **Advances in information and communication technology (ICT) globally are rapidly expanding the learning opportunities and access to educational resources beyond those immediately or traditionally available. It is therefore critical that our education and training system takes advantage of these technological changes. The programme for improving the quality of education cannot be based on 'whether we should introduce ICT in teaching and learning' but 'how we can successfully introduce ICT in schools'.**

> **Given the magnitude of the task ahead of us, it is clear that government cannot do it alone. The public and private sectors need to join hands in ensuring that our children receive high quality learning let us all work together to ensure that our schools have access to appropriate technologies for learning and teaching.**
>
> *Strategy for Information and Communication Technology in Education, November 2001 , p.4*

The ICT strategy is an attempt, among other things, to suggest a framework for the deployment of computer hardware and software into state schools using private-public sector partnerships. It should therefore be mentioned that the strategy goes a long way towards showing the Government's commitment to integrating computer technology into mainstream education. Nevertheless, a strategy is not the same as a policy. While a policy necessarily has to be allocated a budget that supports it, this is not always the case with a strategy.

How learners learn is the key consideration in the development of a curriculum, and research is the most reliable means of understanding that issue. If, therefore, there should emerge compelling research evidence that in order for learners to cope with the current Technology curriculum they will need to have access to computer software and hardware, these will need to be provided unconditionally. Unless this and other related problems are properly addressed, we will not be able to:

> **...ensure that we do not fall behind the rest of the world as a result of the digital divide.**
>
> *President Thabo Mbeki, State of the Nation Address 2001*

Computers are at the core of the information technology revolution and thus, computer technology becomes central to the development of a sound Technology

Education curriculum and a sustainable information and communication technologies regimen. This research project aimed at contributing to the construction of knowledge within the ICT discourse in South Africa in general and the Technology Education curriculum, in particular. The research project's intended outcomes were to:

- identify economically disadvantaged elementary school learners' perceptions of and attitudes towards computer technology;
- investigate the extent to which economically disadvantaged learners are comfortable with computer technology;
- expose elementary school learners to alternative applications of computer technology;
- demystify computer technology for elementary school learners;
- expose those factors that directly influence elementary learners' perceptions of and attitudes towards computer technology and, finally,
- develop and validate an instrument that will reliably assess elementary learners' perceptions of and attitudes towards computer technology.

Unlike science, which has a documented history dating back over 2000 years, the documented history of technology is fairly recent. The most revolutionary technological innovations, such as aviation, television, space travel and computers occurred only in the last century. Research into the epistemological and ontological issues and underlying ideologies will happen with the process of Technology Education and is likely to continue, as it has happened with science, for hundreds of years.

1.3 Rationale for this Research Study

In the South African context, computer education-related problems are further exacerbated by the inequality of access to computer technology. This is particularly true for the majority of South Africans. It would therefore be useful to look carefully into the issue of access to common technologies (or the lack thereof) and how this might influence an individual's disposition towards such technology. This research study intended, among other things, to focus on the situations of elementary school learners, particularly those from economically disadvantaged and previously disenfranchised backgrounds.

As was pointed out above, there is one pertinent question with regard to the introduction and use of computer technology in schools that has either been overlooked, or conveniently ignored. The question relates to the equality of access to computers. According to Sutton (1991), the use of computers in schools increased at an unprecedented rate in the United States between 1975 and 1981. However, along with the rapid increase of microcomputer use in schools, came a concern for the inequality in access to and use of microcomputers (Sutton, 1991). Researchers and practitioners in computer education-related communities did not concern themselves with issues of equity and/or equality of access until the middle of the 1980s. The issue of equity of access and use will be dealt with extensively in the next Chapter. Ironically, the research agenda underpinning research into equality of access was influenced primarily by the effect of the "Nation at Risk" report (U.S. Department of Education, 1983) in the same way that the launching of Sputnik by the Russians in 1957 created panic in the science

education community in the United States. The focus was on the economic and global competitiveness of the United States. As one report on education began:

> **Our nation is at risk. Our once unchallenged preeminence in commerce, industry, science, and technological innovation is being overtaken by competitors throughout the world.**
> *Nation at Risk, U.S. Department of Education Report, 1983*

A number of policy documents published in South Africa since 1994 also refer to the necessity of technological competence for economic progress. This has also been echoed in speeches that the South African president, Mr. Thabo Mbeki, has made both inside and outside South Africa. In 2001 he said:

> **Because of the critical importance of this sector, we will also establish two bodies to assist the government as it works further to ensure that we do not fall further behind the rest of the world as a result of the digital divide.**
>
> **The first of these will be a Presidential National Commission on Information Society and Development (PNC on ISAD). This will be constituted from representatives of our country's public and private sectors.**
> *President Thabo Mbeki: State of the Nation Address 2001*

Furthermore, in Tokyo, President Mbeki said:

> **In terms of Human Development and education, the [ICT] plan supports the immediate strengthening of the university system across Africa, the creation of specialised universities where needed and the creation of specialised institutes of technology.**
>
> **Through this programme we will also seek to accelerate the introduction of ICT in primary schools.**
> *President Thabo Mbeki: United Nations University*
> *Tokyo, Japan; 2 October 2001*

In Oslo President Mbeki remarked:

> **Another important area being addressed under NEPAD is the issue of using Information and Communication Technology to leapfrog the development of the continent forward. In order**

> **for Africa to benefit from the globalisation process and the information age, ICT infrastructure development on the continent is vital.**
>
> *President Thabo Mbeki: University of Oslo*
> *Oslo, Norway; 13 May 2002*

The President's speeches reinforce the fact that science and technology (particularly information and communication technology) are seen as priority areas, not only in education (Mhlane and Mkhize, 1997), but also in the social and economic development of the African continent in general and South Africa in particular. "Technological literacy" has become a buzz phrase and the technology that is emphasised, is computer technology. Hopefully, the primary focus will be to provide individuals with equitable access to technology and the subsequent skills, in order that they may later decide on how to use these and not only on the establishment of a national elite, that is "globally competitive". It is hoped that opinion-makers such as politicians, educationalists, business people and academics share President Thabo Mbeki's vision as encapsulated in his address at Tsinghua University in Beijing, China where he said:

> **Our intention is to develop a pool of ICT-proficient youth and students from which Africa can draw trainee ICT engineers, programmers and software developers and to promote community and user involvement in infrastructure construction, maintenance and management especially in poor urban and rural areas.**
>
> *President Thabo Mbeki: Tsinghua University*
> *Beijing, China; 11 December 2001*

1.4 Limitations of the Research Study

The intention was that this research study should, in some way, be able to address most, if not all of the above matters. However, a research study is only as good

as its design. Consequently, extensive reading was done before and during the course of this research project, as is reflected in the literature review in the next Chapter. There were also discussions with, and inputs from, colleagues, some parents, educators and other researchers before a decision on the research design, and the choice of a research approach were made. This being a new field, the research approach was largely atheoretical and, instead, much more descriptive and fundamentally qualitative. It is no less important to discover more about problems that exist, rather than why they exist (Sutton, 1991).

No attempt was made to interpret the data that was collected during the study in terms of a specific theoretical outlook. The data was instead used to establish a context and provide a perspective that informed the direction and development of the research study. An assumption is sometimes made that researchers, whether novice or experienced, should follow prescribed and relatively unambiguous procedures, irrespective of the context within which the research occurs. That notion might well be valid for certain techniques in the quantitative research tradition, but it would have had a number of serious shortcomings for this study. This dichotomy is addressed comprehensively in a discussion on the "qualitative versus quantitative research" debate that follows later in this Chapter. The reduction of research strategy to a number of discrete steps (e.g. designing a questionnaire, sampling, conducting a structured interview and analysing data) can undermine the essence of the social process, as well as the worth of the ensuing reportage as an academic tool. Research, as a phenomenon, should be a continuous, inter-linked and inter-dependent procedure. Compartmentalising the

research stages, as Burgess (1984) would argue, misrepresents the practice of research and social scientific enquiry. Instead, he suggests that:

> **Recent developments in research methodology indicate that 'methodology' involves a consideration of research design, data collection, data analysis, and theorizing together with the social, ethical and political concerns of the social researcher. In short, research is no longer viewed as a linear model but as a social process. Accordingly, questions now need to be raised about actual problems that confront researchers in the course of their investigations and some consideration needs to be given to the ways in which techniques, theories and processes are developed by the researcher in relation to the experience of collecting, analyzing and reporting data.**
>
> *Burgess, 1984, p.2*

It should also be mentioned that this study was conducted within the constraints of a limited budget and that the research design had to take such constraints into account.

1.5 Context of the Research Sites that were used in the Study

The choice of a site for the research study was critical and, therefore, extremely difficult to decide upon. The research site had to be representative of the majority population in the South African education situation. The researcher was, nonetheless, mindful of the danger that the study could lapse into the "deficit theory syndrome", which has, all too often, characterised educational and social research in South Africa (Breen, 1999).

The researcher has been associated with a number of interventionist projects aimed at putting computer hardware and software in under-privileged schools and has been confounded by the actions of representatives of "big business" when it came to making donations to schools in poor communities. They sometimes

seized the opportunity to "dump" their organisations' outdated hardware on under-privileged schools – and this, usually accompanied by pomp and ceremony, the cost of which often outstripped the value of the donated hardware. Moreover, such actions should be viewed against the absence of a government policy that should regulate and facilitate the deployment of computer hardware and software in state schools.

During his interaction with members of poor communities, the researcher established that a perception existed among them that "big business" is directly responsible for their plight through meagre wages, high prices, lack of infrastructure and poor living conditions. Therefore donations and the accompanying ceremonies were sometimes perceived as condescension, even though that might have been far from the intentions of the organisations concerned. Insistence on lavish and elaborate ceremonies was often a rather unfortunate decision, insensitive and uninformed and usually taken by the organisation's public relations department. It did no more than reinforce a strong view among poor and disenfranchised communities that the rich:

> **...do not perceive their monopoly of having more as a privilege which dehumanises others and themselves. They cannot see that, in the egoistic pursuit of having as a possessing class, they suffocate in their own possessions and no longer are; they merely have. For them, having more is an inalienable right, a right they acquired through their own effort, with their courage to take risks. If others do not have more, it is because they are incompetent and lazy, and worst of all is their unjustifiable ingratitude towards the generous gesture of those who have.**
>
> *Freire, 1972b, p.34.*

The above sentiments have, to some extent, been confirmed by the sort of hardware that large corporations have frequently donated to schools in poor

communities. These tended to be old and outdated computers that could not cope with the demands of contemporary software, while some machines might not even be working. Also, large corporations, although they have the resources, have never committed technical and financial support to the computer systems that they donated, to the same extent that they have provided support to their own systems.

It is also extremely important to bear in mind, particularly in the South African context, that it would be irrelevant to talk about any form of disadvantage outside the context of disenfranchisement. The researcher therefore felt that decision-makers within corporate South Africa (who, incidentally, are predominantly white) and other prospective donors, local and international, should be provided with research-based information to guide their decisions on what they might best donate to schools. It would also be useful to establish how donations could best be used to alleviate the plight of the poor in the country.

A conscious decision was therefore made to locate the research study at the two schools that had computer software and hardware donated to them by the Daily News/McCarthy Retail Education Fund. The two schools[5] were:

- Ikusasalentsha Combined Primary School at Inanda, north-west of Durban and
- Ekukhuleni Senior Primary School in Lamontville, south of Durban.

[5] The computer laboratories in these two schools were donated by The Daily News/McCarthy Retail Education Development Fund after an intricate selection process that all short-listed schools had to undergo.

Both schools served relatively similar communities, i.e. poor and unemployed, and were, therefore, very similar as research sites. The proposed research methodology was experimental in its approach and the plan was that one school would be used as an experimental site and the other as a control site. Ikusasalentsha Combined Primary School was chosen to be the experimental site, while Ekukhuleni Senior Primary School was the control site. The decision as to which school was to be the experimental site and which the control site, was arbitrary.

It should be mentioned that in December 1998 the computer laboratory at Ekukhuleni Senior Primary School was burgled and most of the computer equipment was stolen. Some of the equipment was subsequently recovered with the help of the local community. The fact that one of the schools was broken into during the course of the research indicated the sort of challenges that the research project faced.

As the project continued and processes unfolded, it became obvious that an ethnographic approach was the most appropriate research methodology for this particular research study. A mere comparative study of these two schools was likely to produce very little useful data and/or information, other than what was already common knowledge. On the other hand, it was felt that the naturalistic and exploratory character of an ethnographic approach would provide insight into the teaching and learning processes at various levels in these two institutions. The study sought to describe events, from classroom to community and, finally, at the level of the education system. The ethnographic approach is less

positivistic in that it is more qualitative than quantitative, is descriptive rather than explanatory, explores relationships rather than proceeds from precise definitions, employs naturalistic rather than controlled experiments and leads to hypotheses rather than tests them. The ethnographic approach seeks to understand processes and events through the eyes of those involved and not necessarily the eyes of the researcher. In this particular case those involved would be the learners, the educators, the community around the school and the donor community. Fetterman (1988) argues that:

> **One need only scratch the surface of the qualitative/ quantitative debate to understand that the terms 'quantitative' and 'qualitative' are in themselves misleading. They are commonly accepted handles for both the contrasting paradigms and the methods associated with them.**

As the study progressed, a further decision was made to introduce other research sites into the process. The change in strategy was influenced by the realisation that it would be revealing to establish how Ikusasalentsha and Ekukhuleni compared, not just to each other, but to other schools that were located within quite different economic, social, epistemological and ontological environments. It was at this point that other schools were considered and approached to participate as research sites. This decision was further necessitated by the frequent burglaries at both schools.

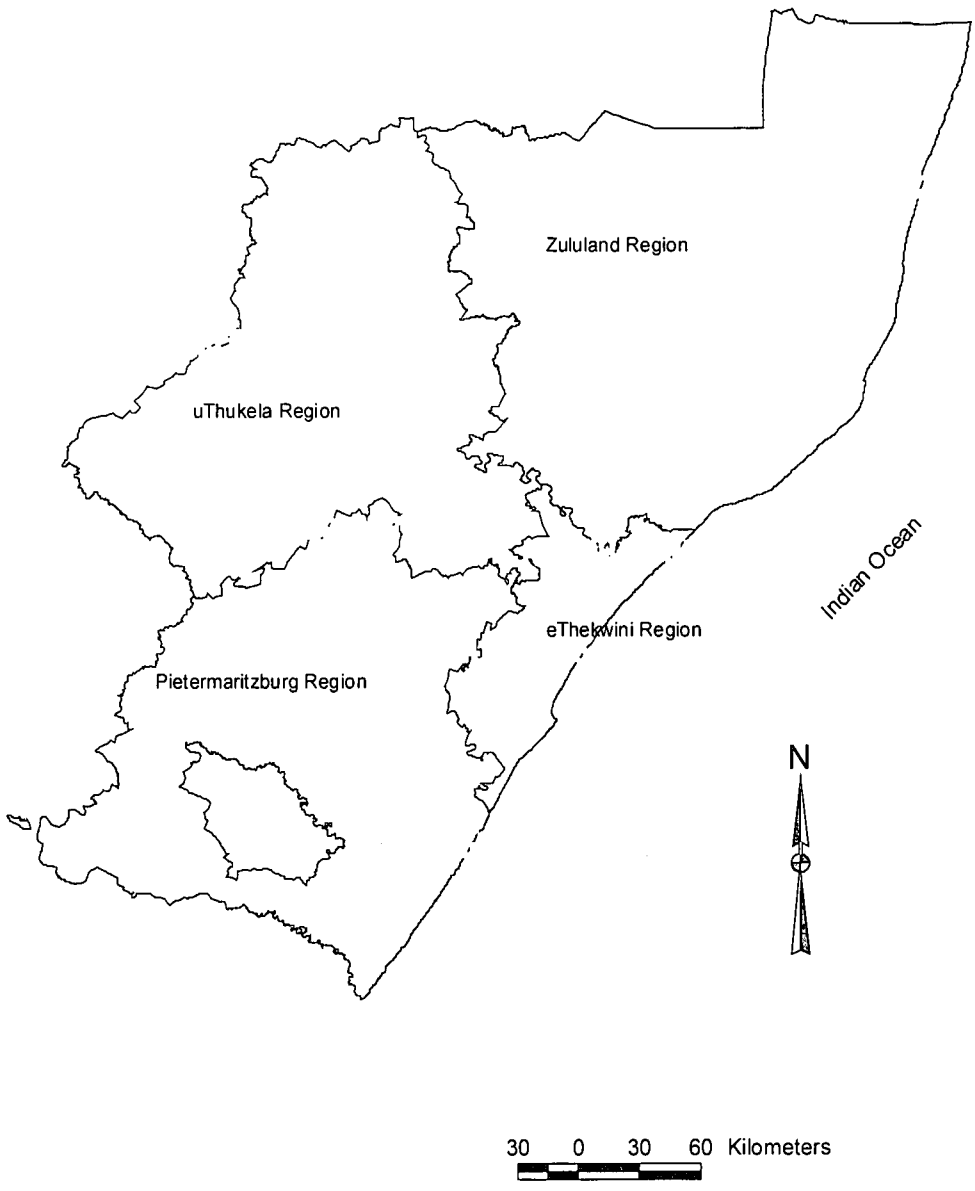
Crawford Preparatory School was one of the schools that the researcher approached to participate in the research study. Contact with Crawford Preparatory School had been established through the principal of Crawford Pre-primary School, who had worked with the researcher on another Technology

Education project concerning the professional development of educators. The developmental nature of educational ethnography facilitated the inclusion of yet three other schools in the research project. These were Nizam Road Primary School in Merebank, Durban, St Wendelins Primary School in St Wendelins, Pinetown and Lyndhurst Primary School in New Germany, Pinetown. These schools were chosen on the basis that they belonged to the former three dominant education authorities of South Africa's apartheid administration, these being the House of Delegates, the Department of Education and Training and the Natal Education Department respectively. These three former departments of education had been the dominant recipients of apartheid education funding in the Province.

Before proceeding, it would be valuable to provide profiles for all six schools that were used as research sites. Also, it is necessary to provide background information on the structure of the KwaZulu-Natal Department of Education and Culture (KZDEC), which is the provincial education authority that presently administers these schools. The data in the following 12 pages is intended to provide the reader with geographic and demographic information on the six schools that were used as research sites during different stages of the research project. Also, recent photographs of each of the schools' computer laboratories were intended to provide the reader with an unambiguous profile and character of the particular research site.

Figure 1.1

Map of KwaZulu-Natal, showing the Department of Education and Culture's administrative regions
(courtesy of the KwaZulu-Natal Department of Education and Culture's Education Management Information Systems)



Ikusasalentsha Combined Primary School was a peri-urban state school situated at Inanda-Newtown Section C, about 30km north-west of Durban. The school served a typical township[6] community and two sprawling informal settlements: one called Bhambayi[7] , to the north of the M25, an arterial road which linked the greater Inanda area to Durban and the other called Ezimangweni, situated to the south-west of the M25. Ezimangweni nestled between the Shembe Village to the west and Sections A, B and C of Ntuzuma to the south-east.

Figure 1.2

Figure 1.2a

An educator setting up computers in the computer laboratory

Figure 1.2b

Security measures at Ikusasalentsha computer centre

Figure 1.2c

A typical work station

Figure 1.2d

A view of the room from the door

[6] A township is, in the South African context, a suburban residential area that during the apartheid era, was zoned via legislation, for members of the black population to reside in. Townships were dormer suburbs for labourers.
[7] Bhambayi was one of the flashpoints at the epicentre of the political violence that ravaged the Province of KwaZulu-Natal in the early 1990s.

Ekukhuleni Senior Primary School was a state school in a high population density inner city settlement known as Lamontville, situated in the Durban south industrial basin within 10km of the city centre. The school was situated within a very poor and crime-ridden community. Figure 1.3a shows a hole in the ceiling through which criminals entered the computer laboratory to steal the equipment. After the burglary, only the four monitors and three keyboards seen in Figure 1.3c remained. The school has since converted the computer laboratory into a classroom for teaching science (cf. Figures 1.3b and 1.3d).

Figure 1.3

Figure 1.3a

A hole in the ceiling made during a burglary

Figure 1.3b

Science equipment and chemicals used for teaching science

Figure 1.3c

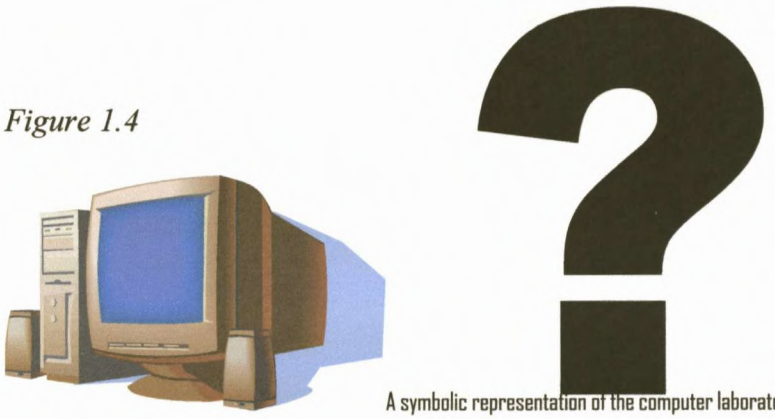
Equipment that remained after most recent the burglary

Figure 1.3d

A view of the room from the door

Crawford Preparatory School was an upper middle-class independent (private) school situated in La Lucia, 11kms from Durban's central business district. The school is a component of the Crawford educational complex that comprises an educare facility, a pre-primary school, a preparatory school and a further education and training college (that includes a pre-university facility). Crawford Preparatory School services six of Durban's most opulent suburbs viz. La Lucia, Durban North, Glen Anil, Glenashley, Sunningdale and Umhlanga Rocks.

Figure 1.4



A symbolic representation of the computer laboratory at Crawford Preparatory School

The researcher was unfortunately not permitted to take photographs of the computer laboratory at Crawford Preparatory. Independent schools are operated according to strict business principles. There are certain aspects of the school that are considered "intellectual capital", and the computer laboratory was one of these. The management of the school felt that the school would be prejudiced if other independent schools had access to the photographs. The researcher respected the school's decision and was grateful for the school's unconditional participation in the exercise.

St Wendelins Primary School was a peri-urban junior primary state school situated at a settlement, known as St Wendelins, south west of the city of Pinetown. St Wendelins was a mission station that had been established by the Catholic Church over 150 years ago. The school served a working class community who sold their labour in the many industrial townships around the settlement. The area was experiencing rapid development and urbanisation. The school was fairly new, as it was only opened in 2000. The computer laboratory in the school was financed by the parents through the school's governing body. Learners were exposed to computers during Technology lessons.

Figure 1.5

Figure 1.5a

Learners working in groups around work stations

Figure 1.5b

An educator walking around helping learners during a lesson

Figure 1.5c

A close up on a typical work station

Figure 1.5d

Learners, discussion during a Technology lesson

Nizam Road Primary School was an urban, state primary school that was situated in a high-density, formerly Indian, urban settlement called Merewent, in the Durban South industrial basin. The school was situated next to an oil refinery that was one of the large industries providing employment to people living in the area. Merewent is a working class community. The parents, through the school's governing body, established the computer laboratory at the school. The educator, who taught Technology at the school, was paid by the school's governing body and had no educational qualifications.

Figure 1.6

Figure 1.6a

The arrangement of the work stations in the room

Figure 1.6b

A view of the room from the door

Figure 1.6

A close up of a typical work station

Figure 1.6d

Two different brands of processors and monitors and keyboards

Lyndhurst Primary School is a state primary school situated in a middle-income suburb called New Germany in Pinetown. The school has a state-of-the-art computer laboratory that was donated to the school by the family of an educator who, while employed at the school, died in an automobile accident. According to the Technology educator at the school, it costs Lyndhurst Primary School up to R40 000 per year to maintain the computer laboratory. The school charges fees of up to R4 000 per learner, per annum. Although this is a state school, its fees make it relatively expensive by South African standards.

Figure 1.7

Figure 1.7a

A name plaque in honour of the family that donated the laboratory

Figure 1.7b

A view of the room from the door

Figure 1.7c

A view of the room from the back

These schools were microcosmic societal, economic, political and educational representations of contemporary South Africa. The study had to take into consideration the educational, social, economic and political realities of the country, which were inter alia:

- the socio-economic divide between the rich minority and the very poor majority;
- the typical[8] (as applicable to the majority of the population) South African elementary classroom as a teaching and learning environment;
- the lack or absence of a culture of teaching and learning[9] in some South African schools;
- the contrasts between home and school environments in the majority of South African communities;
- the lack of infrastructural support – i.e. computer hardware, educational software and locally-developed learning and teaching support material;
- the paucity or absence of resources (human, material and financial) to support education meaningfully in most South African schools and
- the security problem, bedevilling South African schools.

Profiles of the schools indicated the social, economic and educational context of the research site. It is, however, very important to mention that given all the above attributes, any of which could have indicated appropriateness, the chosen

[8] Refer to extracts from the HSRC, Education Foundation and MIET consortium's School Register of Needs Database for the Province of KwaZulu-Natal. The study was conducted in 1996 and was commissioned by the National Department of Education.
[9] The National Department of Education commissioned a number of educational programmes to the South African Broadcasting Corporation (SABC) to raise awareness on the culture of learning and teaching and service in schools in support of a campaign that was colloquially known as COLTS. After extensive research, the SABC in 1999 broadcast a drama series that was entitled YIZO YIZO. The drama portrayed a lack of a culture of teaching and learning in particularly urban, historically African township schools. The television production attracted cult-following, criticism and controversy. The producers however maintained that the characters and events had been based on properly researched, real-life incidents.

research site also had to be educationally functional; it would have been meaningless to conduct this research study in a school that was dysfunctional, no matter how fitting the contextual profile of the school was. Also, the ethos in the chosen schools made them ideal as primary research sites, as did the rapport that the researcher had previously established with the educators and school management.

The advent of computers has had significant implications for both the job market and education. This is, despite the fact, that computers do not, as yet, form part of the core of the South African education curriculum. Technophobia, as it exists worldwide, is largely synonymous with "computer-phobia" because many people are unfamiliar with computers and anxious about the impact they will have on their lives (Jay, 1981). Computer-phobia manifests itself in negative attitudes towards computers and this can have a great effect on an individual's ability to master some of the skills that are associated with computer technology (Levine and Gordon, 1989).

All the aforementioned determinants formed the bedrock of this research project, its purpose being to interrogate these issues within a typical South African context. However, this particular study related to, and relied heavily on, similar research that took place elsewhere and which was acknowledged where applicable. As far as possible, the study drew parallels with issues that are either socially endemic, or educationally significant. It was intended that this study should bring to the top of the research agenda many of the critical issues regarding computer technology in education in particular and within society in

general, given that all successful world economies – e.g. Ireland, Finland, the United Kingdom, the United States of America, to mention but a few – have shifted from being mainly industry-based to being driven by information technology.

1.6 Conclusion

Conventional wisdom has it that human resource development is the basis of the superstructure that determines the socio-economic development of a people, and ultimately, a country. The quality of life afforded by a society is directly and positively related to the extent to which its people understand and effectively use existing technology, as well as creatively develop new technologies, while taking into account key scientific, economic, social and ecological aspects (JISTEC, 1996). All six intended outcomes of this research project, viz. to:

- identify economically disadvantaged elementary school learners' perceptions of and attitudes towards computer technology;
- investigate the extent to which economically disadvantaged learners are comfortable with computer technology;
- expose elementary school learners to alternative applications of computer technology;
- demystify computer technology for elementary school learners;
- expose those factors that directly influence elementary learners' perceptions of and attitudes towards computer technology; and, finally,
- develop and validate an instrument that will reliably assess elementary learners' perceptions of and attitudes towards computer technology;

were chosen with the intention that elementary school learners, as future citizens of this country, should not only understand how to use computer technology, but that they should use it effectively and creatively in providing solutions to existing problems and adapting such solutions to solving similar problems in other areas.

The acid test for any research and development project is its ability to impact positively on the technological, scientific, educational, social, ecological, economic issues that it is intended to address. It is hoped that this research project was able to make that contribution.

1.7 Summary

This Chapter began by looking at the impact of computer technology in present day society. The discussion further presented the aims of this research study and its location within the current debate on information and communication technologies in education, in this particular instance, computers in education.

The researcher put forward the six intended outcomes of this research study and further discussed a rationale for undertaking a study of this kind within the transformational context in South African education.

Finally, the limitations of this research study were declared and the profiles of the six schools that participated in this study were presented. The profiles included the most recent photographs taken inside the school's computer laboratory.

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CHAPTER 2

WHAT INFLUENCES PERCEPTION

2.1 Introduction

There exist two distinct research and development ideologies (associated with computer technology) that are situated in the commercial and industrial sector and in the education sector, respectively. In the commercial-industrial community, computers are seen purely as labour-saving devices. This is reflected in the commercial-industrial approach to the research and development of systems (software and hardware) which has been largely instrumentalist. In this sector, the purpose of developing computer software and hardware has always been to increase speed, as well as the capacity to handle large volumes of data.

Research and development of computer software in the education sector, however, has been humanistic in its approach. Education-related research and the development of computer systems has been geared mainly towards the development of "thinking" systems, which simulate the functioning of the human brain; hence the development of *artificial intelligence* as a cognitive science. The education community has put a very high premium on the role of computer technology in education that goes the beyond the simple bounds of speed and capacity. Also, the education community has considered issues of how learners perceive computer technology and their subsequent attitude towards it to be significant.

For these reasons, some people in the education community tend to have a high regard for computers and this sometimes stems from their lack of a basic understanding of how computers function, what they are capable of and what their limitations are. Among these people, who have tremendous influence on the development of the elementary school learners' perceptions of issues, are educators, administrators, parents and peers. Naturally their opinions with regard to computers and their use in education and elsewhere, are bound to have an influence on the elementary school learner's perceptions of computers as a technology, no matter how misguided these opinions may be.

2.2 The Popular Media

It is a fact that most of the entertainment products that are consumed in the developing world come from the United States of America. It is also a known fact that American[10] society is highly commercialised and its commercial values have been built, deliberately, into most of the products that America exports. American entertainment products, e.g. films and television, carry with them subliminal messages that are intended for the consumer. In the 1960's through to the 1970's the American cigarette industry used films as an effective marketing tool to advertise cigarettes in order to capture the large and lucrative youth market. It was no coincidence that in all the films that came out of Hollywood during this time, film stars smoked particular brands of cigarettes. In the United States, a recent manifestation of this advertising phenomenon is seen in how manufacturers of particular brands of cross-training shoes and clothing have used

[10] This refers to the United States of America

the National Basketball Association and rap music to market their products. These shoes and clothes have tremendous appeal to adolescents between the ages of eight and thirteen. South African youngsters are also exposed to these fashion trends by watching television, music videos and American films. It is not uncommon to find these youngsters dressed in thick baggy t-shirts, chunky cross-trainers and heavy body warmers even though these clothes are extremely uncomfortable in the South African climate. South African youngsters (and this includes elementary school learners) dress up in this manner to imitate popular basketball players and rap artists who, in terms of an image that the popular media creates of them, are not only sport and music icons, but trendsetters, role models and heroes.

The popular media has recognised the tremendous marketing potential that is a consequence of the awe and prestige that are associated with artificial intelligence and computers. The popular media has turned this notion into another powerful marketing tool. Recently, in most television productions, like situation comedies that come out of the United States, there is always a laptop computer that is part of the props in the set, or one that a character in the production is conspicuously made to work on. On local television, we have seen how continuity presenters and newsreaders appear on camera with laptop computers on their desks. However, at no stage during the broadcast do they refer to or use, the computer. The laptop computer is there as part of the broadcasting studio décor.

Further evidence of the successful commercialisation of the prestige that is associated with artificial intelligence can be seen in the increase in the number of

babies' and children's toys that look and operate like desktop or laptop computers. What is of great concern, however, is the tendency of parents to push their children into using computers just because they are fashionable. The results of a research study[11] that was published in the Mail & Guardian in February 1999 show that young children in Britain are increasingly becoming computer-phobic because of the pressure parents put on them to use computers. There exists an opinion within the information society that computers are a fundamental determinant of a new and inevitable social order (Dowling, 1991). If computers can solve problems in education, according to research studies, this usage will have to be integrated into the school curriculum. Computer technology cannot be treated as an extra-curricular activity. The technology and the manner in which it is used will have to be seen and understood from the perspective of the end-users, in this particular instance, elementary school learners. Unfortunately this has not always been the case.

2.3 The Socio-economic Environment

The potential of cognitive benefits that is associated with computer technology has been responsible for much of the attention that the technology has received in education (Chen, 1986). However, the fact that advantages offered by computers will not accrue equally to all socio-economic groups is an area of serious concern. It does appear that in South Africa, as is the case in all developing countries, this important educational tool raises some distinctly familiar questions of equity both in availability and use (Becker, 1985; Rogers et al., 1982). The

[11] Mail & Guardian, February 19 to 25 1999, p.35.

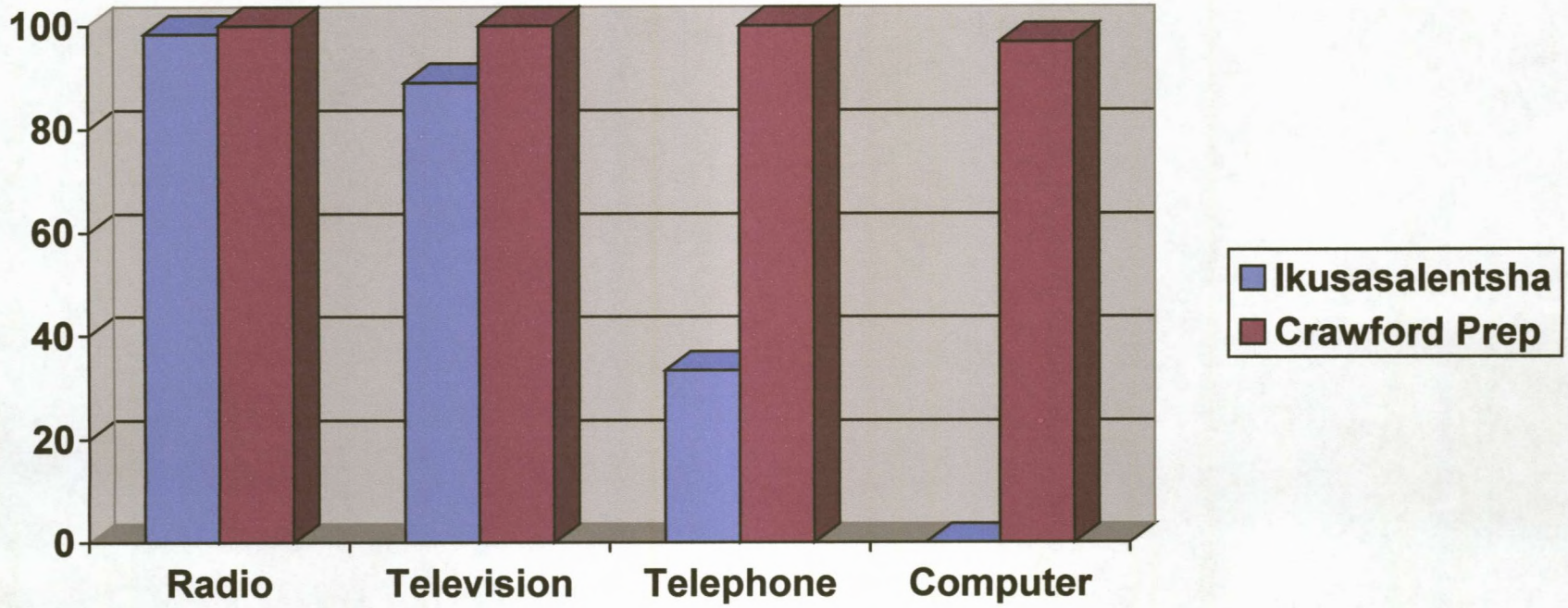
"inequity faultline" occurs along the social divisions of wealth and gender. The issue of gender will be discussed separately in the section on societal values.

Computers require substantial investment (Chen, 1986) in terms of setting up the infrastructure and the continued maintenance of that infrastructure. In South Africa, the province of Kwazulu-Natal alone has over 6000 schools. It would have cost the province R15 billion to set up a laboratory with 25 networked computers in each school. This cost would have excluded maintenance, software and hardware upgrades, learning support software, educator professional development and other allied expenses. It is therefore not surprising that South Africa does not, as yet, have a policy on computers as a technology that supports education in the school (*cf. Chapter 1, pp.5-6*).

However, recent studies – including the South African School Register of Needs, 2000 – indicate, quite predictably, that schools and homes, with a higher socio-economic status, have already adopted computer technology. This is confirmed by a comparative survey that the researcher did at Ikusasalentsha Combined Primary (a comparatively disadvantaged school that participated in the study) and Crawford Preparatory School (an affluent independent school that participated in the study) on the availability of information and technological devices in elementary school learners' homes. The snap survey revealed that **none** of the 63 learners, who were randomly sampled at Ikusasalentsha, had access to a computer outside of school. At Crawford Preparatory, only **1** learner out of the 32, that were sampled, did not have access to a computer at home (*cf. Chart 2.1*).

Chart 2.1

Comparison of the Availability of Different Technological Devices in Learners' Home Environments



In South Africa, learners from poor, working class backgrounds have virtually no access to computers outside of school, compared to their middle-class counterparts. Comparative studies done in the United States have also revealed that the purposes and ways of using computer technology vary considerably between rich schools and poor schools (Sutton, 1991). In South African education, although no documented evidence exists, the researcher's experiences point to a direction that is similar to that in the United States. The researcher's experiences are that in poor, historically African schools computers, where these are available, are used mostly for drill and practice, while in affluent, historically white schools computers are used largely for more challenging tasks such as programming and computer-assisted design.

Sutton (1991) argues that elementary school learners from poor backgrounds gain most of their experience with a computer when the computer is in control asking questions, expecting a response and informing the learner when he/she is correct. By contrast, learners from affluent backgrounds gain considerable experience when they are in control, giving the computer instructions and observing the consequences of those instructions. This was corroborated by how differently Ikusasalentsha and Ekukhuleni used computers in education when compared to Crawford and Lyndhurst. This differential use of computers, as an educational technology, is consistent with established beliefs (Doyle, 1991) that learners must first show mastery of basic processes before they can be exposed to higher order learning (Laboratory for Comparative Human Cognition, 1989), further confirming the discriminatory notion that learners from poor socio-economic backgrounds are deficient in the basics compared with their counterparts from

affluent backgrounds (Herrnstein and Murray, 1994). Unless major school curricular reorganisation occurs, computers (as has been the fate of many other technologies before them) will continue to be used in a manner that reflects conventional practice and separatist ideology. Both these factors have a significant bearing on how elementary school learners relate to computer technology.

2.4 Societal Values

Present-day society is highly computerised. In an attempt to better prepare children for a highly computerised society and to create positive attitudes towards computer technology many educational systems have, to a greater or lesser extent, introduced computer education into their curricula (Levine and Gordon, 1989).

> **For children to feel that computers are approachable, that they are machines rather than frightening beings, children must have an early and frequent contact with computers.**
>
> *Bitter & Watson, 1983, p.136.*

> **It is in the elementary grades, perhaps even among preschoolers, that computers may ultimately challenge and radically alter traditional instructional modes.**
>
> *Martin, 1981, p.41.*

The drive to prepare children for a computerised society seems to have brought with it a number of unforeseen problems, associated mainly with an inequitable exposure, based on gender, to computers. The inequity in computer use is not necessarily a case of boys being more successful than girls in computer courses. In two separate studies, Webb (1985) found that girls performed as well as boys in computer programming courses. Inequity in computer use and differences in

attitude between male and female learners (usually in favour of males), is a result of society's reinforcement of sexual stereotypes (Sanders, 1984). Shashaani (1994) argues that while the gender gap in academic achievement in areas such as mathematics, which has always been a male dominated discipline, has slightly improved, the same cannot be said of computer-related fields where female involvement has declined. Also the female drop-out rate in computer science related studies has increased in most universities and colleges in the United States (Leveson, 1991).

Men have always outnumbered women in the traditionally male fields such as engineering, computer and information science, mathematics and physical science. Women have always dominated in education, psychology, home economy and languages (Shashaani, 1994). Young learners who grow up in these environments will be influenced by these stereotypes. Their career choices later in their lives are likely to be modelled on adults who, in some way, were involved in their lives. These could be parents, teachers or family members.

The Table on the following page compares male and female participation in selected fields of study. Although the research study, on which the Table is based was done over fifteen years ago, it can be argued that the situation has hardly changed from what it was then. Gender stereotyping has generally affected the plight of female learners adversely and family tradition also plays a prominent role in affirming gender-typing. Parents, no matter how sophisticated their backgrounds, frequently purchase computers and computer games for their sons and not necessarily for their daughters (Lockheed et al., 1983). Many

societies are generally patriarchal and so it is the father who will, more often than not, purchase and place computers in the home. This makes fathers *de facto* primary agents in encouraging the use of computers at home. In the process of helping their children, fathers offer the model of a gender-typed computer user. In the process, they will unconsciously tend to encourage their sons more than they do their daughters (Eccles et al., 1982; Jacobs, 1991).

Table 2.1

Percentage Distribution of Earned Degrees in Selected Fields by Sex and Level of Degree (1986) in the USA.

Field of Study	Doctorate		Masters		Bachelors	
	M	F	M	F	M	F
Engineering	93	7	87	13	86	14
Computer and Information Science	**87**	**13**	**70**	**30**	**64**	**36**
Mathematics	83	17	65	35	54	46
Physical Science	83	17	76	24	73	27
Home Economy	25	75	12	88	93	7
Foreign Language	41	59	30	70	72	28
Education	47	53	27	73	24	76
Psychology	48	52	35	65	31	69

Source: Fact Book on Women in Higher Education by J.G. Touchton and L. Davis (1991)

Learning institutions such as schools, colleges and universities also play a role in reinforcing the belief that computers are in the "masculine domain" (Wajeman, 1991). Female learners sometimes experience very subtle and covert discrimination in school which makes them think that computers are a male preserve.

> **The culture of the school is involved in constructing gender and sexuality through the "hidden curriculum" – teaching in an implicit way meanings and behaviours associated with femaleness and maleness, with femininity and masculinity. Studies of classrooms show that teachers behave differently to boys and girls, they speak to them differently, they require different responses and different behaviour from them.**
>
> *Wajeman, 1991, p.152.*

Educators, who come from the same society as these learners, bring their own sexist attitudes and belief systems. Because of this, albeit unconsciously, they will tend to provide more opportunities for male learners to learn and use computers (Kiesler et al., 1985). Research has provided empirical evidence that there exists "a positive relationship between females' low-self-confidence in using computers and perceived educators' beliefs that computing is more appropriate for males" (Shashaani, 1993).

Software designers and developers are sometimes guilty of producing gender-typed computer software. Computer games and some educational programmes have been designed to appeal to boys without any consideration as to how the same sort of software could motivate girls. It should, however, be mentioned that computer hardware and software are not inherently gender-biased. Both gender-imbalance in using computers and gender-discrepancies in attitudes towards

computers are social constructions (Shashaani, 1994). This means that in order to retain gender-equity in computing, the attitudes of those people who have responsibility in rearing and educating our children must be changed.

Other societal influences are subtle, less obvious and abstract but they, nonetheless, impact significantly on perception. There is general agreement that there is a relationship between social relations and technological design and that this relationship further extends to how technology is used. According to Noble (1977) explanations of this relationship derive, to a greater or lesser extent, from the concept of technological determinism wherein technology is considered to be an independent variable that affects changes in social relations. It is believed that technology (including computer technology) has its own immanent dynamic development path that follows a single-course track. Further, it is an irreducible first cause from which social effects automatically follow and these effects are commonly called its "social impact" (Noble, 1991).

It can be shown...

> **That technology is not an autonomous force impinging upon human affairs from the "outside", but is the product of a social process, a historically specific activity carried on by people, and not others, for particular purposes.**
>
> *Noble, 1991, p.13.*

In the design, development and deployment of technology, there are always possibilities and alternatives that those, with the power to choose, will make. These choices reflect their intentions, social position, ideology and relations with other people (Noble, 1991). The choices are guided by beliefs that these

individuals hold about children, teaching, learning, curriculum, technology and other facets of education.

When beliefs are used to develop, guide and evaluate an educational programme they are referred to as "educational principles" (Clements, 1985). The following are some examples of educational principles that could be used by elementary school educators when using computers in their classes (Clements, 1985):

- there are situations in which computers should be used and there are situations in computers should not be used;
- priority should be given to computer applications that place children in the role of active learners with some control over their educational environment;
- both experiential and drill programmes are beneficial. However, learners should receive as much practice as possible in the context of higher-level experiences;
- children's preferences should not be the only basis for curricula decisions;
- child development should be the guideline;
- learners should experience a wide variety of computer applications;
- computer activities should be integrated into the curriculum;
- children can and should use computers meaningfully in ways that facilitate their intellectual, social, emotional and creative growth;
- every computer lesson should be consonant with the overall principles of the educational programme;

- learning with computers should be a means to achieve educational goals, not an end;
- the educator is the key to successful use of the computer.

2.5 The Effect of Prior Computer Experience in Shaping Computer Perceptions

A number of empirical studies have reported that ***access*** to the computer in the home significantly influences performance and achievement in computers (Shashaani, 1994). In a survey conducted by Nichols (1992) on 96 Grade 2 learners and 75 Grade 5 learners, home computer owners outperformed those who did not have computers at home, on both LOGO and Basic post-test scores. Miura (1986) found that learners who had computers at home were more interested in pursuing further computer-related studies. This means that such learners' dispositions towards computer technology and computer study was more positive compared to their counterparts, who did not have computers in their homes. Chambers and Clarke (1987) also confirm this fact. Their study investigated the computer attitudes of 951 elementary and secondary school learners. They reported that disadvantaged learners, "those who were less likely to have a computer at home, or access to computers outside class time, and were less likely to have a written computer program", showed less positive attitudes towards computers. They further reported that those learners, who had had experience with computers prior to coming to class, participated actively in computer-related learning activities, unlike their counterparts, who lacked such experience. According to Koohang (1989), it is not only prior computer experience that is related to attitudes towards the technology, but the nature of the computer experience was also a significant factor.

2.6 Conclusion

Elementary school learners' perceptions and attitudes towards computer technology are influenced and directed by the manner in which it is initially introduced to them and subsequently, the way in which it is used. There has been an international groundswell in support of the use of computers as an educational resource both within formal and informal education. Despite this, very little is known about how computer technology is actually introduced and subsequently used in the classroom. Also, we know very little how both the manner in which computer technology is introduced and the way in which it is used interact with the social processes of classroom environments, particularly elementary classrooms (Cochran-Smith, 1991). It is a fact that computer technology has been used in a particular manner in schools. What is not known, however, is whether the manner in which computer technology has been used has been successful, effective and efficient in achieving the intended educational outcomes. In terms of the National Curriculum Statement[12], the South African education system has seven critical and three developmental outcomes. The seven critical outcomes envisage learners who, at the end of their learning, will be able to:

- identify and solve problems and make decisions using creative and critical thinking;
- work effectively with others as members of a team, group, organisation and community;

[12] Revised National Curriculum Statement Grades R-9 (Schools) Policy, Gazette No. 23406. Vol. 443, May 2002.

- organise and manage themselves and their activities responsibly and effectively;
- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use Science and Technology effectively and critically showing responsibility towards the environment and the health of others;
- demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

While the five developmental outcomes envisage learners who are also able to:

- reflect on and explore a variety of strategies to learn more effectively;
- participate as responsible citizens in the life of local, national and global communities;
- be culturally and aesthetically sensitive across a range of social contexts;
- explore education and career opportunities;
- develop entrepreneurial opportunities.

2.7 Summary

In this Chapter, the researcher critically discussed some of the factors that influence perception. This he did by first looking at artificial intelligence as a cognitive science and how it has influenced software development in the education sector.

The researcher further investigated how the popular media, such as television, computer games and films influence the general public and elementary school learners in particular. The influence of the family and society on perception was also discussed.

Arguments on the role that the socio-economic environment plays in determining whether elementary school learners access computers outside the school were advanced. Finally the effect of prior computer experience in shaping perception on computers was exposed. Research has shown that prior computer experience plays a major role in determining and influencing perception.

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CHAPTER 3

COMPUTERS IN EDUCATION IN SOUTH AFRICA

3.1 Introduction

Elementary school learners are social, cultural and psychological beings and their perceptions, values and opinions are shaped largely by the environment in which they develop. This environment consists of institutions such as the family, the school, religion and sport. The school plays a pivotal role in the elementary school learner's cognitive development and young learners are known to challenge their parents if what they say is in conflict with what is said at school. Education is supposed to be the dominant activity happening in the school and this research study was conducted in a school environment.

In order that the reader should appreciate the discussions in the next Chapter, the researcher felt that it was critical to expose the ideological principles upon which the South African education system is based and the values it espouses. The discussions on learning theory and sociological perspectives that follow here, give "accounts of" and "accounts for" (Breen, 1999) the ideological principles and values peculiar to the South African education system. The researcher further investigated and interrogated, more closely, various philosophical aspects of computer technology and its role – past, present and possible future – in education. In doing so, he did the following:

- critically reviewed how cultural, economic, social, political, ideological and educational (epistemological and ontological) contexts influence educational praxis;

- looked at a spectrum of contending and converging international views on learning theory, drawing firstly from the psychology of education and secondly from the sociology of education.

3.2 Learning Theory: Implications for Computers in Education

The successful incorporation of computer technology into education (as an educational resource) can only happen if the technology is used in the context of a valid theory and understanding of how learners learn – in this particular case, learners in the elementary school.

Over the past two decades, a lot of work has been done in an attempt to explain the nature of human cognitive abilities (Williams, 1989). This has happened in the four cognitive sciences, that is *artificial intelligence* (associated with information technology), *psychoneurophysiology*, *cognitive psychology* (associated with educational psychology), and *psycholinguistics*. Although these cognitive sciences differ markedly in other aspects, they share important fundamental and instructive principles on cognition. Among them is finding that "internal" rules govern mental function (Williams, 1989).

A common philosophical thread that runs across these cognitive sciences is a paradigm called *cognitivism* (Gardner, 1985). When behavioural psychology cannot provide answers to certain questions on the nature of cognition, cognitive psychologists decide that the behaviourist view of the mind as a "black box" has failed. They suggest that a study of the mind's inner workings is crucial in providing answers to key questions about cognition.

According to Williams (1989), cognitivism is held together by the following four principles:

> *Methodological Individualism* - **whereas behaviourists equated psychology with the search for relationships between environmental stimuli and behavioural responses, treating the mind as a 'black box,' cognitivists, who see the behaviourist programme as a failure try to understand the box's inner workings.**
>
> *Methodological Structuralism* - **what the cognitivist wants is an account of the structure of the fully mature capacity or cognitive structure. Thus, one of the striking features of cognitivism is the relative lack of interest in developmental or learning issues. Where questions of learning arise, learning is modelled on full adult competency, typically that of hypothesis formation and confirmation.**
>
> *Intellectualism* - **This is the idea that all behaviour is to be explained by some prior act of rule-governed cognition. Such explanation may be couched in terms of a practical syllogism in which the premises are beliefs and desires of the subject with the behaviour as the conclusion; or it may be explained in terms of the manipulation of symbols according to the principles of logic; or it may be couched in terms of the processing of information.**
>
> *Psychological Realism* - **the mind is an arena of cognitive structures that are real and invariant across cultures. Environmental, social and contextual features are needed only to help discover the nature of the underlying psychological realities; they are not theoretically essential to characterising those structures and capabilities themselves.**
>
> *The Foundation Module, Division of Education, University of Sheffield, 1995, p.19.*

All the above four principles share the two founding philosophies of the development of learning theory, that is *empiricism* and *nativism*.

Empiricists like John Locke [1690] argue that "at birth the human mind is a blank page *(tabula rasa)* which is written upon by experience." Other philosophers

who fall within the British empiricist tradition, e.g. John Stuart Mill [1806-1873], Thomas Hobbes [1588-1697] and George Berkely [1685-1753], share Locke's view on cognition. Pavlov's and Skinner's theories of *classical conditioning* and *shaping*, two examples of learning theories that are founded on Empiricism, formed the nucleus of the behaviourist tradition. Early in the Twentieth Century, empiricism was challenged by philosophers from the nativist tradition (Husserl, 1901; Cassirer, 1923). These philosophers drew their inspiration from the work of Immanuel Kant [1724-1804].

Behaviourism focuses upon the primary significance of appropriate stimuli producing desired responses. Pavlov's ideas on "classical conditioning" are based on the ringing bell (an appropriate stimulus) triggering a conditioned reflex (salivation) in dogs. In "shaping" behaviour patterns, Skinner suggests small incremental changes in responses. This concept was used extensively in mental asylums, prisons and other correctional institutions. Behaviourism was much admired by Western educationalists in the 1950's and 1960's as making learning outcomes quantifiable and it is still admired by most conservative educationalists in South Africa. Although behaviourism does not recognise educational subtleties such as intuition, creativity and interactive learning, it still remains valuable in the field of conditioned learning, as in computer-assisted drill and practice.

The nativist challenge to empiricism took place towards the end of the Nineteenth Century and continued throughout the Twentieth Century. The process culminated in the development of cognitivism, a learning theory that has

continued to influence education to this day. Nativists are of the view that the human mind has congenital propensities to organise the environment in certain ways, and seeks to impose its own order and meaning on things. Nativism is founded on the ideas of Plato and Rene Descartes, the latter following Plato almost two millennia later. The limitations of operant conditioning theory in relation to teaching and learning is seen in its omission of the following concepts:

- *human creativity.* During the process of learning a language, children will produce phrases and sentences without having previously heard such phrases and sentences. They appear to be constructing these sentences and phrases according to a set of implicit rules. There is no way that this phenomenon can be explained in terms of operant conditioning;
- *learning as a cognitive process.* Behaviourists conveniently, and deliberately avoid using the mental concepts such as "understanding" or "emotion". It is common knowledge that learners do not simply react to stimuli, but interpret them according to the kind of rules and concepts that they already have internalised;
- the conventional truism that what counts as *knowledge is a result of a process of sharing and negotiation.* It does appear that children, particularly in the early years within the home environment, learn mostly by comparing their views with others.

Although nativists like Piaget, Bruner and Ausubel came from varied backgrounds, they agree that human beings actively seek knowledge. Human beings are stimulated by problems, which they will try to solve, and it is during the process of trying to solve these problems that meaningful learning will take

place. Learning for them is a process that goes beyond responding to an external stimulus.

The development of educational psychology did not simply leapfrog from behaviourism (empiricism) to cognitivism (nativism). There were other schools of thought, from writers such as Tolman and Lewin in the 1930's, and Gestalt psychologists in the 1930's and 1940's. It was development in the information technology industry from the 1970's onwards that catapulted cognitivism into a dominant theory in educational psychology. The industry had seen the arrival of artificial intelligence - that is, the development of software that gave computers capabilities of modelling psychological processes such as perception and problem-solving. Learning theories in the psychology of education have, ever since, spanned the philosophical spectrum bordering on the empiricist tradition on the one extreme and the nativist tradition on the other.

Cognitive psychologists suggest that the mind's inner workings are independent of the individual's relations to other human subjects, social practices or the context (environment) within which they find themselves. However, Williams (1989) argues that once we recognise how early and how powerfully social factors are involved in an infant's life and development, it becomes increasingly unclear where a line can be drawn between the natural and the social. In other words how do we distinguish between what is already "within" the child when she/he is born and awaits only inner maturation and what is provided to and shapes the child from outside.

In attempting to answer the question of how learners learn, learning theory instead suggests how they should be taught. Newman & Holzman (1993), in their critical review of Lev Vygotsky's literature on the zone of proximal development (ZPD), unconditionally endorse his notion that although **'play is not the predominant feature of childhood ... it is a leading factor in development'**[13]. This is particularly relevant to very young learners who, in most educational environments, are not afforded the opportunity to play.

According to Cochran-Smith (1991), Genishi found that "individual children constructed microworlds, or individual social contexts within which computers were used, primarily through talk with peers and educators. In some cases these contexts controverted the intentions of educators or software designers." It would be useful to establish how these micro-worlds are constructed and what they entail. The researcher attempted to do this by sitting down with an educator and a group of learners to plan a learning programme; using computer hardware and software as a resource. The process was cumbersome and fraught with logistical problems. The variables were many and difficult to control. However, in light of the research evidence (specifically the work that was done by Genishi) it is crucial that both educators and learners somehow contribute to the design of a learning programme that is being developed for their use. Admittedly, this is not always possible because of practical implications and other constraints. However, the reason for the involvement of educators is different: as Cochran-Smith (1991) points out individual educators have a significant impact on the

[13] VYGOTSKY, L.S., (1978) Mind in Society, Cambridge, Harvard University Press.

implementation of technology in classrooms – albeit in some cases, unexpected and, in many cases, unacknowledged.

3.3 Foundations of South African Educational Praxis

Elementary school learners spend eight hours daily at school. This accounts for over 50% of their active time. If these learners are to develop opinions on computers, they are likely to develop these opinions mostly during this time. This is because for the majority of South African elementary school learners, exposure to computers only happens at school. The school is an environment with a distinctive ethos. In order for us to make sense of the school as a sociological institution, it would be instructive to look into the evolution of educational sociology over three historical periods. These periods reflected three sociological perspectives, these being *structural functionalism*, *interactionism* and *Marxism*. These sociological perspectives have influenced the provision and support of education in South Africa in general and the province of KwaZulu-Natal, in particular.

Structural functionalism in South Africa manifested itself via an ideology that in education was called Christian National Education. Christian National Education goes back to the beginning of the 20th Century. After the Anglo-Boer War (in which the Boers were defeated by the British) the British set up public schools in which the Dutch language was forbidden and the Church's influence in education was reduced (Perold and Butler, 1985). The intention was to break the back of Boer (Afrikaner) nationalism and promote British values and language. In response to this political "onslaught", Boer educators, military and church leaders

established the Commission for Christian National Education in 1902. The Commission in turn established over 200 private Christian National Education schools for the education of Afrikaner children. Christian National Education re-emerged with the growth of Afrikaner nationalism in the 1930's and the 1940's. In 1939, an Afrikaner Volkskongres (people's congress) founded the Institute for Christian National Education (the current Potchefstroom University for Christian Education). The Institute published a document outlining Christian National Education policy in 1948. The introduction to this policy document read as follows:

> **We want no mixing of languages, no mixing of cultures, no mixing of religions, and no mixing of races. The struggle for the Christian and National school still lies before us.**
> *SPROCAS 1971:74.*

During the same year, the National Party won the Whites only general election and introduced the policy of apartheid in South Africa.

Christian National Education is founded on two ideological commitments. The first commitment maintains that South Africa is culturally and religiously a homogeneous and monolithic society that has shared Christian values and norms (Kilian and Viljoen, 1974). The ideology emphasises and gives recognition to the group rather than the individual. It sees Christianity as the foundation (Kruger and Whittle, 1982) on which the South African "culture" and the South African way of life are based. However, within this "shared culture" there exist **distinct** linguistic, racial or ethnic entities. The second commitment, on which the ideology is based, is that the individual should be "moulded" so that she/he is able to harmonise with shared societal values and norms (Steyn et al., 1985). The

religious, social and political systems had structures that were set-up to deal with those individuals who could not conform to the shared norms and values.

Many South African educationalists and practitioners have, at some stage in their careers, been directly or indirectly, exposed to and/or been influenced by *Fundamental Pedagogics,* the prevailing educational philosophy at the height of the apartheid era. Education departments from a number of South African universities, based their educator training programmes on this approach (Duminy, 1967; Luthuli, 1981; Vester, 1977). Christian National Education supports Fundamental Pedagogics as is reflected in the Pretoria School's phenomenological approach to education.

In South Africa, during the 1950's and the 1960's (as was the case in the United States and Britain) much research into teaching and learning was informed by structural functionalism (Niven, 1973). The over-emphasis on a group, rather than the individual, makes structural functionalism compatible with apartheid ideology. On becoming Minister of Native Education in South Africa, Dr. Hendrik Verwoerd indicated his ideas of "proper education" for black South Africans during a parliamentary debate on 17 September 1953:

> **I will reform it so that Natives will be taught from childhood to realize that equality with Europeans (White South Africans) is not for them...Racial relations cannot improve if the wrong type of education is given to the Natives. They cannot improve if the result of Native Education is the creation of a frustrated people who have expectations in life which circumstances in South Africa do not allow to be fulfilled...**
>
> *Dr. H.F. Verwoerd (1953): Hansard for Parliamentary Speeches.*

Within Christian National Education, and hence apartheid, learners are seen as part of tribal or ethnic entities, with each tribe or ethnic group having a common language and a common culture because of its supposedly shared values and norms (Dreyer, 1974, 1979; Duminy, 1967; Luthuli, 1981). Apartheid ideology sometimes uses the terms "language" and "culture" interchangeably. Some of the research studies that were conducted up to the end of the 1960's, went so far as trying to explain how learning happened differently within different social, ethnic, racial or economic groups (Lawton, 1969). In Europe and North America, groups would sometimes be socio-economic classes (Banks, 1976; Reid, 1977), while in South Africa groups would be primarily racial or ethnic.

Structural functionalists consider poverty to be the biggest contributor to educational problems (Davie et al., 1972; Douglas, 1964). They are concerned with finding out why children from poor or working class backgrounds under-achieve when compared with their counterparts from middle-class or well-to-do families. In South Africa this has become a race comparison rather than a class comparison because of the legacies of apartheid and colonialism. Special interventionist programmes were introduced to compensate for the deficit in the potential of the children of the poor to learn. These programmes were linked to the social, cultural and economic status that the learners occupied in society. Computers were used as a medium to deliver these programmes. During the late 1970's through to the mid 1980's, the South African ministry of education for

Africans living outside of the Bantustans[14] and known as the Department of Education and Training, imported a computer-assisted instruction programme called TOAM from Israel to help with the teaching of English and mathematics in township schools. This project never went beyond the pilot stage.

The proliferation of educational non-governmental organisations (NGO's), working within the predominantly poor African communities in South Africa is a manifestation of the cultural deficit theory of under-achievement in education. These computer-based drill and practice educational programmes, particularly in mathematics and English, are used to supplement the learning programmes of children from poor backgrounds. However, no report that the researcher consulted on the evaluation of these interventionist programmes provided evidence of their contribution towards the improvement of the education of children of the poor.

The failure of structural functionalism to address the problems in education led to the emergence of a radical form of educational sociology. The process started in the early 1970's and this "new sociology" challenges, among others, the notion that institutions like the school are neutral (Hargreaves et al., 1975; Hargreaves, 1976). It also disputes the theory that "educational outputs" (*success or failure in official terms*) are determined by "educational inputs" (*social class or family background*). The name of the new sociology is *interactionism* and it was underpinned by three theoretical perspectives viz., *symbolic interactionism*, the

[14] In apartheid South Africa, 'Bantustans' were geographic entities created by legislation solely for African inhabitance.

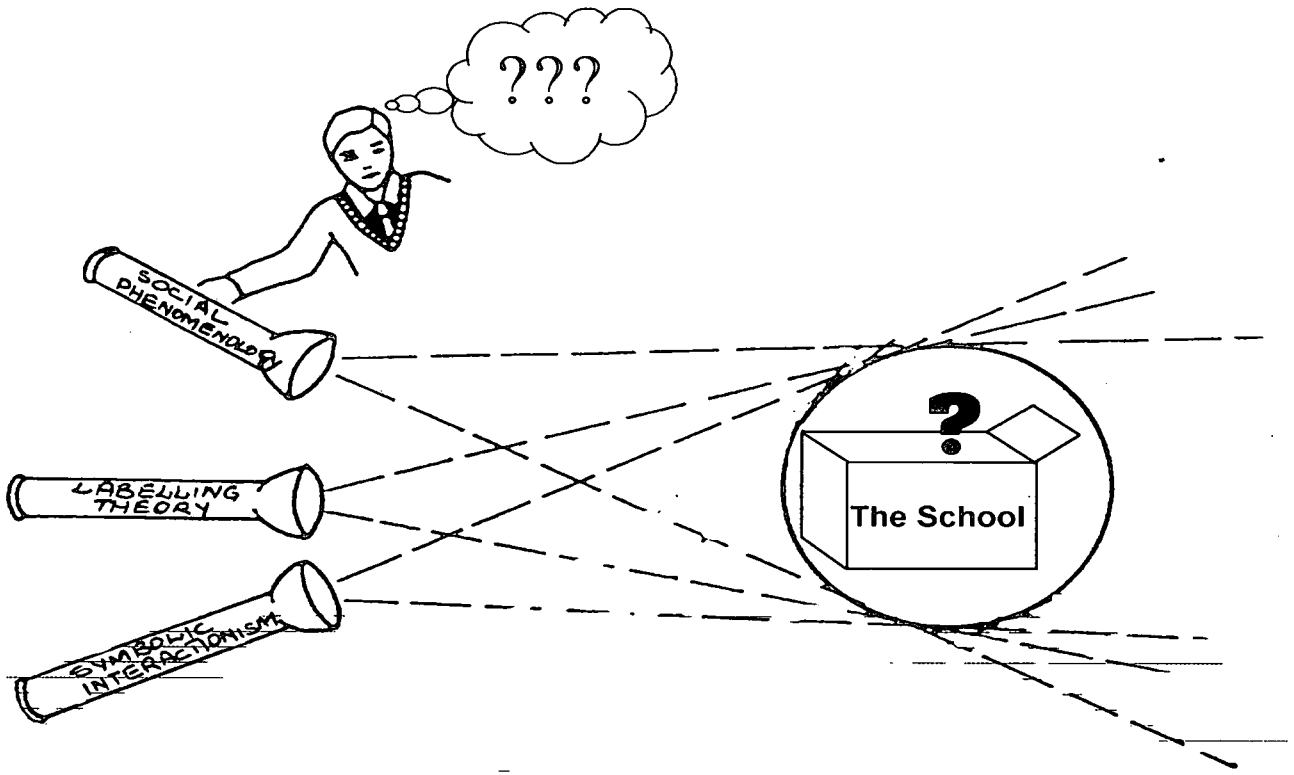
labelling theory and *social phenomenology*. The three perspectives are used by interactionists to look into the success, or the lack thereof, of the school in supporting the education enterprise.

Structural functionalists view the school in the same way as industrialists view a factory. You have raw materials (inputs) entering at one end and, after going through a manufacturing process on the production line, coming out at the other end as finished products (outputs). It may be argued that a school is as good as the quality of teaching and learning that goes on in it. The structural functionalist educational model spurred interactionists to prise open this "black box" (*the school*) in order to carefully investigate what went on inside it (cf. Figure 3.1).

The diagram (Figure 3.1) overleaf is a product of the researcher's imagination. With the diagram is intended to provide the reader with a conceptually evocative illustration of how research studies, based on the three perspectives of the new sociology, attempted to "shed light on the black box" and also to ask questions on the use of the school as a construct for ideological, social and political control. During this process, some of the practices in the school that had been accepted as norms were challenged (Lacey, 1970, 1976).

Figure 3.1

A conceptual diagram symbolising the three perspectives associated with interactionism



Among other manifestations, the labelling theory looks at the classification and categorisation of learners in respect of deviant behaviour. Studies show that learners behave according to the labels that have been given to them: that is, "bad" learners behave badly, not necessarily because they are bad but because, in a sense, that is how society "expects" them to behave by virtue of the label they have been given. The *pro-school*, and similarly, the *anti-school* cultures (Lacey, 1976) are of particular relevance to the current education milieu in South Africa. In African townships in major urban centres, there exists a low to non-existent work ethic among some educators, and an anti-school culture among some learners. Educators claim that learners do not want to learn and therefore justify their not teaching them. However, learners are aware of the label that has been given them by educators and perpetuate it either by not coming to school, or by absenting themselves from some classes if, and when, they decide to come to school. In such schools there is a complete absence of any culture of teaching and learning. Ironically, it is generally known that some of the educators who teach in African township schools often do not send their own children to the schools in which they teach. Instead their children attend mainly Indian or White state schools, which are generally regarded as more appropriately resourced, more orderly and educationally effective and reputable (O'Neill, 1993).

Educator behaviour can be profiled along a behavioural spectrum. At the extreme ends of the spectrum exist the two types of educators that are found in a typical township school. These educators are:

- "deviance-insulative" – constantly encouraging and avoid ridiculing and punishing;
- "deviance-provocative" – punishing inconsistently and ridiculing perpetually (Hargreaves et al., 1975).

Educators who belong to the former category are usually in the minority, while the majority of educators tend to fall into the latter category.

In some township schools learners only arrive to attend the lessons of those educators that they respect and trust and immediately go home afterwards (O'Neill, 1993). Alternatively learners hang around in the school, outside classrooms and will, from time to time, selectively attend lessons offered by "deviance-insulative" educators while avoiding those lessons that are offered by educators that they (the learners) consider to be "deviance-provocative".

There exists a fundamental sociological problem, associated with most computer-assisted instruction learning programmes that have, so far, been used in disadvantaged schools. Most of these programmes are founded on the deficiency theory, in that learners who are subjected to them realize, sooner rather than later, that they (the learners) are perceived as deficient. These learners will therefore subconsciously behave according to the deficiency label that they have been given. This creates a vicious cycle, perpetuating the apartheid legacy of ineffectual schooling for disadvantaged learners.

In the mid 1970's, the interactionist notion that fundamental improvement in education was possible, even though such notional change was confined to the

school, was challenged by people like Paulo Freire (1972a). The re-emergence of the Marxist philosophy in education was due to political and economic problems which were being experienced in some of the major capitalist countries of the world. The perception was that education systems were not just social constructs, as had been believed in the past, but that they were socio-political constructs. Education was seen as a crucial part of the superstructure on which all capitalist economies are based. Control of all capitalist economies depends upon the control of three factors, land, labour and capital. Of these three, labour was the most difficult to control. Such sentiments find an echo in the words of a National Party parliamentarian in the South African National Assembly, in 1945.

> **The schools should not give the natives an academic education, as some people are prone to do. If we do this we shall later be burdened with a number of academically trained Europeans and non-Europeans, and who is going to do the manual labour in this country?**
>
> *J.N. le Roux (1945):*
> *Hansard for Parliamentary Speeches.*

The success of the National Party's job reservation policies depended on the system of education providing the economic system with the "desired" type of worker. This was re-affirmed by Dr. Verwoerd in 1953 when he asked:

> **What is the use of teaching a Bantu child mathematics when he cannot use it in practice?**

or his statement:

> **Education must train and teach people in accordance with their opportunities in life.**
>
> *Dr. H.F. Verwoerd (1953):*
> *Hansard for Parliamentary Speeches.*

Marxists see schools as agencies of social and political control. Marxism sees two types of social control, *repressive* that is by state apparatus, such as the police and the army and *ideological*, through institutions such as the church, education, the family and trade unions (Freire, 1985). The ideological neutrality of the education system and, hence, the school, as perceived within structural functionalism, is challenged. The separation of, and the subsequent difference in status between vocational and academic learning, it may be argued, is a manifestation of the use of education as a form of ideological control.

The value system, which ideologically-controlled education engenders in poor and disadvantaged learners, provides a recognition that their own class culture is "worthless" and valueless and that the other "culture", which they had not received, is "noble" and valuable (Freire, 1985). This is, possibly, nowhere else in the world as evident as in South Africa post 1994. Consider South African education as an example. It is very significant, that after the de-segregation of schools in the early 1990's, many African parents moved their children from exclusively African schools to schools that the apartheid government had set aside exclusively for racial groups other than Africans. This was done in the belief that these schools are superior and so can provide an education of a better quality. Again the use of skin lighteners and hair straighteners by African people in the middle of the last century is another extreme example that confirms the devaluing of their own culture.

Many institutions (social, cultural, religious, political or educational), that are themselves creations and manifestations of ideological control, reject the Marxist

sociological perspective as it challenges their very existence (Freire, 1972b). It is common knowledge that in South Africa, the apartheid state went to the extent of establishing research institutions, like the Human Sciences Research Council (HSRC), to do research that would help to give credibility to its policies. Some of the "research" that was undertaken by these institutions was very questionable in that through research emanating from the HSRC, the National Party government was able to justify its segregationist political and educational policies. Freire (1972b) contends that through ideologically-controlled education, "the power of the dominant and the oppression of the powerless becomes hidden and mystified".

3.4 Computers as a Pedagogical Tool

There exists "mythinformation" and "technoromanticism" (Mackay, 1991), associated with computer technology among the majority of the South African population and this includes elementary school learners. Considering that the world has moved from an industrial age to an information age and that computers will increasingly play a significant role in people's daily lives, it is, therefore, important that mythinformation and technoromanticism are dispelled at an early age before they set in and become difficult to unlearn.

The abacus and the microprocessor (found in all modern computers and calculators) are both used to process data with the intention of transforming them into useful information from which certain conclusions can be drawn and decisions made. These two technological artefacts are separated by over 3000 years in age of invention. Nonetheless, the efficacy of the two devices is the

same when it comes to the performance of calculations using the four basic arithmetic operations on numbers, that is, addition, subtraction, multiplication and division.

While the achievement of virtuosity and high calculating speed rely on the abacus operator's skill and practice (Fernandes, 1997), capacity and design will determine the accuracy and speed at which a microprocessor performs calculations (Sanders, 1988).

Figure 3.2

A store clerk in Beijing, China uses the abacus to total up sales (*photograph by Peter Wouda, September 1997*).

From the creation of the abacus circa 1000 BC to Blaise Pascal's calculating machine invented in the middle of the 17th Century and to the development of the first microprocessor-based personal computer in 1974, the technology of the microprocessor had been developing slowly, but the end of the 1970's ushered in a period that was characterised by revolutionary and rapid development, which has remained ever since in the evolution of the microprocessor.

Very few people are, in the researcher's opinion, even vaguely aware of the fact that the arithmetic processor (microprocessor) in the central processing unit (CPU) of any computer system (from a basic calculator to the most sophisticated mainframe computer) does not have a built-in capacity to perform multiplication or division (as does the human brain). Instead, multiplication and division are performed in terms of addition and subtraction in the same way as an abacus. Notwithstanding this fact, the personal computer has, over the past two and a half decades, been fêted as the greatest technological innovation of the 20th Century.

Perhaps at this point it would be useful to consider an example of how a computer system would multiply or divide two numbers.

EXAMPLE

8 X 5 = 40

A computer system will interpret the multiplication operation "**X**" as an instruction to "**add 8 to itself 5 times**" i.e. 8+8+8+8+8 = 40 (or alternatively 5+5+5+5+5+5+5+5 = 40);

while **6 ÷ 2 = 3**

would be performed by subtracting 2 (subtrahend) from 6 (minuend), and thereafter making the resulting difference the minuend until a difference of 0 (zero) is obtained; i.e. (((6-2)-2)-2) = 0.

The resulting **quotient (3)** is the **number of times** that the divisor will be subtracted from the dividend to get the result zero. In this particular case it was 3 times hence the resulting quotient was 3. Steps 1, 2 and 3 below show how the CPU would accomplish this process.

Step 1: The **dividend (6)** will be the **minuend** and the **divisor (2)** will be the **subtrahend**

$6 - 2 = \mathbf{4}$

Step 2: Take the resulting **difference (4)** and make it the **minuend,** and again subtract the divisor (2) from it

$4 - 2 = \mathbf{2}$.

Step 3: Take the resulting **difference (2)** and make it the **minuend,** and again subtract the divisor (2) from it

$2 - 2 = \mathbf{0}$.

As can be seen, the process of subtracting the subtrahend from the minuend was repeated **3 times** before a difference of zero was obtained. The **quotient** (the answer) is therefore **3**.

This is evidence to convince even die-hard sceptics that, after all, there is nothing profound in the way computers perform fundamental arithmetic operations. What makes a significant difference is the **speed** at which they can perform these operations (Sanders, 1988). Unlike its predecessor the abacus, however, the computer can also perform other non-arithmetic operations on alphabetic, numeric and other symbols that we use to present data and information. It is

these multiple uses that make the computer an extremely functional device. Ironically, the abacus is nevertheless still being used quite extensively in Japan, China and parts of North America today (Fernandes, 1997). It would be interesting to know why there is still continued use of the abacus alongside the computer in these countries that are generally considered as advanced technologically (*cf. Figure 3.2, p. 70*). This may be a potential research area.

The above background is intended to assist the reader to develop an independent conceptual viewpoint concerning computer technology, without the glamour and "hi-tech" status that are always attributed to it. Although computer technology has come to be part of our daily lives, applied in control systems of household appliances, children's toys, administrative systems, scientific research and data and information management, very little is known or understood regarding individual perceptions of computer technology. This is particularly true in education where the use of computer technology increases daily.

The computer can be an "interactive" learning tool and this distinguishes it from other passive ICT-related pieces of teaching and learning equipment e.g. tape recorders, television sets and video cassette recorders. With a computer the provision of feedback directly to the learner is possible, whereas with other instruments feedback is almost entirely up to the educator (Weir, 1989). In South African education, the potential use of computers as either administrative tools or resources for curriculum support has barely been tapped. Among the reasons for this is the fact that the computer hardware in many schools is inappropriate (Sutton, 1991). The computer systems found in most schools may be regarded as

glorified typewriters; that is, the hardware and software have only the very basic word-processing capabilities.

The time has come for those involved in education to move the use of computer technology beyond the narrow definition of technological literacy, i.e. the teaching of keyboard skills and the writing of simple programmes in languages such as Basic and elementary word-processing (Mackay, 1991). Computer technology should be used following a particular educational rationale that includes the development of appropriate educational programmes and teaching and learning materials. Computer technology should be regarded as a primary educational resource, instead of a luxury that is a preserve of those few privileged schools that can afford the software and hardware. This study will also show that there are cost-effective ways in which this can be achieved.

The education and training sectors have embraced computer technology in the hope that it will provide immediate solutions to the many problems they face (Linn, 1991). There has been a proliferation of computer software and computer-based teaching and learning programmes that are aimed at promoting and developing computer-assisted instruction (CAI) and computer-assisted education (CAE). In the discussion that follows we shall consider three examples of CAI and/or CAE programmes that have been used in education in South Africa.

TOAM is a CAI programme that was used extensively in some South African schools and educator training institutions to improve the teaching and learning of mathematics and English in the 1980's. The word TOAM is a phonetic

translation of a Hebrew acronym corresponding to Computer-Assisted Testing and Practice. The software that was used by the TOAM system was designed and developed by Israel's Centre for Educational Technology (CET), while the hardware was designed and manufactured by Degem Systems in Israel. TOAM had been designed with the aim of facilitating and accelerating the learning of arithmetic and English among elementary school children in Israel, who were of immigrant origin from Eastern Europe, the former Soviet Union and North Africa.

TOAM was introduced, as a pilot project in SOWETO, in 1983, in the South African education system. The system was aimed at learners, who were born of poor African parents and were considered to be "struggling" in learning arithmetic and English. In the mid 1980's, the former Department of Education and Training (DET) made TOAM its official CAE programme. The TOAM pilots were subsequently extended beyond SOWETO in Gauteng Province (then Transvaal), to KwaZulu-Natal (then Natal) and the Western Cape (Cape Province).

Another system was the Plato system that had also been designed to improve the teaching and learning of mathematics. International research identified a number of problems in the teaching and learning of mathematics (Frankenstein, 1989) in elementary and secondary schools (Martin et al., 1997). The Plato system was purchased, with official funding, by most colleges of education in the KwaZulu homeland and Natal Province in South Africa for the training and development of mathematics educators.

Both TOAM and Plato were introduced into the South African education system in the early Eighties but its use, as an educational resource, was discontinued by the former KwaZulu Department of Education and Culture (KDEC) a few years later, while TOAM was also abandoned by the DET at the beginning of the 1990's. This was a financial loss as the hardware associated with these systems could not be used for anything else.

Officials linked to the former Department of Education and Training and the former KwaZulu Department of Education and Culture were interviewed by the researcher. Both the DET and the KDEC had installed TOAM and Plato. The officials said that the following were possible reasons for abandoning the two programmes:

- the programmes were not cost-effective to run (they used specialised hardware);
- the hardware that supported the software was not compatible with computer systems that are based on the popular IBM architecture;
- some of the hardware could not be upgraded as that would have made the costs prohibitive.

Also, evidence[15] exists that there were neither technicians who were trained to set up these systems nor provide technical support to their users.

[15] Investigations, done by the researcher, have established that the Plato system, that was set up at the former Madadeni College of Education, was unceremoniously withdrawn under a cloud of controversy that has never been explained. Madadeni College of Education provided educator pre-service education and training for the former KwaZulu Department of Education and Culture. It was based in Newcastle in KwaZulu-Natal.

It does appear that this was the only time in the history of South African education that there was an official policy position on the use of computer technology in education. There is no other evidence of policies on computers in education even from the former White education departments, that is the Cape Education Department, the Transvaal Education Department, Natal Education Department and the Education Department of the Orange Free State. As former White departments, these were heavily funded by the former South African apartheid government. However, schools belonging to these departments also relied heavily on donor funding to set up computer laboratories and implement CAI and/or CAE programmes. It is noteworthy that, ten years into South Africa's new democracy, there is still no official policy on computers in education.

SERGO is probably the first locally-produced commercial CAI programme. The programme was designed and developed by two Pretoria-based university professors to facilitate the teaching and learning of mathematics. SERGO differs from TOAM and Plato in that it does not use specialised hardware and so is able to use personal computers based on the universally available IBM architecture. The system can be upgraded to include other features such as voice recognition, audio, voice synthesis and interactive video.

The SERGO system was first introduced into private schools, such as St Stithians College in Randburg, near Johannesburg. It may be argued that perhaps the strategy of first introducing it into a well-known independent school was to give

the product credibility. If SERGO could break into the country's wealthy and sophisticated market, this would have put its efficacy and educational worth beyond question. It would then have been fairly easy to convince an education authority, which held the key to the huge and lucrative African education market, that SERGO was an appropriate intervention programme. Potentially this would give SERGO the edge over competition particularly as it was not a product designed specifically to deal with, what could be regarded as a Third World problem. SERGO is still in use in some independent schools in South Africa.

The extent to which CAE or CAI interventions have benefited education is unclear, even though some of the reports (Metrowich, 1984; Osin, 1981) on the evaluation of these programmes claims evidence of some educational gains. However none have presented convincing arguments or evidence in support of such gains. Instead, there are indications that most of these interventions are associated with negative social and educational stereotyping and, as a result, learners associated with these interventions are stigmatised as being slow in cognitive development. Other interventions have built-in negative stereotyping (Freire, 1985). One bizarre belief associated with computer technology is that individuals, who come from an environment in which computer use is common, are cognitively and intellectually superior to those who have had no access to computer use (Fernandes, 1997). This is a strange case of intelligence by association.

In most elementary classrooms, the use of computer technology is usually limited to drill and practice (Sutton, 1991). This could be either in mathematics or

language learning. The misconceptions came up quite often in the discussions that the researcher had with individual educators. This stereotyping and mistaken beliefs influence our understanding and perception of particular social phenomena, a fact that will emerge in the ensuing discussions in the next Chapter.

3.5 Conclusion

It is customary to refer to particular periods in history by the name of the technology that was either dominant or characteristic of that time, for example the Stone Age, the Iron Age, the Steam Age, the Atomic Age and the Information Age. Dowling (1991) argues that technologies are social processes, rather than just artefacts, systems or machines. He further explains how and why the use of technology in education is a cultural phenomenon by arguing that technologies are defined by culture rather than particular cultures defined by their technologies. Nevertheless there is a dominant opinion in the information society that computer technology is the fundamental determinant of a new and inevitable social order (Dowling, 1991). Such thinking epitomises a contemporary example of a concept known as technological determinism.

First World[16] societies who believe that their technologies (and hence their cultures) are not only developed, but "appropriate" (Steyn et al., 1985; Hollster, 1972), are usually guilty of condescension towards other technologies (and subsequently cultures) which, in their perception, are regarded as under-

[16] In this context, the term 'First World' refers to people, economies and socio-political systems in developed countries in western Europe and north America.

developed and "primitive" (Bielawski, 1991). Usually those who are guilty of such condescension will deny that it exists.

The consequences of technological determinism can sometimes be ludicrous as will be confirmed by the following anecdote. In 1946, a United States Army newspaper, the *Stars and Stripes*, sponsored a contest between the Japanese abacus and the American electric calculating machine. The people representing Japan and the United States of America in the contest were Mr. Kiyoshi Matsuzaki, a skilled abacus operator who was based at the Savings Bureau of the Ministry of Postal Administration, and Private Thomas Nathan Wood from the 20th Finance Disbursing Section, General MacArthur's headquarters. He had been selected in an arithmetic contest as the most expert operator of the electric calculator in Japan (Kojima, 1954).

The competition results reflected in Table 3.1 on the next page are not by themselves very significant, until they are considered against the political climate that prevailed at the time. It was just after the 2nd World War, in which the Japanese and the Germans had been vanquished by the forces of Britain and the United States. Just before the war ended, the United States dropped an atomic bomb on Hiroshima and Nagasaki. At that time, the atomic bomb was regarded as First World technology, the development of which no other country in the world had accomplished.

Table 3.1

Results[17] *of the contest; Matsuzaki (abacus), Wood (electric calculator)*

Type of Problem	Contestant	1st Heat	2nd Heat	3rd Heat	Score
Addition:	**Matsuzaki**	1m. 14.9s	1m. 16s		1
50 numbers each containing 3 to 6 digits	**Wood**	2m. 0.2s	1m. 58s		0
Subtraction:	**Matsuzaki**	1m. 4s	1m. 8s	1m	1
5 problems with minuends and subtrahends of from 6		all correct	4 correct	all correct	
to 8 digits each	**Wood**	1m. 30s	1m. 35s	1m. 22s	0
		all correct	4 correct	4 correct	
Multiplication:	**Matsuzaki**	1m. 44.6s	1m. 19s	2m. 14.4s	0
5 problems each containing 5 to 12 digits in the		4 correct	all correct	3 correct	
multiplier and the multiplicand	**Wood**	2m. 22s	1m. 20s	1m. 53.6s	1
		4 correct	all correct	4 correct	
Division:	**Matsuzaki**	1m 36.6s	1m 20s	1m 53.6s	1
5 problems each containing 5 to 12 digits in the		all correct	all correct	4 correct	
dividend and the divisor	**Wood**	1m 48s	1m 19s	1m 25s	0
		all correct	all correct	4 correct	
Composite problems:	**Matsuzaki**	1m 21s			1
1 addition, 3 subtraction, 8 multiplication and 3		all correct			
division problems involving 5 to 12 digits numbers	**Wood**	1m 26s			0
		4 correct			
	Matsuzaki				4
TOTAL SCORE	Wood				1

[17] Reproduced from the book, "The Japanese Abacus, Its Use and Theory", written by Takashi Kojima. In five categories, the abacus and its operator scored a total of 4 points against 1 point for the electric calculator and its operator.

Technological determinism is reflected in the manner in which two papers, the *Stars and Stripes* and the *Nippon Times*, reported on the contest. The American army newspaper reported the defeat of the electric calculator by the "centuries old" abacus as "a step backward"; the Japanese newspaper described the victory of the abacus as the "tottering of civilisation on the threshold of an atomic age". These are excerpts of what the two papers reported on the contest:

> **The machine age tool took a step backward yesterday at the Emie Pyle Theatre as the abacus, centuries old, dealt defeat to the most up-to-date electric machine now being used by the United States Government...The abacus victory was decisive.**
>
> *Stars and Stripes as cited from Kojima (1954)*

> **Civilisation, on the threshold of the atomic age, tottered Monday afternoon as the 2000-year-old abacus beat the electric calculating machine in adding, subtracting dividing and a problem including all three with multiplication thrown in, according to UP. Only in multiplication alone did the machine triumph...**
>
> *The Nippon Times as cited from Kojima (1954)*

This was no longer a competition between the abacus and the electric calculator, but a contest in which the national pride and culture of each country was at stake. The human element (*the two operators*) had been conveniently ignored in the reports in both papers, while the two instruments are portrayed as though they had an intellect of their own and were, perhaps, even animate. There are individuals within the information society who have similar sentiments with regard to computer technology. It is therefore incumbent upon every reasonable human being to guard against such positivistic influences, especially on the young and impressionable minds of children in the elementary school.

3.6 Summary

This research study happened in a school environment. The school is therefore one of the institutions that influence elementary school learners perceptions. In this Chapter, the researcher critically reviewed the impact of cultural, economic, social, political and ideological aspects on South African education and how these shaped education as it currently occurs.

Furthermore, the researcher looked at the evolution of educational sociology as reflected by the three sociological perspectives represented by structural functionalism, interactionism and Marxism. The researcher thereafter discussed the contribution of learning theory to the South African educational praxis.

In conclusion, the researcher looked at some examples of computer-assisted instruction and computer-assisted education programmes that have been used in South African education, their ideological underpinnings and their impact.

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CHAPTER 4

REFLECTIONS ON AND ANALYSIS OF ELEMENTARY SCHOOL LEARNERS' PERCEPTIONS OF COMPUTERS

4.1 Introduction

Computers have benefited individuals, organisations and society, often resulting in an improved quality of life. This the technology has done by:

- helping workers, researchers, scientists, entrepreneurs and many others do their tasks effectively and efficiently by providing them with information, which is accurate and timely, and the facility to analyse that information promptly so that they are able to make correct decisions;
- providing programmes that are both educational and entertaining. This happens in a range of categories, such as reading, communication, science, mathematics, music and the arts;
- enhancing the quality and provision of products and services that institutions, such as government agencies, banks, businesses and information agencies, provide to the public.

This essentially means that the education community cannot continue to ignore what computer technology has done for other sectors of society and what it potentially can do for education. It is important to remember that when learners use computers as an educational resource, they should be able to exercise epistemological and ontological control over the learning processes and, furthermore, they should be able to control the pace at which they are learning. This means that the use of computers in education should not become an end in itself but a means to achieving an identified and specific end.

In education, the use of computer technology has benefited the teaching and learning of science and many technology-related professions such as engineering and medicine, particularly at tertiary institutions. The use of computer technology has made it possible for complex, dangerous and expensive experimental work to be simulated in research and teaching laboratories. In these laboratories the processes of data administration (collection, analysis and retrieval) have improved greatly in speed, accuracy and reliability. In elementary schools, computers have been used to improve the teaching of science in laboratories and science classes (Friedler et al., 1989; Levine and Donitsa-Schmidt, 1996) and mathematics and language in computer and language laboratories. In South Africa, unfortunately, the same cannot be concluded as in the majority of primary and secondary schools, computers (if a school has any) are usually used as glorified typewriters in computer literacy classes.

In spite of the many benefits associated with its use, computer technology has great potential for problems and dangers. According to Sanders (1988), although computers have, in the main, had a positive impact on the lives of people, there is potential for their usage to impact negatively on individuals, organisations and general society and this would include elementary school learners.

4.2 Understanding Social and Cognitive Processes in Learning Environments

As physical, educational and social environments, classrooms[18] are an important component of teaching and learning. Educational research that was done during

[18] The term classroom has been used beyond the narrow and simplistic confines of a physical structure. It is a dynamic and living environment with a physical aspect (the building, furniture, fittings etc.), a social aspect (teachers and learners) and an educational aspect (teaching and learning materials, the curriculum etc.) associated with it. This is like the difference between a house and a home.

the last two decades of the 20th Century suggests that the key to understanding the social, and cognitive processes that occur in learning environments, such as classrooms, is the careful study of these environments (Levine et al., 1996).

The Getzels-Thelen model (1960) provides a theoretical framework for the study of classroom environments as social systems. The model suggests that a classroom has a unique identity and that this identity emanates from a peculiar combination of specific characteristics such as the curriculum, learner-learner interaction, educator-learner interaction and the social background of both the educator(s) and the learners.

According to Fraser (1986), most evaluation projects and research conducted in schools fail to provide a holistic portrait of the classroom environment. This is because such studies over-emphasise academic achievement, while ignoring classroom environment processes. The lack of success of a multitude of intervention programmes, that have been established to address the failure rate at the matriculation level (Grade 12) in South Africa, is a manifestation of this problem. The view of a classroom as purely an academic environment is seriously flawed. The study of classroom climate is therefore an important tool for evaluating innovation in education (Fraser, 1986; Levine, 1981) and the introduction of computers into the elementary classroom is one such innovation. Marshall (1992) believes the study of the classroom – as a specific teaching and learning environment – would lead educational researchers to redefine the purpose and meaning of learning and provide an understanding of how learners

learn, thus helping educators extend learners' knowledge of the world, of content areas, and of themselves (self-actualisation).

The majority of studies that have attempted to investigate classroom environment processes have focussed on classroom climate as a variable of either class size (Anderson and Warlberg, 1974), the learners' age level (Welch, 1979), the learners' gender (Lawrenz, 1987), the type of school (Hofstein et al., 1980), or the size of the school (Campbell and Robinson, 1981). Fraser (1981, 1986) argues that there is relatively little research that uses learners' perceptions of the classroom climate for evaluating educational innovation. This suggests that research should take into account that the learner has an opinion on the classroom as a learning environment. The environment includes physical resources (for example computers) and human resources (educators and fellow learners). Such research has been shown to be more sensitive and precise in identifying and reflecting on both short-term and long-term educational changes (Herman, 1994). There is growing recognition and acknowledgement that studies in this direction are not only desirable, but essential. The present study is an attempt to contribute to this aspect.

The acknowledgement of the significance of classroom environment processes has resulted in the development of many questionnaires (Moos, 1979; Walberg, 1979) for data collection purposes. However, the common weakness among these data collection tools has been that they are designed for a "universal" classroom. The design process fails to recognise a critical fact: that learning takes place not only within the individual, but also through social interaction

between the individual and the complex environment around him/her. Social constructivists suggest that an opportunity should be provided for both peer collaboration and learner-educator colloquy on the teaching and learning activity (Vygotsky, 1978; Wertsch, 1985). According to the social constructivist view, learning must be relevant to learners' lives and interests, as well as to their perceptions, so that it may become an extension of the learners' actual existence. The validity of the concept of a universal classroom is therefore questionable, as the climate in each classroom differs from society to society, from community to community and circumstance to circumstance.

During the last decade of the 20th Century recognition of the uniqueness of each classroom has led to the development of specific questionnaires, that can be used in the study of different classroom environments: the science laboratory class (Fraser et al., 1992), the science inquiry-based computer class (Maor and Fraser, 1993), the constructivist-learning environment (Taylor and Fraser, 1991), the computer-assisted learning environment in geography classes (Teh and Fraser, 1993), the small college and university class (Fraser et al., 1984) and the physics class (Wubbles et al., 1991). These data collection tools seek to accentuate the unique demands of the educational (teaching and learning) processes in different educational settings, specific subject areas and learner age levels.

A similar approach has been used in the present study. A questionnaire (*see Appendix C*) that has been adapted from the Taylor-Fraser (1991) tool, "*A Constructivist Perspective on Monitoring Classroom Learning Environments under Transformation*", was used to help establish a learner profile of the schools

that participated in the study. The questionnaire comprised 31 questions that had been classified into five categories. To the existing set of questionnaires, this study added a specialised data collection tool, suitable for collecting specific categories of data in the classroom. The collection process, data analysis and the interpretation of the data are discussed later in this Chapter.

The reader is none the less reminded that some of the most important data that was collected during the course of the research study, was collected through informal means, that is during the researcher's casual chats with colleagues, his observations during school visits, his interactions with learners during school visits, his discussions with parents, school principals, software and hardware vendors, information from literature, such as magazines and newspapers, and the Internet's world-wide web. Information and data are, therefore, not only based on the questionnaire. The eclectic nature of educational ethnography means that methods and techniques that are used to gather data and information from these sites are many and varied in the search for patterns within, and relationships among, events and processes.

A research study is in essence an exercise in knowledge creation. The process of knowledge creation is multi-faceted, complex, spontaneous, non-linear and not necessarily structured. In the process of knowledge creation, therefore, every contribution is equally significant even though it might not be regarded as formal by the academic community. Rudduck and Hopkins (1985) have encapsulated this notion in the words of Harry Torrance, when he says:

> **That question is concerned with how knowledge is produced and valued. Schools often constrain intellectual development and the possibility of free and equal participation in democratic debate by ignoring and hence obscuring the process of knowledge production. Our aspiration is for schooling to facilitate an understanding of knowledge as socially generated. In this context a fruitful move might be to elevate everyday reflection and learning to equal status with the academic. We all know a great deal about the world, about our social world, and a formal opportunity to reflect upon one's own process of coming to know things might offer us a purchase on what authoritative others term 'knowledge'.**
>
> *Rudduck and Hopkins, 1985, p. 73.*

It is conventional to distinguish between so-called professional knowledge and lay knowledge, scientific knowledge and common-sense, research methodologies in the natural sciences and research methodologies in the social sciences and, it is this distinction that lies at the heart of both positivism and naturalism (Hammersley and Atkinson, 1983). The discourse that is associated with the concepts of positivism and naturalism (by which the researcher is expected to be pre-occupied with objectivity and the validity of her/his research instruments and where the researcher is expected to adopt the "*fly-on-the-wall*" approach in order that she/he may not interfere with the natural setting of the research environment) has, to a significant extent, influenced the choice of the research methodology that a researcher will decide to use in a study that she/he is conducting. However, the same discourse does, at times, become self-defeating.

> **In the early days of science, it was believed that the truth lay all around us ... was there for the taking ... waiting, like a crop of corn, only to be harvested and gathered in. The truth would make itself known to us if only we would *observe* nature with that wide-eyed and innocent perceptiveness that mankind is thought to have possessed in those Arcadian days before the Fall ... before our senses became dulled by prejudice and preconception and *observe things as they really are.***
>
> *Medawar, 1979, p. 70.*

This should however not be necessary as according to Blumer (1969),

> **reality exists in the empirical world and not in the methods used to study that world. Research methods are mere instruments that are designed to identify and analyse the obdurate character of this empirical world, and as such their value lies only in their suitability in enabling this task to be done.**
>
> *p. 124.*

Trying to eliminate the effects of the researcher on the data is not only futile but it can, at worst, be apocalyptic. Hammersley and Atkinson (1983) contest the view that the researcher can escape the social world that she/he lives in, in order to study that world. Fortunately, this is not necessary. It is important to remember that how research subjects respond and react to the presence of the researcher, given a particular research environment, may be as revealing as how they respond and react to other situations.

Some advocates of the "scientific method" of research are of the opinion that educational ethnography, as a form of social research, is intuitive, open-ended, unstructured, non-scientific, unproblematic, needs no special expertise (*i.e. anybody can do it*) and requires little or no preparation (Hammersley and Atkinson, 1983). This fallacy can be blamed on die-hard naturalists who have sometimes appealed to natural history and ethology to legitimate their recommendation of exploratory observation and description (Lofland, 1966; Blumer, 1969; Speier, 1973). Nonetheless, inasmuch as it is a fact that ethnographic research cannot be pre-determined, it is critical that the research design and pre-field preparations are thought through very carefully prior to the commencement of the research study.

Before starting to work with the learners, it was considered important to establish a profile of the type of learner that the research study was going to be investigating. The data for building this profile was collected by a questionnaire. Data and/or information was collected on the following aspects:

- demographic information i.e. the age, gender and current grade of the learner;
- information and communication technologies that the learner was exposed to in the home environment (e.g. *radio, telephone, television, computers*);
- how learners generally spend their time in the classroom;
- learner-educator and learner-learner communication in the classroom;
- learners' opinions of the educator who teaches them most of the time (*at elementary school usually the same educator teaches all the learning areas*);
- the general socio-economic background of the learner.

4.3 Analysis of Data Collected from Participating Schools

Before the data collection process could commence, logistical issues and the methodology for the data collection process had to be considered. A number of data collection techniques were considered for this exercise and eventually a decision was made that a questionnaire was most appropriate. The next question then became how the questionnaire could be administered to young children so that the data was accurate, valid and reliable. It is common knowledge that there are many problems associated with young learners' literacy skills in South Africa. There might also be problems with regard to learners' interpretations of

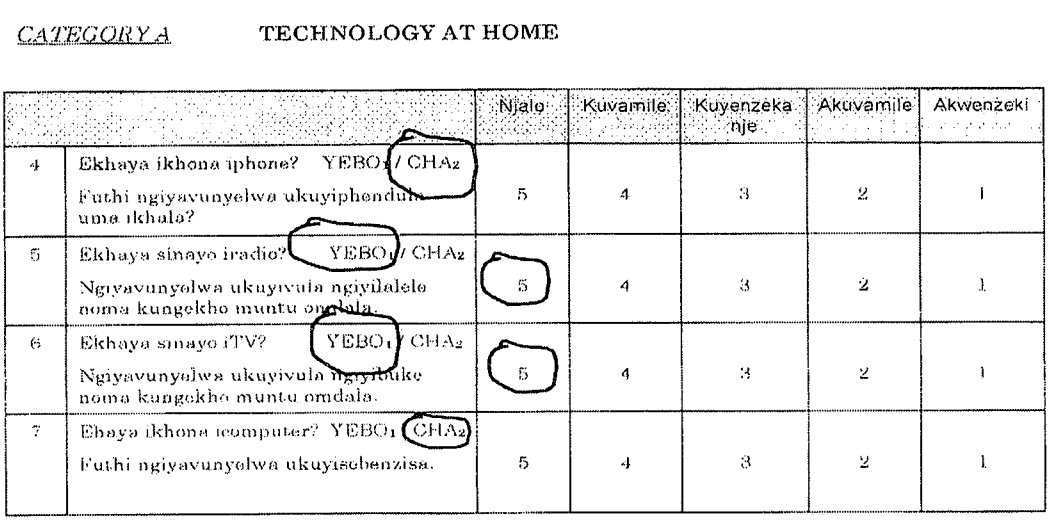
the questions. One possible way around some of these problems would have been to administer the questionnaire to each learner through a structured interview. That, however, was impractical, considering the number of interviews that would have had to be done. There was also a possibility that the learners would be intimidated by the interviewing process, given that the interviewers would be their own educators. Learners, for example, would have found it awkward to respond honestly to questions relating to their relationship with the educator. In an attempt to minimise this problem, it was decided that learners would fill out an anonymous questionnaire and this they would do by themselves.

The next consideration was the language in which the questions in the questionnaire would be expressed. The language issue was critical to the success of the data collection exercise. To facilitate a decision on the matter, a pilot test was undertaken. Two language versions (isiZulu and English) of the same questionnaire were administered to a group of thirty **Grade 6** learners that had been picked randomly. These learners were from Ikusasalentsha Combined Primary School. The group were asked to complete an English version of the questionnaire. The same group was subsequently given an isiZulu version of the same questionnaire. The exercise was designed in such a way that it would be possible to identify both the isiZulu and English versions that had been filled out by the same respondent. **PILOT QZ01** identified copy number 1 of the isiZulu version of the questionnaire and this corresponded to **PILOT QE01** which identified copy number 1 of the English version. **PILOT QZ01** and **PILOT QE01** were respective copies of two language versions of the same questionnaire that were filled out by the same respondent.

Figures 4.1 and 4.2 below are extracts from actual copies of the two language versions of the questionnaire (**PILOT QZ01** and **PILOT QE01**) that were filled out by the same respondent.

Figure 4.1

An extract from an actual copy, Pilot QZ01, of the isiZulu version of the questionnaire showing a learner's responses to questions in a section referred to as Category A

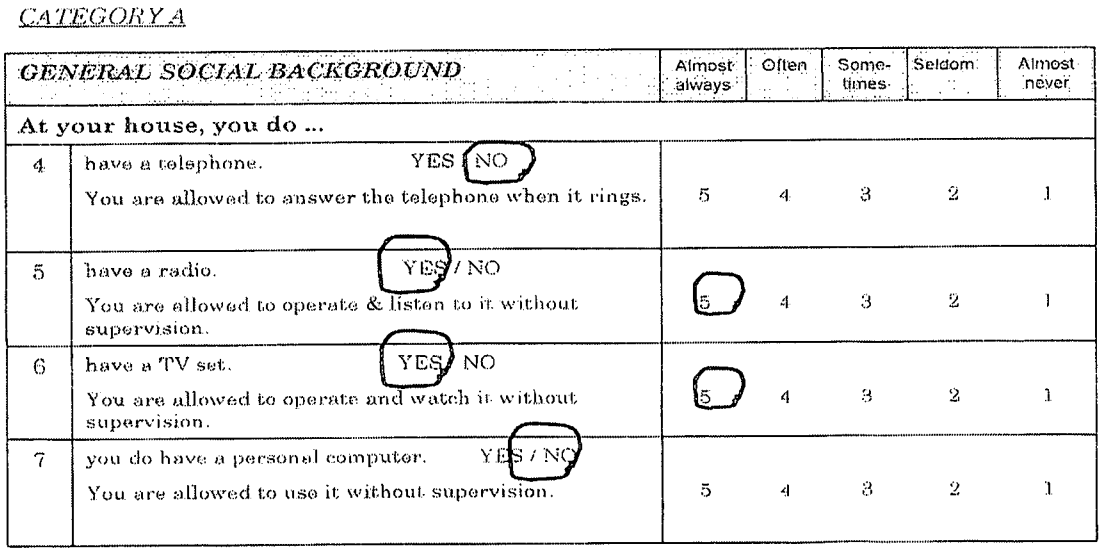


CATEGORY A TECHNOLOGY AT HOME

		Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
4	Ekhaya ikhona iphone? YEBO$_1$ / CHA$_2$ Futhi ngiyavunyelwa ukuyiphendula uma ikhala?	5	4	3	2	1
5	Ekhaya sinayo iradio? YEBO$_1$ / CHA$_2$ Ngiyavunyelwa ukuyivula ngiyilalele noma kungekho muntu omdala.	5	4	3	2	1
6	Ekhaya sinayo iTV? YEBO$_1$ / CHA$_2$ Ngiyavunyelwa ukuyivula ngiyibuke noma kungekho muntu omdala.	5	4	3	2	1
7	Ekhaya ikhona icomputer? YEBO$_1$ CHA$_2$ Futhi ngiyavunyelwa ukuyisebenzisa.	5	4	3	2	1

Figure 4.2

An extract from an actual copy, Pilot QE01, of the English version of the questionnaire showing a learner's responses to questions in a section referred to as Category A



CATEGORY A

GENERAL SOCIAL BACKGROUND		Almost always	Often	Some-times	Seldom	Almost never
At your house, you do ...						
4	have a telephone. YES / NO You are allowed to answer the telephone when it rings.	5	4	3	2	1
5	have a radio. YES / NO You are allowed to operate & listen to it without supervision.	5	4	3	2	1
6	have a TV set. YES / NO You are allowed to operate and watch it without supervision.	5	4	3	2	1
7	you do have a personal computer. YES / NO You are allowed to use it without supervision.	5	4	3	2	1

Clearly, the above responses, in respect of both language versions of the questionnaire, were reliable. It was also unlikely that the respondent could have "memorised" the responses to one version and then simply transcribed these to the other version. Furthermore, the two questionnaires had, deliberately, been set out differently. It was therefore reasonable to assume that the responses were genuinely those of the respondent and could hardly be attributed to coincidence.

Again, **PILOT QZ04** and **PILOT QE04** were examples of the two language versions of the questionnaire that were completed by the same respondent.

Figure 4.3

An extract from an actual copy, Pilot QZ04, of the isiZulu version of the questionnaire showing a learner's responses to questions in a section referred to as Category A

CATEGORY A **TECHNOLOGY AT HOME**

		Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
4	Ekhaya ikhona iphone? YEBO1 / (CHA2) Ngiyavunyelwa ukuyiphendula uma ikhala?	5	4	3	2	1
5	Ekhaya sinayo iradio? (YEBO1) / CHA2 Ngivunyelwe ukuyivula ngiyilalele noma kungekho muntu omdala.	(5)	4	3	2	1
6	Ekhaya sinayo iTV? (YEBO1) / CHA2 Ngivunyelwe ukuyivula ngiyibuke noma kungekho muntu omdala.	5	4	3	2	1
7	Ekhaya ikhona icomputer? YEBO1 / (CHA2) Ngivunyelwe ukuyisebenzisa.	5	4	3	2	1

Figure 4.4

An extract from an actual copy, Pilot QE04, of the English version of the questionnaire showing a learner's responses to questions in a section referred to as Category A

CATEGORY A

GENERAL SOCIAL BACKGROUND		Almost always	Often	Some-times	Seldom	Almost never
At your house, you do ...						
4.	have a telephone. (YES) / NO You are allowed to answer the telephone when it rings.	5	4	(3)	2	1
5.	have a radio. (YES) / NO You are allowed to operate & listen to it without supervision.	(5)	4	3	2	1
6.	have a TV set. (YES) / NO You are allowed to operate and watch it without supervision.	5	(4)	3	2	1
7.	you do have a personal computer. YES / (NO) You are allowed to use it without supervision.	5	4	3	2	(1)

In the isiZulu version the respondent said there was no telephone at home, while in the English version he (the respondent was male) said that they did have a telephone. Again with regard to the question on the personal computer, although the respondent said they did not have one at home, he went on to say that he was "almost never" allowed to use it. The question became how the respondent knew whether or not he would be allowed to use a personal computer if there was none at home.

For each of the thirty respondents, responses to the same question in both isiZulu, and English were compared. It was found that in respect of the English version of the questionnaire there were a significant number of questions (78% to be exact) to which respondents had failed to respond and, as such, it was not always

possible to compare particular English responses to their corresponding isiZulu counterparts. The only reasonable explanation that could be suggested for this was that some respondents had difficulty understanding the questions because they had to respond in a non-mother tongue language, in this particular case, English.

To further accentuate the difficulty that some learners had in understanding the English version of the questions, let us consider one subject's responses to questions 26 to 31, Category E (General Economic Background) and compare the Questions on a one-to-one basis for both the English and isiZulu versions of the questionnaire. For Question 26, which inquired whether the respondent's mother had a job, the respondent answered "yes" for both versions. Question 27 asked what type of job the respondent's mother did. In the English version the respondent answered that his mother worked "at the Durban Station", while in the isiZulu version he answered that his mother "uyadayisa" – which means "she is a hawker". Incidentally, the Durban railway station is popular with hawkers. The respondent further provided consistent responses, for both the English and isiZulu versions, for Questions 28 through to 31. The difference in the sense of the responses to Question 27 was significant. This is one example of the many factors that were considered in deciding on which language version of the questionnaire would be appropriate to use at which school. It must be mentioned that this turned out to be a very tedious exercise that was, nonetheless, critical in making an informed decision.

The two versions of the questionnaire were then treated as two distinct data sources. The data from the two language versions of the questionnaire were analysed and the results of the analysis compared. Once again there were significant idiosyncratic variations in the results of the analysis of the data associated with only the English version of the questionnaire. The two tables on the next page represent the results of the cross-tabulation of the variables "respondents having a telephone at home" and "respondents allowed to answer the telephone when it rings." To attempt to make some sense of the figures, a detailed analysis follows later in the discussion.

Table 4.1

Cross-tabulation of the English version of the questionnaire i.r.o. variables 'respondents having a telephone at home' and 'respondents allowed to answer the telephone when it rings'.

Count

		Respondents allowed to answer telephone when it rings							Total
		No response	Almost always	Often	Some-times	Seldom	Almost never		
Respondents having a telephone at home	Yes		7		2				9
	No							20	20
Total			7		2			20	29

Respondents having a telephone at home. * Respondents allowed to answer telephone when it rings. Crosstabulation

Table 4.2

Cross-tabulation of the isiZulu version of the questionnaire i.r.o ' variables respondents having a telephone at home' and 'respondents allowed to answer the telephone when it rings'.

Count

		Respondents allowed to answer telephone when it rings							Total
		No response	Almost always	Often	Some-times	Seldom	Almost never		
Respondents having a telephone at home	Yes	1	2	1	2		1		7
	No							23	23
Total		1	2	1	2		1	23	30

Respondents having a telephone at home. * Respondents allowed to answer telephone when it rings. Crosstabulation

Table 4.1 (*derived from the English version*) suggested that **9 respondents** had a telephone at home, **20 respondents** did not have a telephone at home and **1** did not respond. ***Table 4.2*** (*derived from the isiZulu version*) returned **7 respondents** who had a telephone at home and **23 respondents** who did not have a telephone at home. Closer examination of the figures in respect of the two language versions reveals some interesting information. The questionnaire was based on a five point Likert scale.

A comparison of data in Table 4.1 and Table 4.2 revealed the following in respect of learners who had telephones in their homes. According to Table 4.1 (English version) 7 respondents are, **almost always**, allowed to answer the telephone when it rings and 2 are, **sometimes**, allowed to answer the telephone when it rings. Table 3.2 (isiZulu version) returns 2 respondents who, **almost always**, are allowed to answer the telephone when it rang, 1 respondent who was **often** allowed to answer the telephone when it rang, 2 respondents who were **sometimes** allowed to answer the telephone when it rang and 1 respondent who was **never** allowed to answer the telephone when it rang.

Furthermore, 20 respondents out of a total of 29 (70%) did not have a telephone at home (English version), while 23 respondents out of a total of 30 (76%) did not have a telephone at home (isiZulu version). The six percent difference between the two figures is statistically not very significant. In spite of this, it would be useful to establish why 6% of the respondents responded the way they did.

There is no evidence to show that the two versions of the questionnaire differed in any way other than linguistically. It was thus reasonable to declare that the two language versions of the questionnaire were essentially the same and that the essence of the questions was not affected by language.

The two language versions of the questionnaire were administered in accordance with the language profile of the learners in the school. For example, Crawford Preparatory, Lyndhurst Primary and Nizam Road Primary had learners with a predominantly English profile, (these learners used English in both their home and school environment), while learners at Ekukhuleni Senior Primary, Ikusasalentsha Combined Primary and St Wendelins Junior Primary used isiZulu in their home and school environments. After being refined and improved, the English version of the questionnaire was used in the former group of schools, and the isiZulu version was used in the latter group. The concept and format of this questionnaire was used as a foundation for all other data collection activities during the course of the research study.

Before one can make any credible assumptions on learner perceptions and come up with reasonable conclusions why such perceptions exist, one needs to:

- accept that these perceptions exist;
- discover what influences them; and,
- determine how one can interpose in the process.

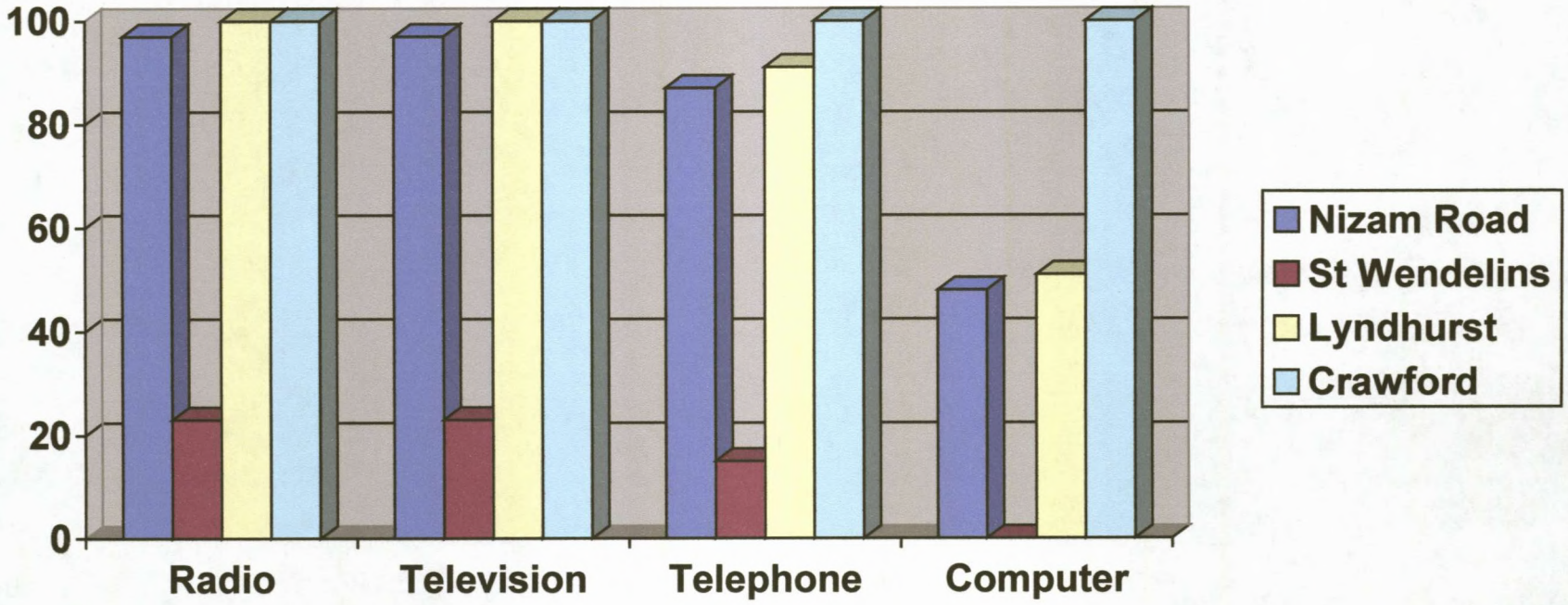
The learners that participated in the research study experience technology at home and in school. It is possible that their perceptions had been influenced by

such experiences. Chart 4.1 is the result of the analysis[19] of data, from four of the six schools, that was collected on learner experiences of different information and communication technologies in the home environment. The chart confirmed what was established in Chapter 2 in terms of the relationship between a learner's socio-economic background and exposure to technology. Classroom visits and chats to learners outside the classroom (the researcher had access to some of the learners from Lyndhurst, Ikusasalentsha and Ekukhuleni outside school time) showed that learners from Lyndhurst were more adventurous and assertive in their approach to their computer activities, while learners from Ikusasalentsha and Ekukhuleni were rather tentative and in the classroom they tended to await instructions from the educator. This pattern was also observed with learners from St Wendelins.

[19] In the analysis of data that was collected from the six schools, the researcher decided to use data from four of the six schools, that is Crawford Preparatory School, Lyndhurst Primary School, Nizam Road Primary School and St Wendelins Primary School. The reason for excluding data from both Ekukhuleni Senior Primary School and Ikukusasalentsha Combined Primary School was because both the schools' computer laboratories were no longer functioning after the spate of burglaries. The researcher, therefore, felt that as learners from these schools were no longer using computers, they could not provide reliable and valid data for the analysis process.

Chart 4.1

Technology in the Learners' Home Environments



Computer games, it does appear, do make an indirect contribution to young learners' dexterity and skill in navigating the computer's operating system. Most of the young learners, who had access to a computer at home, exchanged games, which they then installed in the computer systems in their own homes. In most instances these games are pirated copies with no installation instructions. In order for the learner to be able to play the game they had to be able to install it into the system. In desperation they did a lot of research and even consulted the "help menu" in order to install the computer game and eventually play with it. The motivation was the ultimate satisfaction of being able to play the game. Unlike their counterparts from disadvantaged backgrounds, for these individuals the computer is not a gadget that they regard with awe and sometimes trepidation, but a toy that they derive pleasure from using. It is something that they can afford to take for granted. This following quotation was cited earlier in Chapter 3 and it is worth repeating here:

> **Play is not a dominant feature of childhood but it is a leading factor in development.**
>
> *Vygotsky, 1978, p. 101.*

and further,

> **Many psychologists take play to be important for development (often, however, because – in tautological fashion – they believe it to be a dominant feature of childhood). In common belief and common practice in most industrialised societies play is taken to be the main feature of childhood, but little consideration is given to its relevance for development and for learning. If it weren't so, there would surely be much more play taking place in primary (not to mention secondary) schools.**
>
> **Play is associated with a host of other concepts and activities: games, imagination, fantasy, symbolic representation, pretending, performing, pleasure and fun, to name but a few. There are also different conceptual frameworks in which the concept play 'live'.**
>
> *Newman and Holzman, 1993, p. 94.*

Charts 4.2 and 4.3 reveal that in schools in the middle to upper middle-class category (Lyndhurst and Crawford) the situation in the classroom was still relatively competitive. "Competitive" here has been used in the sense that learners worked individually rather than in groups and it did not necessarily mean that they competed with one another. Poorer schools (Nizam Road and St Wendelins), on the other hand, appear to have embraced cooperation and collaboration. It is reasonable to speculate that they do this in order to stretch their meagre resources. During classroom visits the researcher observed that the learners at St Wendelins had mastered the art of sharing a work station. This was also the case for Ekukhuleni and Ikusasalentsha. At both Lyndhurst and Crawford, learners worked at individual work stations and therefore there was "no talking to one another during the lesson". This is confirmed by Chart 4.2 which shows that at both St Wendelins and Nizam Road learners tend to work in groups and also that they are allowed to talk to one another while they worked. This then brings up an interesting question whether it is possible to turn around the challenge of a lack of resources in poorer schools and use this to the benefit of teaching and learning in the classroom. How do we, as educators, use the limited resources that are available to us (in this case computers) to enrich the social life of the classroom. Hawkins et al. (1982) argue that:

> **While there is very little evidence to date about this new technology in classrooms, what evidence there is suggests that microcomputers provide opportunities for interaction and collaboration among students [learners] in classrooms. There are several reports that children often work together and teach their peers over microcomputers (Levin & Kareev, 1980; Papert, Watt, diSessa & Weir, 1979; Sheingold et al., 1981). Sheingold et al. report from case studies of three different school systems that, in those schools where students [learners]**

> were permitted to work together on computers, teachers often commented on the amount and quality of social interaction which took place around computers. Levin and Kareev have been using the computer as a context within which to study children's social interaction when they are solving problems because, in their view, it provides a rich and revealing environment for such investigation. If microcomputers prove to be a classroom context which facilitates children's collaborative activity, then their use in the classrooms becomes an interesting naturalistic context for examining the effects of this learning activity.
>
> In addition to the possibility that microcomputers in classrooms may provide new opportunities for interaction, collaboration, and teaching, microcomputers may also contribute to the emergence of 'computer experts' in classrooms. Teachers in classrooms with microcomputers report that there are children on whom others rely for help at the computer (Sheingold et al., 1981). These children, as a result of their expertise, become valued by their peers as resources.
>
> *Hawkins et al., 1982, pp. 362.*

Inasmuch as classrooms in poorer schools (Ikusasalentsha, Ekukhuleni and St Wendelins) were inherently collaborative (*cf. Charts 4.2 and 4.3*), the obvious benefits of such collaboration did not seem to be manifested in the activities that the learners were engaged in during computer lessons. These learners did not have the same level of confidence in the handling of computer software and hardware that their counterparts from affluent schools demonstrated. As was mentioned earlier, learners from poorer schools were tentative and lacked initiative during their computer lessons.

Chart 4.2

Time Spent in Class Working in Groups

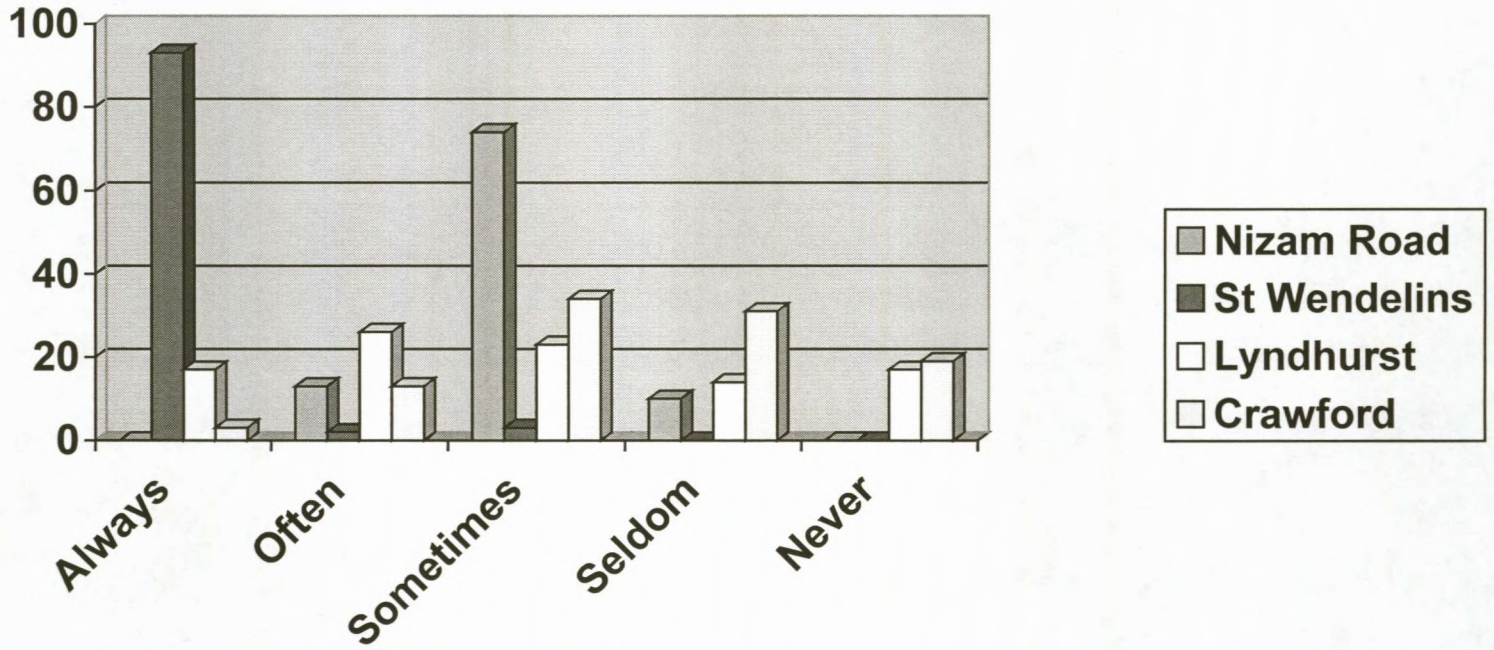
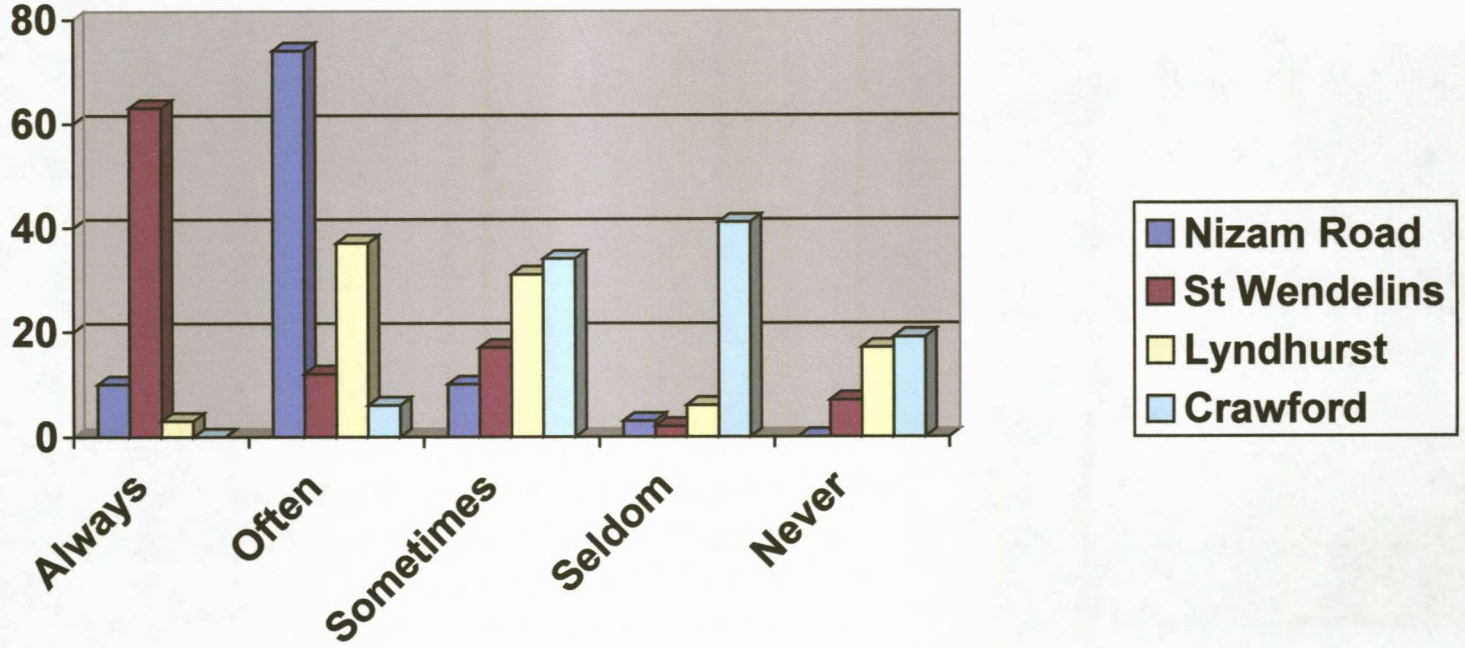


Chart 4.3

Classroom Communication – Learners Talk to One Another While Working



Charts 4.4 and 5.5 make rather interesting reading. The respondents had provided very strong opinions about their educators. The majority of learners not only believed that their educators explained things clearly, but also they overwhelmingly believed that their educators enjoyed teaching them, almost always. Commonsense and simple logic have it that the way learners feel about the educator who teaches them, has a direct causal relationship to the way they feel about the subject that the educator teaches and that such feelings have a direct influence on how learners perceive the subject that the educator teaches and hence their own attitude towards the subject.

Chart 4.4

Learners Think Educator Explains Clearly

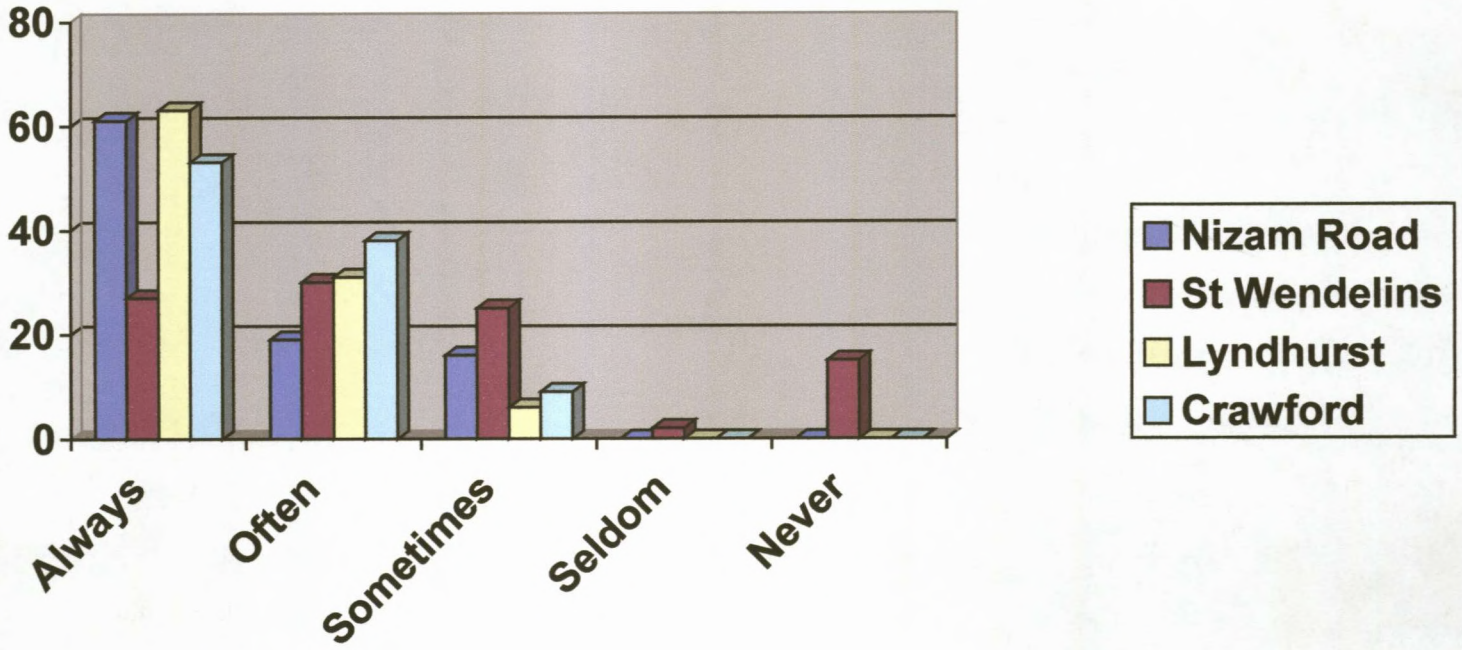


Chart 4.5

Learners Think Educator Enjoys Teaching Them

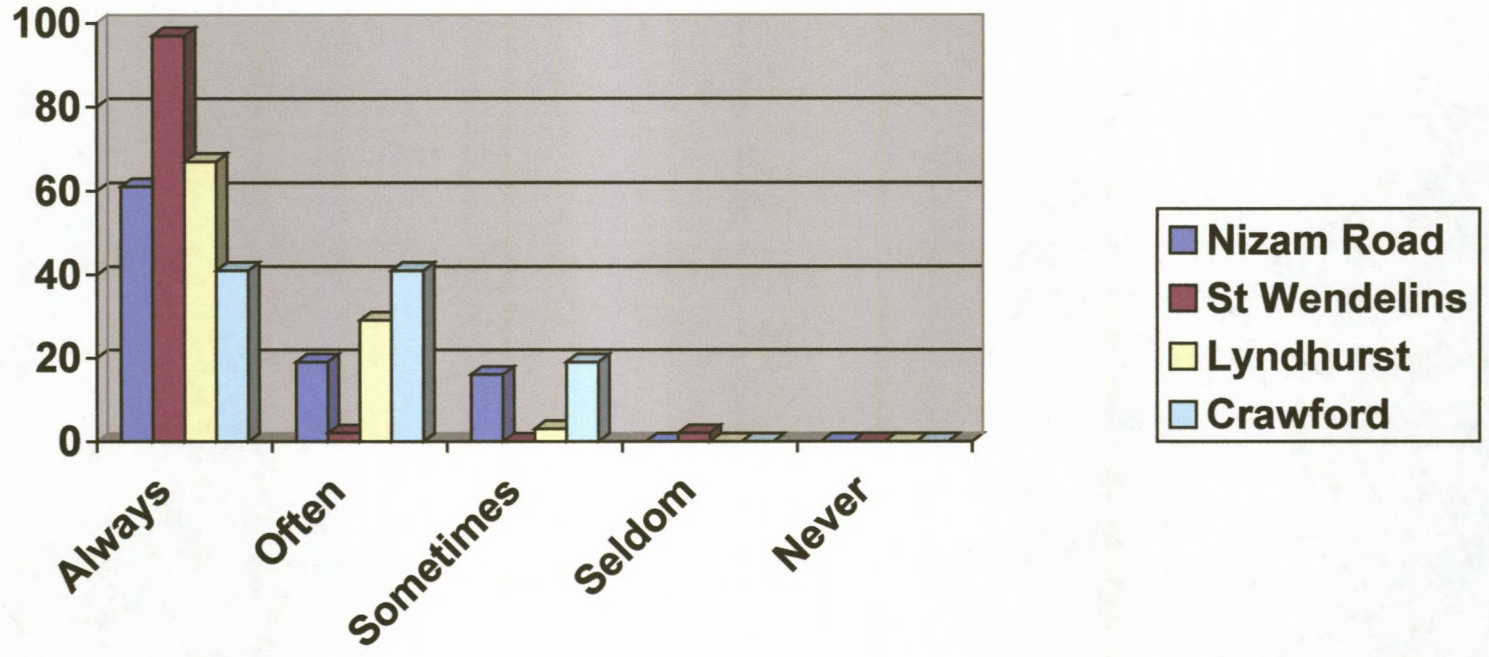
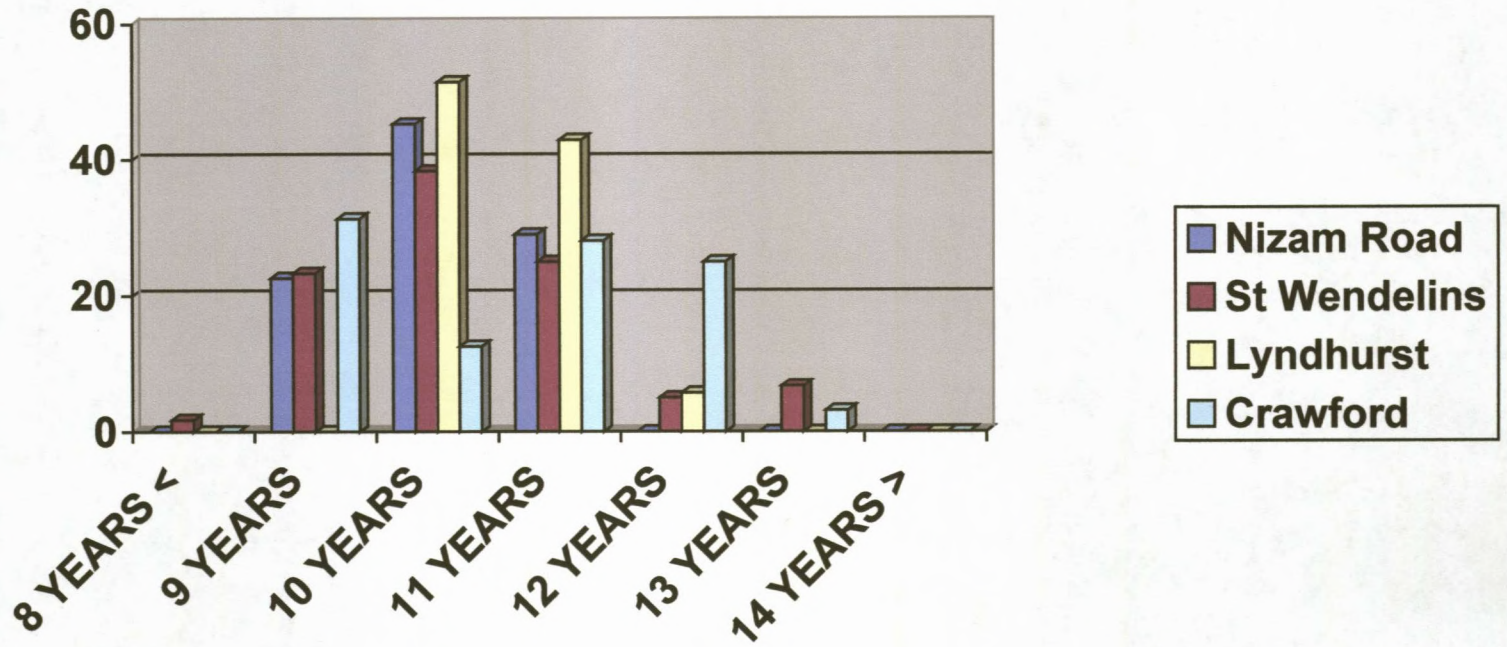


Chart 4.6

Breakdown of the Ages of Learners Who Participated in this Research Study



Finally, Chart 4.6 shows a normal distribution of the ages of learners that participated in the research study.

4.4 Classroom Observations

Working with elementary learners in the schools' computer laboratories was an educational experience that was most fulfilling. During the course of the research process, a substantial amount of time was spent entirely in classroom observation. On average, the researcher spent two hours a day, once a week, at one of the six research sites observing and interacting with the educator and with the learners, as they worked at their computer terminals.

Classroom observation exercises revealed that in the majority of the research sites, computers had one or more of the following software packages installed in them:

- a computer-assisted mathematics learning programme, usually SERGO (cf. Chapter 1, p12);
- a word-processing package, usually Microsoft Word or Corel WordPerfect;
- a spreadsheet, usually Quattro Pro or Microsoft Excel;
- one or more software packages for teaching keyboard skills;
- games (both educational and non-educational);
- a software package for teaching English.

In two of the six research sites, the software and the hardware had been donated by the same donor and so were similar. Microsoft is the most popular operating system in South Africa used in almost all personal computers and so appeared

frequently. Finally, SERGO is the only locally-produced CAE programme for the teaching and learning of mathematics and is, therefore, affordable in terms of price.

In all the research sites, with the exception of Crawford Preparatory, the learning programmes that the learners were exposed to were unstructured and furthermore there was no integration into the school's curriculum. The learning programmes also varied significantly from site to site. The variations were either conceptual, in terms of programme make-up, in terms of programme content or in terms of pedagogy. Classroom activities were driven by the nature and format of the software package that was used, instead of a pedagogical approach that was designed by the educator.

During one visit to Ikusasalentsha Combined Primary in 2000, a group of Grade 5 learners using SERGO were working with polygons, in what was, supposedly, a mathematics lesson. The learners were responding to multiple choice questions on the computer screen. The questions were set on the following topics:

- the definition of a type of polygon;
- calculation of perimeter around a type of polygon; and
- calculation of the surface area inside a type of polygon.

The researcher enquired from the educator whether this was an extension of a mathematics lesson, or indeed, a consolidation of a series of mathematics lessons on the geometry of polygons. The educator replied that he was not aware what the learners were currently doing in their mathematics class as he was only teaching them "Computer Literacy". Clearly what these learners were busy with

in this particular lesson, at this particular instance, could have had nothing to do with their mathematics curriculum. This was a classic case of no connection between the mathematics that is taught in the mathematics classroom and the mathematics that is taught in the computer laboratory.

A visit to Nizam Road Primary School at one point revealed that learners were busy learning computer architecture. Learners were being taught what a disk drive is and what its function was. Again, it should be remembered that the educator at Nizam Road Primary School was not professionally trained. His post was funded by the school's governing body from school funds raised from school fees. The type of computer training that the educator had himself received was of the type offered by the many private colleges in South Africa that offer computer courses to unemployed Grade 12 graduates. These courses are based on computer architecture, spreadsheets, word-processing and speed typing. These are essentially crash courses on the identification and use of input and output devices of computer systems and the practical application of popular commercial software packages.

At St Wendelins, the computer laboratory was part of a resources centre, which included a media centre. The educator was employed in what is known as a "curriculum transformation post". Curriculum transformation posts are used by the Department of Education to encourage South African state schools to embrace the new outcomes-based curriculum. Over and above their normal allocation for teaching posts, schools can apply for these curriculum transformation posts. However, the Department of Education prescribes the

qualifications of the educator that will be appointed to the post, as well as the learning area in which the appointed educator will be expected to teach. The educator at St Wendelins was qualified in the teaching of the learning area, Technology, in the foundation phase (junior primary).

During a visit to this school in 2002, the educator was observed teaching an environmental education lesson in the computer laboratory. This was a lesson on the usefulness of insects in the ecosystem. The message in the lesson was that learners should not kill insects because insects are friendly and useful. The lesson further provided some information on the anatomy of the insect. This was an integrated lesson on communication (language) and the environment. The use of the computer here was mainly for animation (graphics), in the same way that one would use video technology. Animated pictures and colour seemed to appeal to the Grade 2's who were involved in the lesson.

The approach adopted by Crawford Preparatory in the use of computers in education was different in many ways. As was mentioned in Chapter 1, Crawford Preparatory is an expensive independent school. As was expected, the type of computer hardware and software that they had was far superior to that in any of the other five schools. What was interesting, however, was how this hardware and software was used to support the curriculum. It should, nonetheless, be mentioned that the researcher came upon some of this information, not during a visit to Crawford, but when he attended a South African Association for Science and Technology Educators (SAASTE) Conference that was hosted by the Glenwood campus of Crawford Schools on 2-3 October 2002.

The theme of this conference was "Surviving Curriculum Change". Miss Shona Elridge, an educator at Crawford Glenwood, presented a session on how all Crawford schools used computers to support the curriculum. The following information has been distilled from her presentation.

During lesson planning and the development of their learning area or subject-specific learning programmes, educators in the different learning areas (or subjects) submit a project to the Technology (computer) educator in which the use of a computer at some stage of the learning activity, or project, will be required. The Technology educator discusses the project with the individual subject/learning area educator, providing technical assistance and advice to him/her. At Crawford, computers are seen as a resource to help in the teaching and learning of subjects or learning areas. The emphasis is not on the teaching of "computer skills". The assumption is that learners will acquire such skills during the learning process. Learners do not spend time learning how to handle a mouse, or improving their keyboard skills by typing meaningless text using a word-processor. Instead they are provided with a learning activity, which would be in any of their subjects or learning areas and in which they will be required to use computer technology to do to one or all of the following:

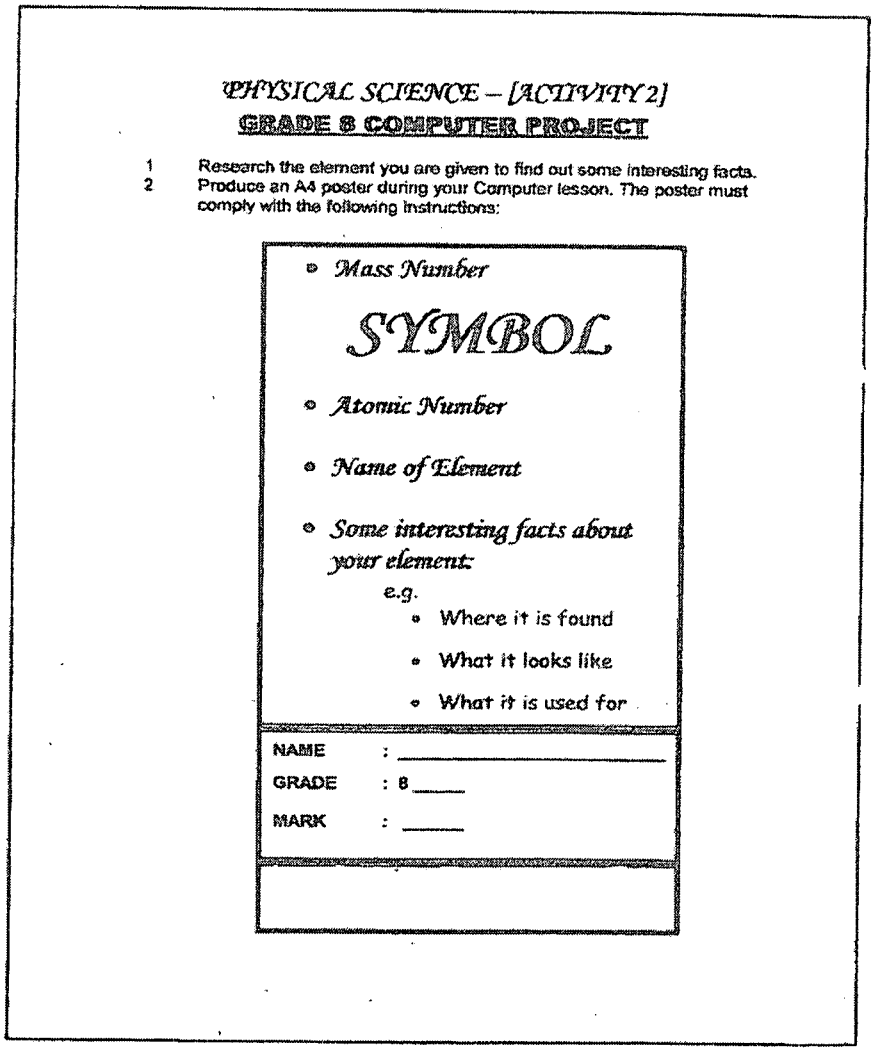
- do research, that is look for information in the Internet's world-wide web or a cd-rom;
- present their project, that is type the project report using a word-processor, include charts where necessary using a spreadsheet, include graphics using scanned or downloaded digital images. Some learners use

presentation packages (e.g. Microsoft PowerPoint) to present their projects to their classmates.

The following are some of the examples of learning activities and projects that educators in the school had developed:

Figure 4.5

Examples of integrated computer-based learning programmes from Crawford Preparatory School



PHYSICAL SCIENCE – [ACTIVITY 2]

GRADE 8 COMPUTER PROJECT

1 Research the element you are given to find out some interesting facts.
2 Produce an A4 poster during your Computer lesson. The poster must comply with the following instructions:

- *Mass Number*

SYMBOL

- *Atomic Number*
- *Name of Element*
- *Some interesting facts about your element:*

e.g.

- Where it is found
- What it looks like
- What it is used for

NAME : _____

GRADE : 8 ____

MARK : _____

Figure 4.5 (a)

COMPUTER TASK [ACTIVITY 1]

Your activity is centred around the **"ATOMIC MODEL"**.

The smallest individual particles of matter are the atoms. They are too small to be seen by the naked eye. Over the years, scientists and others have constructed hypothetical models of an atom.

During your Computer lesson, you are required to trace the historical development of the Atomic Model and briefly state the contribution made by each of the under-mentioned persons.

While there have been other contributions, our emphasis for this task will be only on those persons listed below.

1.	DEMOCRITUS	[Greek philosopher around 400BC]. 2 facts
2	DALTON	[English chemist – 1803] 3 facts
3	FARADAY	[1834] 1 fact
4	THOMPSON	[English scientist – 1897] 2 facts
5	RUTHERFORD	[British scientist – 1908] 2 facts
6	BOHR	[Danish Scientist – 1913] 3 facts
7	CHADWICK	[1935] 1 fact

Don't you marvel at the work each has done!!

Figure 4.5 (b)

GRADE 9 FRONT PAGE TEST.
Time: 2 lessons.

Design WebPages on a topic of your choice. It must be rounded off and ready to publish and view.
Your page must be exciting and must draw a websurfer's attention. You may add as many extra features to enhance your website but the following minimum requirements will be checked.

1. Your site must have at least 2 pages.
2. On any of the pages you must have hyperlinks connecting your different pages, and hyperlinks to an e-mail address, and a hyperlink to an existing website.
3. At least 2 graphics in the form of clipart or other pictures must be visible.
4. Clipart must be labeled
5. One of the pages must have a table with 5 Rows and 3 columns.
6. The table border must be red and the background green
7. The table border must be 5 ' thick.
8. Row 1 must be merged with the table heading in uppercase and centered
9. On one of the two pages you must include a form that looks similar to the one below. Remember to adapt your questions to your own topic.

name:

Surname

e-mail

'ell us more about your encounter with UFO's.

Scrolling Text Box

› you think they will visited you again?

› Yes ○ No

Why do you they visited you

Drop Down Menu

Which of the following magazines do you subscribe to?

☐ Gottcha ☐ I want to leave ☐ Aliens ☐ Amazing

10. Add a hitcounter.
11. Save your work on a stiffy, put your name, topic and class group on the disk

Figure 4.5(c)

GRADE 9 – DATABASE ASSIGNMENT

OBJECTIVE/SKILLS:

- **To design an access database using DESIGN VIEW.**
- **To design an access database form using the Wizard.**
- **To enter data into the database using:**
  - **DATASHEET VIEW (Table)**
  - **FORM VIEW (Form)**
  - **DATASHEET VIEW (Form)**
- **To apply Simple Selection Queries to the Table in Order to answer questions.**

TASK:

In your next double (60-min) period of Computer Literacy, you will be expected to create a database of the first 36 elements of the periodic table.

Your database will be required to contain the following:

- **Atomic Number**
- **Symbol**
- **Elements name in full**
- **Metal/Non-metal**
- **Relative Atomic mass**
- **Group Number**
- **Period**

Once the data has been entered you will be required to interrogate your database to answer questions about the first 36 elements.

You will have to print out your table, as well as answering questions about the database. For example: An Alphabetical list of all non-metals.

THIS IS FOR MARKS so please make sure that you can do the above!!!!!!!!

Figure 4.5 (d)

Even though the examples that were presented were for the junior secondary school, upon enquiry the researcher was told that the approach was the same for the elementary school. It was clear that there was much diversity concerning the use of computers in different schools. Although the intention was not to generalise from these observations, it was, nonetheless, of concern that, of all the six schools that participated in the research study, no two schools were similar. It was as if one was looking at schools in different countries, or indeed on different planets.

During a research exercise researchers are often tempted to collect more data than will probably be needed, or used, in the analysis. These are difficult decisions that researchers often have to make. It could, however, be argued that the more data one collects, the clearer will be the picture that is presented in the analysis and the stronger will be the arguments that the researcher presents in respect of conclusions. Research is about controlling some variables while varying others to create a particular environment to which the research subject will respond in a particular fashion. Before one is able to manipulate these variables, one needs to have a good understanding of the current situation.

In the education community, it is a truism that the physical condition of learning spaces (that is if such learning spaces exist) and the availability of teaching and learning resources make a significant contribution towards the success of any system used to deliver education. It was for this reason that, in 1996, the South African National Department of Education (DoE) commissioned a survey that documented the conditions of physical infrastructure in South African schools to

find out whether such infrastructure was appropriate for teaching and learning. The survey culminated in the compilation of a database, known as the **School Register of Needs Survey**. Table 4.3 below is an extract from the 1996 School Register of Needs Survey's database. The figures in the Table are percentages showing the extent of lack of resources in schools. Schools in the country were defined in terms of the following three categories:

- **None** (*the school does not meet the basic resource requirements to be able to function at the minimum threshold*);
- **Inadequate** (*the school does have resources but these are inadequate*);
- **Adequate** (*the school has enough resources to support teaching and learning meaningfully*).

Table 4.3

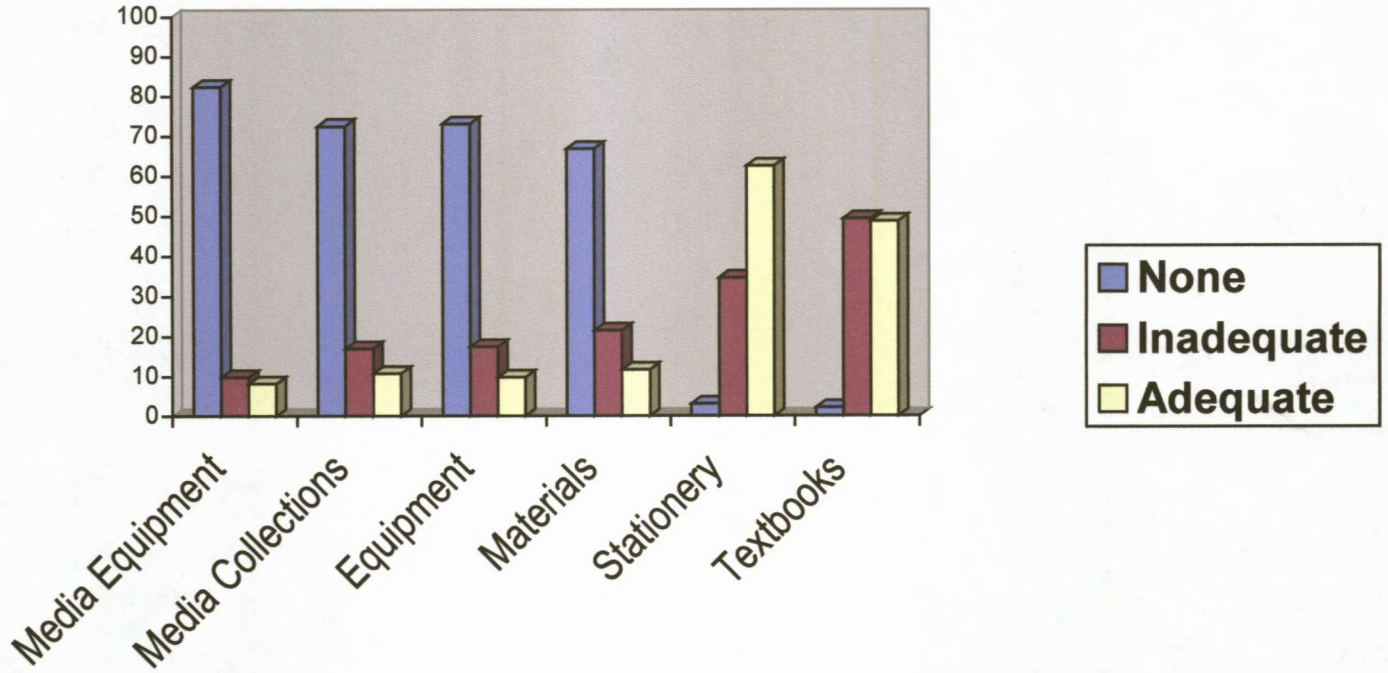
The Provisioning of Schools in South Africa (Education Foundation, May 1997).

Resource(s)	None	Inadequate	Adequate
Media Equipment	82.3	9.7	8.1
Media Collections	72.4	16.9	10.7
Equipment	**72.9**	**17.4**	**9.7**
Materials	66.8	21.5	11.7
Stationery	3.1	34.5	62.4
Textbooks	2.1	49.3	48.6

The data in Table 4.3 above is presented graphically in Chart 4.7 on the next Page, for easier interpretation.

Chart 4.7

The Provisioning of Schools in South Africa.



If one works on the assumption that computer hardware is categorized under equipment, it is obvious that less than 10% of the schools in South Africa have the adequate infrastructure to support the teaching and learning of computer allied subjects. KwaZulu-Natal (among the three poorest provinces in South Africa) is below the national average in terms of the shortage of equipment in schools. Considering that there are ±5 734 schools in KwaZulu-Natal, this means less than 500 schools can support the teaching and learning of computer-related subjects in the Province.

The successful deployment of computer technology as a resource for teaching, and learning in schools should be considered against the amount of other allied teaching and learning resources. The fact that less than half of the schools in the country have an adequate supply of textbooks and only just over 60% of the schools have an adequate supply of stationery must, most certainly, be of grave concern to the South African education authority. If computers are classified under "equipment", then far more than 70% of the schools in the country do not have equipment.

In order that human and material resources may be effectively used in a school, common sense has it that the school should be of a sound physical structure. Computer hardware requires an above average physical infrastructure because the equipment is adversely affected by conditions that are hot, dusty and moist.

Table 4.4 below contains data on the physical condition of the schools in each of the country's nine provinces. Schools have been categorized as follows (Report on the School Register of Needs Survey, 1996 and 2000):

- **Very Weak>Weak** (*schools with a below average to dilapidated physical infrastructure*);
- **Minor Repairs** (*schools needing minor repairs*); and
- **Good>Excellent** (*schools with a physical infrastructure between good to excellent, including new schools and schools that have been recently renovated*).

Table 4.4

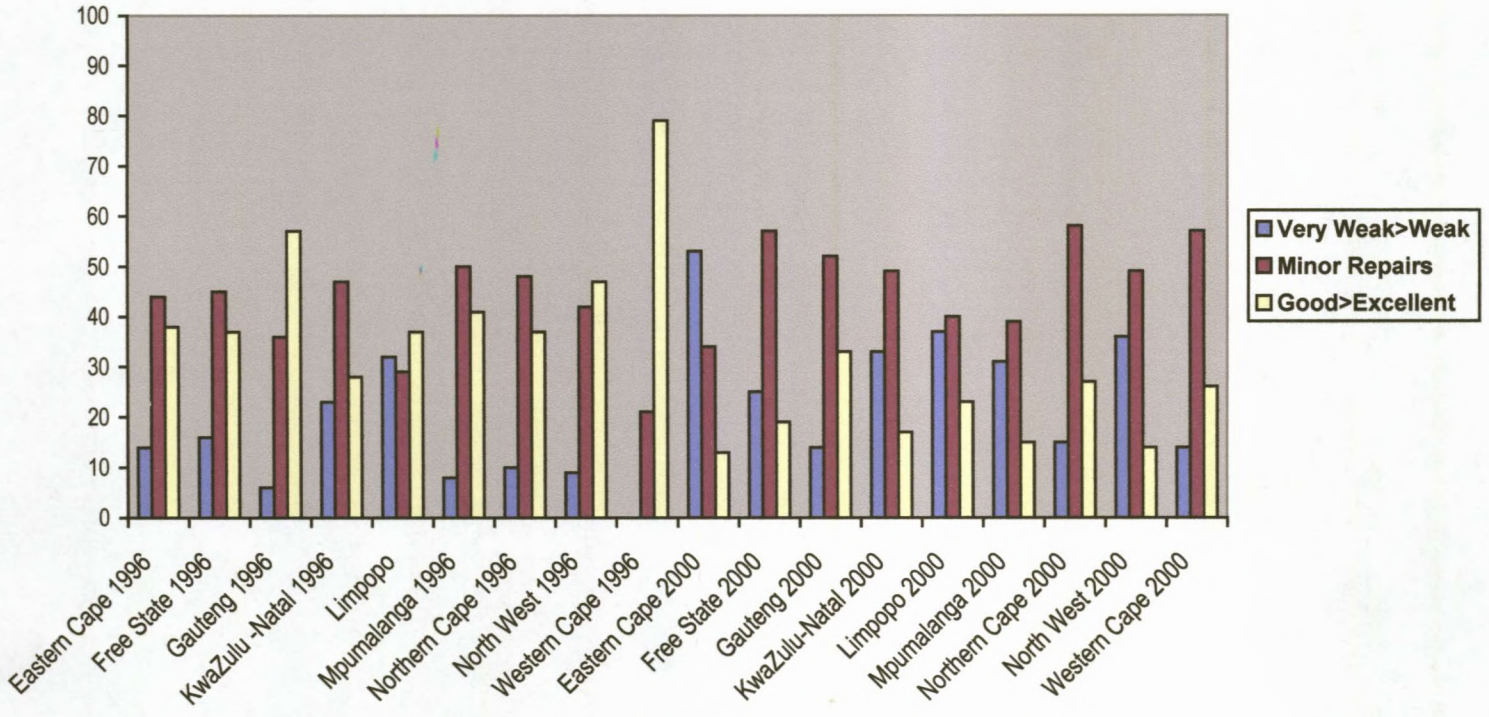
Conditions of Buildings in State Schools, by Province, in South Africa
(Source: Report on the School Register of Needs Survey, 1996 and 2000)

PROVINCE	Very Weak > Weak		Minor Repairs		Good > Excellent	
	1996	2000	1996	2000	1996	2000
Eastern Cape	836	3 299	2 590	2 110	2 257	787
Free State	457	612	1 313	1422	1 065	466
Gauteng	122	312	786	1 157	1 235	725
KwaZulu-Natal	**1 193**	**1 896**	**2 432**	**2 818**	**1 469**	**1 001**
Limpopo	1 328	1 569	1 209	1 719	1 544	960
Mpumalanga	156	554	938	706	763	264
Northern Cape	55	73	255	279	209	129
North West Province	218	839	981	1 119	1 122	324
Western Cape	12	221	333	902	1 339	422

Chart 4.8 on the next page presents the above data graphically.

Chart 4.8

Conditions of Buildings in State Schools, by Province, in South Africa.



According to the 1996 figures of the Survey Report, only 28% of the schools in the province of KwaZulu-Natal may be considered to have a physical infrastructure that is appropriate (i.e. **Good<Excellent**) and so can support the deployment of computer equipment. This figure decreased to 17% in 2000 and no reason has been provided for this decrease. Table 4.5 below confirms a point, that was made earlier in Table 4.3 and Chart 4.7, in respect of the provisioning of schools in South Africa. Extrapolating from the figures on the availability of equipment in schools, it was stated that less than 10% of the schools had computers. Data from the School Register of Needs Survey below confirms that only 8,7 % of schools in South Africa in 1996 had computers that were deployed for teaching and learning, but this rose to 12,3% in 2000.

Table 4.5

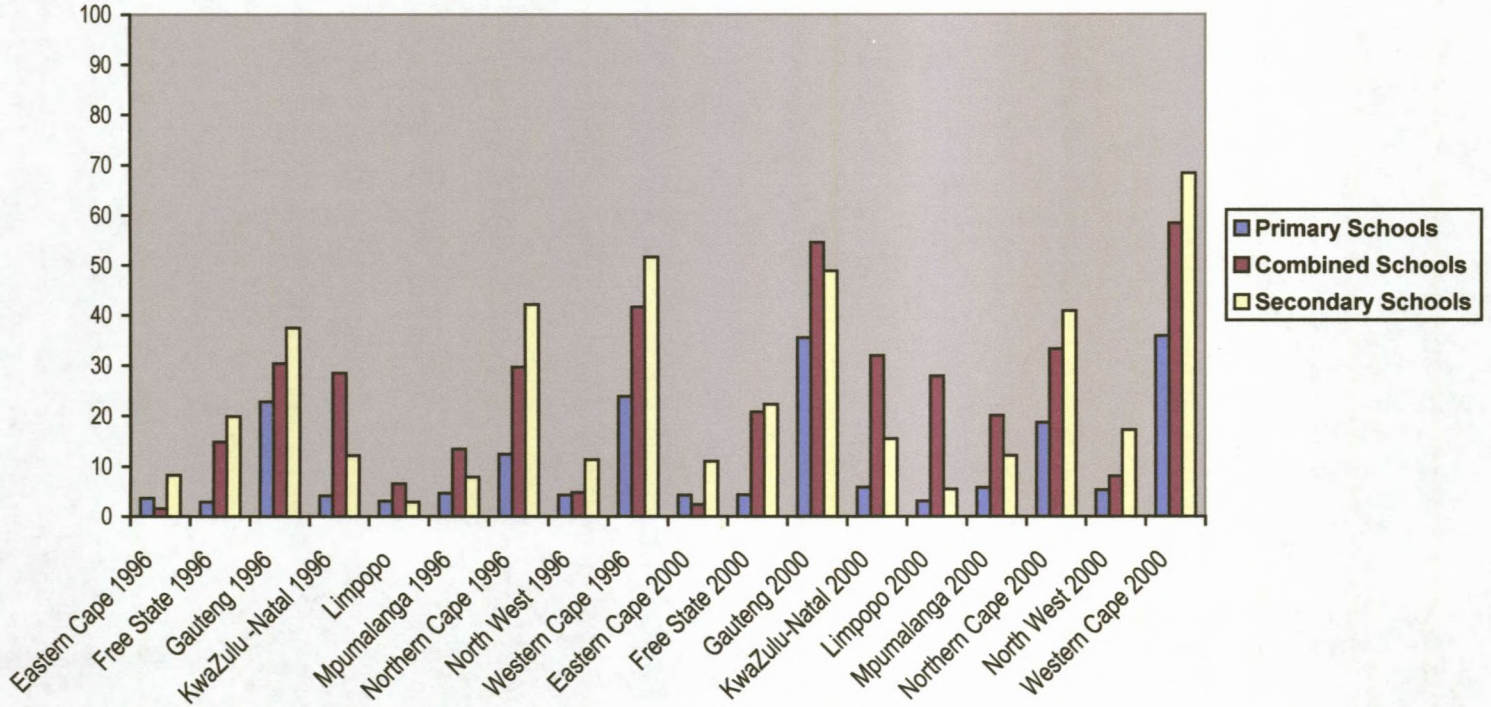
Percentages of Schools with Computers for Teaching and Learning by Type, by Province, in South Africa
(Source: Report on the *School Register of Needs Survey, 1996 and 2000*)

PROVINCE	Schools with computers as a % of Primary schools		Schools with computers as a % of Combined schools		Schools with computers as a % of Secondary schools	
	1996	2000	1996	2000	1996	2000
Eastern Cape	3,7	4,3	1,6	2,4	8,3	11,1
Free State	2,9	4,4	14,9	20,8	19,9	22,3
Gauteng	22,8	35,5	30,4	54,5	37,5	48,8
KwaZulu-Natal	**4,2**	**5,9**	**28,5**	**32,0**	**12,2**	**15,5**
Limpopo	3,1	3,1	6,6	27,9	2,9	5,5
Mpumalanga	4,7	5,8	13,5	20,1	7,9	12,2
Northern Cape	12,5	18,7	29,7	33,3	42,2	40,9
North West Province	4,3	5,3	4,8	8,1	11,4	17,2
Western Cape	23,9	35,9	41,7	58,4	51,6	68,4

Chart 4.9 on the next page presents the above data graphically

Chart 4.9

Percentages of South African Schools with Computers for Teaching and Learning by Type and by Province.
(Source: Report on the *School Register of Needs Survey, 1996 and 2000*)



The statistics that have been presented, first on the resourcing of schools, the physical condition of school buildings and the availability of computers for teaching and learning, show that South Africa's educational challenges are, unfortunately, characteristic and typical of a developing country. This situation is unlikely to improve in the short to medium term: indeed, it is more likely to deteriorate. This is confirmed by the report of the surveys that were conducted in 1999 and 2000.

The data on the physical infrastructure shows KwaZulu-Natal to be among the three poorest provinces in South Africa, including the Eastern Cape and the Northern Province. The national situation on the resourcing of schools looks even bleaker. According to the Report on the School Register Needs 2000 Survey only 9,5% of the country's primary schools have computers for teaching and learning, compared to 14,8% and 18,8 % in combined and secondary schools, respectively. Giving meaningful and significant attention to the elementary school and the elementary school learner becomes even more crucial for South African education because very little investment has been made in this area. The physical condition and the resourcing of schools have an influence on how computer technology is exploited in a particular school and thus how learners will perceive it as an educational resource.

According to the School Register of Needs Survey (1996; 2000), South Africa has more elementary school learners than secondary school learners. It is precisely for this reason that the country should invest in elementary schools. In KwaZulu-Natal, there are approximately **three** learners in the elementary phase

for every **one** secondary school learner. It can never be over-emphasised that the formative years (elementary school) are important for a learner's cognitive and intellectual development. Thus the significance of providing quality instruction to elementary school learners cannot be over-emphasised. The role of computer technology in a school should be to facilitate instruction and thus improve the quality of learning.

Table 4.6

Numbers of State Schools, in each Phase, in the Province of KwaZulu-Natal.
(Data Source: EMIS Snap Survey 2001 and EMIS Annual Survey 2000)

POPULATION	PERCENTAGE	NUMBER OF SCHOOLS
Pre-Primary	0,02	93
Primary	67,00	3873
Secondary	25,00	1454
Combined	4,80	281
Special Schools	0,01	60
TOTAL	100,00	5761

Chart 4.10 on the next page presents the above data graphically.

Chart 4.10

Proportions of Types of Schools in Respect of State Schools in the Province of KwaZulu-Natal.

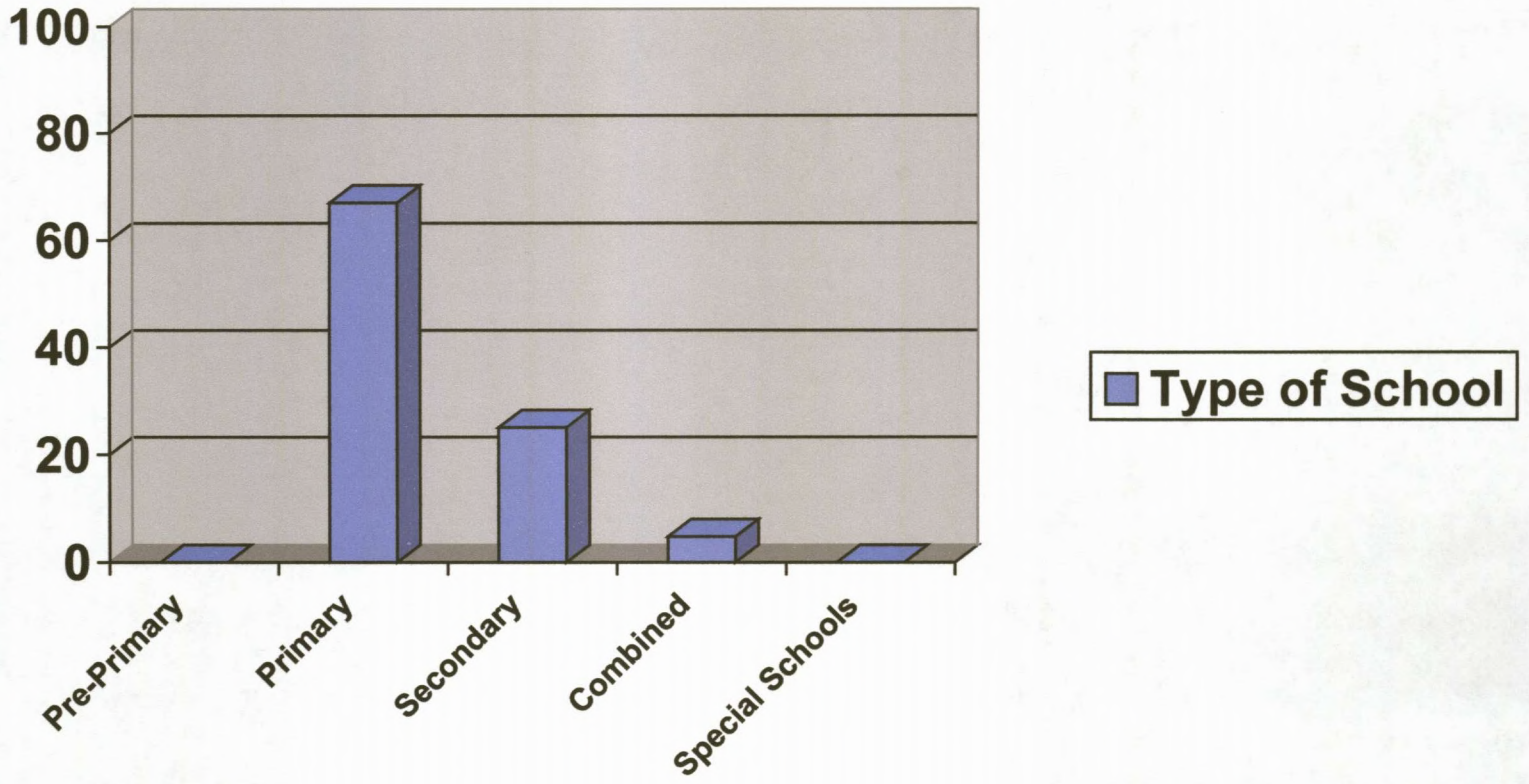


Table 4.7

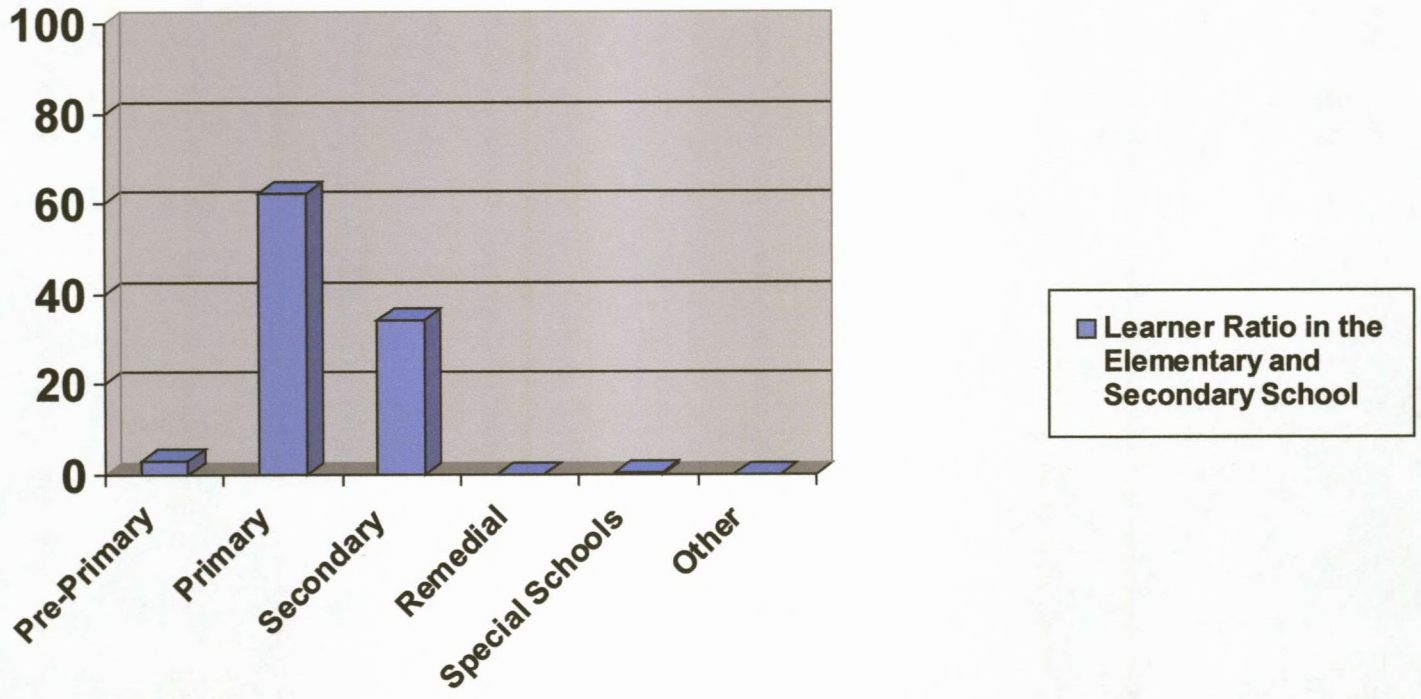
Numbers of Learners in State Schools in each Phase in the Province of KwaZulu-Natal.
(Data Source: EMIS Snap Survey 2001 and EMIS Annual Survey 2000)

POPULATION	PERCENTAGE	NUMBER OF LEARNERS
Pre-Primary	3,19	85 584
Primary	62,24	1 669 217
Secondary	34,13	915 241
Remedial	<0,01	596
Special Schools	0,41	10 909
Other	<0,01	207
TOTAL	100,00	2 681 754

Chart 4.11 on the next page presents the above data graphically.

Chart 4.11

Learner Proportions by School Type in respect of State Schools in the Province of KwaZulu-Natal.



Any meaningful educational intervention in South Africa, in general, and in the province of KwaZulu-Natal, in particular, will have to take serious consideration of these facts.

> **Despite the paucity of the research base, evidence shows that physical environments make a difference even though their influences can be very subtle; which means dramatic educational transformations cannot be expected as an immediate response to any physical change. What needs to be clarified is how, and under what conditions physical conditions exert their effects. A question that needs to be asked is whether facilities are just a technical factor, or do they have wider, perhaps indirect, influences. Apparently, beyond the distinct technical roles that facilities have, they also create a special atmosphere that suggests activities and affects learner perceptions.**
>
> *Arzi, 1997, P. 7*

Looking further into the situation in the province of KwaZulu-Natal, as described in the 1996 and 2000 School Register of Needs Survey, it is revealed that **70%** of the schools in the province are situated in rural areas while the remaining **30%** are found in either urban or peri-urban areas.

If the South African education authority is to put computers in rural schools and some peri-urban schools it faces the problem of no electricity supply, without which the technology cannot function. Moreover, computers, like most electronic devices, are not compatible with portable electricity generators that run on internal combustion engines because, these generators cannot supply electric current at a constant frequency. The fluctuating energy supply damages the computer's circuitry and interferes with the CPU's logic. Evidence of this can be seen when one attempts to use a hand-held calculator whose power supply (cells

or battery) has been exhausted. These are but some of the serious challenges facing the introduction of computer technology into most South African schools.

4.5 Conclusion

The data that was collected from the participating schools and the information that was obtained from the analysis of these data provided the researcher with some insight into the perceptions of the learners in respect of computers. The reader is again reminded that there was never an intention to generalise on the results of this research study. Nonetheless, the purpose of the study was to juxtapose what happened in these research sites on the broader South African education system. Furthermore, the purpose of the study was to try and understand what elementary school learners' perceptions and opinions of computers are. But before one draws conclusions and makes recommendations on the basis of this data, it is important that one should discuss some of the factors that either worked for or against the success of the research project. It is hoped that the discussion will help other researchers who might be contemplating undertaking a similar exercise. The next Chapter provides a snapshot of some of the logistical challenges that the research study faced, the Chapter further highlights and presents some of the gains that, unintentionally, accrued from the process. Finally, the researcher draws conclusions on the basis of the data that was presented in this Chapter and makes recommendations which will, hopefully, contribute positively to the discourse on information and communication technologies in education, particularly computers in schools, in South Africa.

4.6 Summary

This Chapter reflected on, and analysed the data that was collected during the course of the study. To this end, social and cognitive processes in the classroom, as a learning environment, were discussed. The discussions detailed the process that the research study followed. The data that was collected during the course of the research study was presented and then analysed.

The researcher further reported on classroom observations that he made during his interaction with the participating schools. Finally, an overview on the provisioning of schools in South Africa was also given to lay a foundation for the process of concluding on the findings and making recommendations.

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CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

When the researcher began this research study, he was naïve, trusting and perhaps over-ambitious. He approached a number of people in the South African big business sector (*cf. Appendix D*), requesting them to give financial support, either partially or fully, to the research project. The purpose was to establish computer laboratories in schools in poor communities. These laboratories would be used for research purposes. The research that would be undertaken in the schools aimed to provide research-based information regarding strategies for the deployment of computer technology (software and hardware) in schools. As this exercise would be linked to the research study, it would further provide cost-effective models for the use of computer technology as an effective pedagogical tool in the classroom. This was less than two years after South Africa's first democratic election and the country was still riding the crest of the wave of the "political miracle".

The researcher submitted several business plans (proposals) to potential corporate sponsors, detailing how the proposed laboratories were going to help to improve both the social and educational plight of the poor and formerly disenfranchised. These business plans were, in his humble opinion, professionally prepared and carefully thought through.

5.2 Reflecting on the Research Study

It is, however, ironic (as the researcher was soon to realise) that getting sponsorship from corporate South Africa in order to do educational research and development work aimed at the poor and the disadvantaged, has become almost impossible, compared to the situation during the apartheid years. This was because post-apartheid corporate South Africa now held a different view than that which had prevailed before April 1994, on research and development in education. The generosity of big corporations to the poor and disenfranchised, that was typical of the period of the 1980's to the early 1990's, was eventually exposed for what it had always been, false charity aimed at supplicating the poor.

The researcher must point out that reading on educational theory helped him to get a better perspective on the impact of socio-political dynamics in education. It was for this reason that the researcher was able to understand the strange behaviour of corporate sponsors. He suddenly realised why it had been so difficult to come up with working solutions to the problems of education, not only in South Africa, but internationally.

A development programme, aimed at the poor and formerly disenfranchised, is unlikely to succeed unless the affected community is involved in the design of the programme. Paulo Freire (1972b) argues that the restoration of the dignity and humanity of the poor can only be accomplished by the poor themselves. He continues that the poor are better prepared to understand the terrible significance of an oppressive and impoverished society. When the researcher consulted with educators and parents in the communities of the two schools that were initially

involved in the study, there was consensus that the best way for the study to put something back into these communities was for it to leave behind a tangible legacy. There was also agreement that there was no better legacy than a computer laboratory.

The research study benefited from the support of international researchers outside South Africa. In 1997, the researcher visited Israel for five weeks at the invitation of the Israeli Foreign Ministry to study a course in Education for Science and Technology. The ideas that went into creating the business plans, that were mentioned above, came from his experiences in Israel and his interaction with policy-makers, theoreticians and practitioners in the Israeli system of education. Israel is probably the fastest developing country in the world – both economically and technologically – and there is much that the researcher learnt during his stay there.

In the proposal that was submitted and approved by the research committee, the researcher had indicated that he was going to collaborate with the School of Education at Tel Aviv University in Israel. The following email message was sent by the researcher to Dr. David Mioduser, head of the School of Education at Tel Aviv University, on the 24th of February 1997 requesting cooperation and collaboration with the School's post-graduate programme.

> **Dear Dr. Mioduser**
>
> **I sent you an email message on the 18th February 1997. I am however not sure whether you received the message. I visited your institution on Tuesday the 4th of February, with a group of 27 international students that were attending a course on Education for Science & Technology at the Aharon Ofri**

International Study Centre (MASHAV), based at Ramat Rachel in Jerusalem.

I spoke to you briefly during the tea break, in which time I suggested to you that I was involved in a similar kind of research project here in South Africa. However my concern is that we (South Africa) do not, as yet, have resources (e.g. research literature, case studies, academic papers, human expertise etc.) inside the country to support this kind of research. I therefore requested if I could, in some way, link what I was doing here to the work (within Masters and PhD programmes) that was already happening in the School of Education at your institution.

I was particularly interested in the demonstration on control systems that was done for us. I wish to do a similar project with elementary school learners here. I would like to take advantage of the work that you have already done. Would it be possible for you to send me some literature, on that project, so that I may plan mine either as a parallel or comparative study.

I have discussed this with my institution (Technion Natal) and also my supervisor, Dr. John Gardener. Both are very excited at the prospect of international collaboration in research, especially with an institution from a country that has achieved so much both in technological development and developments in technology education curriculum research and development. I also had a meeting with Dr. Kopano Taole, from the Foundation for Research Development (FRD), an organisation that recommended my name to MASHAV and is likely to fund my research project.

My proposal to both the Technion Research Committee and the FRD will therefore, either swim or sink, on the quality and amount of support that I will receive from yourself , as an individual, and the School of Education as an institution. I have also solicited support from other individuals that I met during my stay in Israel.

I wish to thank you in anticipation and Shalom.

Yours sincerely

HINTSA MHLANE

cc Dr. John Gardner — Associate Director – School for Post-secondary Education, Technion Natal
Dr. Kopano Taole — Effective SET Education and Awareness, FRD

Dr. Mioduser responded on the 9th March 1997:

From:	David Mioduser < miodu@post.tau.ac.il>
To:	CASME < casme@iafrica.com>
Subject:	Re: "Linking my Research Project in Technology Education to work currently being done within the School of Education at the University of Tel Aviv
Date:	09 March 1997 06:52

Dear Hintsa Mhlane
I apologize for the delay in answering our message.
In principle I'll be glad to think about some sort of cooperation in a plan based on our own research on children and robotics. We run several projects having a different focus target population, and we can think about a given set of research topics we can collaborate on.
About formalisation of cooperation links I think this should be defined (e.g. a research project) and then look for ways of establishing the linkage. Do you have precise ideas in mind? How do you see the configuration between your project and our group or School?
Sincerely,
David.

::::: Dr. David Mioduser
::::: Tel-Aviv University, School of Education, Ramat-Aviv 69978, Israel
::::: Tel. : 972 – 3 – 6408465 ~ Fax: 972 – 3 – 6407752 ~ miodu@post.tau.ac.il

This collaboration required a formal relationship between the Natal Technikon[20] and the University of Tel Aviv. Relationships of this kind are formalised at the highest level of the respective institutions' management structures. Dr. David Mioduser, who was Head of the School of Education, was willing to cooperate and collaborate with the researcher, but it was not possible for him to do this outside a formal and recognised working agreement between the two institutions.

[20] The Technikon Natal has since merged with M.L. Sultan Technikon to form the Durban Institute of Technology

Regrettably, the formal relationship between the two institutions did not materialise. Dr. Mioduser and the researcher had to make do with an informal and private arrangement. This denied the researcher a rich research and development resource environment that would have been available to him had this relationship been formalized. Also the intention was to make, at least, one study trip to Tel Aviv University during the course of the study and spend some time there interacting and sharing ideas with other post-graduate students who were involved in similar studies. Again this was regrettably not realised because the researcher was unable to raise funds to finance the trip himself in the absence of a formal cooperation agreement between the Technikon Natal and Tel Aviv University.

As the research was school-based, timing was crucial considering that the work could only be done during the school term. The school terms that were most ideal were the **Second** and **Third**. The problem with the First Term of school was that it takes some time for schools to settle down and do some work. By the time this happens it is usually half way through the term. The Fourth Term was out of the question as this is the busiest time of the year for schools and an added "disruption" like a research study cannot be accommodated.

Logistical problems however forced the researcher to change the original plan. The researcher had spent the period between September and November 1997 training educators who were in the research team. The plan was to do the school-based work during the Second and Third school terms of 1998. The whole of

1998 went past without this happening because the National Research Foundation (NRF) (previously Foundation for Research Development or FRD), did not release the research funds. The NRF withdrew its funding for Dr. John Gardner's Learning Radio project, to which the researcher's bursary was linked. A dispute arose between the NRF and Dr. John Gardner, the grant-holder, for the Learning Radio Project. The researcher spent the whole of 1998 re-negotiating with NRF to have his bursary separated from John Gardener's Learning Radio Project.

School-based work eventually commenced during the First Term and continued through to the Second Term of 1999. This process was, nonetheless, short-lived because one of the schools that was being used as a research site, (Ekukhuleni Senior Primary School) was burgled and all the equipment in the school's computer laboratory was stolen. Although most of the computer equipment that had been stolen from the school's computer laboratory during the burglary was recovered with the help of the community surrounding the school, this was unfortunately not the last time that the school's computer laboratory was burgled. The burglaries at this particular school were to become endemic and there was a potential risk that all the work that had been done thus far, would come undone. However, as the research study progressed and literature on other similar research projects was consulted, it became clear that a comparative study between the two schools was not going to come up with anything new, other than the information that was already available. Consultation with other international researchers on the subject confirmed this fact. It was at this point that a decision was taken to include other schools as research sites to, in computer vocabulary, "back up" the process. It was also at this point that the research approach was changed from

purely comparative, to eclectic ethnographic. This both broadened and deepened the research context.

A number of eminent researchers and educationists contributed, directly or indirectly, towards the realisation of the study and the philosophical underpinnings of the research approach. Correspondence between the researcher and these individuals helped to shape the research approach and to focus and guide the research methodology. What follows are two examples of e-mail correspondence that the researcher exchanged with Professor David Metzer of the Open University in Israel and Professor Joan Solomon of the Department of Educational Studies at the University of Oxford in England. After the researcher had emailed Professor Solomon his draft research proposal, she replied:

> **From:** joan.solomon@educational-studies.oxford.ac.uk
> **Date sent:** Wed, 11 Jun 1997 11:11:33 + 0000
> **To:** Mr Hintsa Mhlane <mhlane@SHEPFS@.UND.AC.ZA
> **Subject:** Draft Research Proposal
>
> **Dear Hintsa**
> **I have been away, and am off again at the end of the so I am replying to your letter in somewhat of a hurry.**
>
> **The proposed research is quite straightforward – a questionnaire, an experimental group and a control group and a committed group of teachers. You will, I guess, get some positive results since the pupils and teachers both want to install and use the computers. But will you find anything about the other factors which lead to success or failure.**
>
> **Could you include interviews with parents or teachers?**
>
> **Could you record, by using pairs of students, the effect of more or less demanding work?**
>
> **If you allow them to 'play' how will you judge when play gives way to purposeful activity? They are not the same.**
>
> **That's all for now.**

Best wishes,

Joan.

Professor David Metzer of the Open University in Israel was an eminent project, programme and curriculum evaluator. Having had a number of discussions with Professor Metzer, the researcher thought it would be prudent to seek Professor Metzer's opinion on the research proposal. The draft research proposal was emailed to Professsor Metzer for his comments before it was submitted the Durban Institute of Technology's Research Committee. This was Professor Metzer's response via e-mail.

Date sent: Wed, 21 May 1997 14:11:55 + 0300 (IDT)
From: David Metzer <davidme@oumail.openu.ac.il>
To: Mr Hintsa Mhlane <mhlane@SHEPFS@.UND.AC.ZA
Subject: Re: RE-ESTABLISHING CONTACT

Dear Mr. Hintsa
I am very glad to hear from you, I hope you are doing well. Concerning your question on attitudes of students as related to computers, I think you need to conduct a search in ERIC documentation, there are plenty of articles dealing with attitudes. I suggest you search for the last ten years. As of the statistical analysis, if you use an attitude questionnaire, you will need to conduct a factor analysis or a cluster analysis, to check for the different constructs. Since you deal with elementary students, I would suggest not to include in your sample lower classes than the sixth grade. Attitudes are unstable among young children.
I hope I was of help to you. Let me know about your advancement.
David.

These, therefore, are some of the inputs that influenced the direction of the research study, resulting in some of the changes that were effected and subsequently informed the research approach. The change in the approach enriched the study tremendously in that a number of non-conventional data

collection methods could be used because of the flexibility of educational ethnography.

The measure of the success of a research project is the extent of the implementation of its findings. It is common knowledge that very few of the projects on academic research that have happened within tertiary, and in some instances, research institutions, have been implemented. This is particularly true for research associated with academic qualifications. This research study was undertaken with a view to implement its findings to support the teaching and learning of Technology in the school system in South Africa. The researcher felt that if the research and development community understood how elementary school learners perceived computer technology, this would expedite the process of putting computers in schools.

A major contribution from the whole process, however, is the fact that a pilot study on the use of LEGO Dacta in the classroom will be undertaken in the five state schools that were used as research sites. This pilot study will be modelled around the INFOESCUELA Project on the educational impact of LEGO Dacta materials that was commissioned by the Ministry of Education in Peru, between October 1998 and 1999. There are a number of similarities between South Africa and Peru as both are developing economies. This will present the researcher with an opportunity to inform the emerging country's ICT strategy, particularly in respect of the effective use of computers in the elementary school curriculum.

Researchers are always faced with difficult choices of whether standard research methods and procedures, no matter how inappropriate, should be adhered to even if it meant undermining the delicate relationship that existed between the researcher and the subjects. The case in point was the refusal of the management of Crawford Preparatory School to have the facilities in their computer laboratory photographed or videotaped. As it turned out, it was not necessary to record verbatim accounts of either the classroom observations or the interviews and, as such, very little if any was lost by not using these machines. The researcher made mental notes during lesson observations, or during discussions with educators. These mental notes would only be recorded in the field notebook when the researcher was in his car or back at the office. During the process of compiling field notes, areas that needed further enquiry would be flagged for the next visit, or followed up with a telephone call to the educator or school concerned. Links with information from other sources were also identified.

This research study was characterized by intense dynamism, which necessitated that changes and/or adaptations to planned research procedures, methodologies and techniques had to be made readily. Some of the conventional data collection methods that had been suggested in the research proposal had to be reviewed and were eventually discarded. Among these was capturing on video the lessons that were observed during scheduled visits to each of the participating schools. Capturing the lessons on video tape was abandoned because, in the researcher's opinion, this was more intrusive than would provide useful data. Furthermore, this had the potential to spawn artificial behaviour from the research subjects (learners). The use of video cameras and tape recorders would have confirmed

any latent anxieties existing among the participating educators (and schools) that whatever data was collected from them, or about them, might, in some way, be used against them.

5.3 Conclusions and Recommendations

Research studies on perception are extremely challenging. This is made even more complicated by the fact that a researcher cannot detach himself or herself from the process. Also perceptions, attitudes and opinions among very young subjects are fairly unstable, as Professor David Metzer had wisely pointed out and the researcher was soon to realize. Moreover, it has always been difficult for researchers to exclude their own opinions, biases, theories and even beliefs in the collection and analysis of data and the interpretation of the results. Bertrand Russell once said this about how the cultural background of the researcher manifested itself in what she/he thought and said:

> **Animals studied by Americans rush about frantically, with an incredible display of hustle and pep, and at last achieve the desired result by chance. Animals observed by the Germans sit still and think, and at last evolve the solution out of their inner consciousness.**
>
> *Cited from Imamura and Ney (1969), p. 112.*

The concept of a purely "scientific", objective and neutral research study is, therefore, a myth and, consequently, no such claim is being made for this particular research study. It is, nevertheless, equally perilous to present personal opinion, prejudice and sometimes hearsay as fact. The collection and analysis of data during any research exercise serves a specific purpose and takes place within a particular context. This is also the case with the tools that are employed to

collect the data and the methods and techniques that are subsequently applied to manipulate and interpret that data.

Furthermore, before a researcher begins to investigate a process or a situation, there are certain assumptions that a researcher makes and these assumptions will be the principle that underpins the investigation. It is for this reason that researchers should never lose sight of the fact that there exists a thin line between an informed opinion and prejudice, a belief and a fact, an observation and a perception. The researcher, therefore, needs to exercise vigilance in managing and maintaining these delicate subtleties all the time.

The questions that this research study attempted to address were built into the outcomes that were cited on page 6 of Chapter 1, which will be discussed later in this Chapter. The study occurred within the context of attempting to conceptualise an appropriate information and communication technology (ICT) regime in the South African education system and to contribute towards the development of a sound, functional and sustainable Technology Education curriculum in the South African school system. Technology Education is resource intensive. Computers are an expensive and scarce resource. If, therefore, we do not understand how elementary learners perceive computers as a technology we will not be able to use them effectively in the classroom. Despite their potential in supporting cognitive development, if not used appropriately, computers are likely to follow in the wake of other technological resources that have failed to add value to teaching and learning in the classroom.

To this end, it would be important to recapitulate on the outcomes that the research study was intended to achieve, which were:

- ***to identify economically disadvantaged elementary school learners' (4th grade) perceptions (and attitudes) towards computer technology;***
- ***to ascertain the extent to which economically disadvantaged learners are comfortable/uncomfortable with computer technology;***
- ***to expose learners to different applications of computer technology;***
- ***to demystify computer technology for these learners;***
- ***to isolate those factors that will directly influence learners' perceptions and attitudes to computer technology;***
- ***to develop and, possibly, validate an instrument that will reliably assess elementary learners' perceptions (and attitudes) towards computer technology.***

The previous discussion provided some background and advanced possible reasons why some of these initial outcomes, that were not achieved. The current discussion continues, and to a great extent concludes, the discourse that was presented throughout the first four chapters of this dissertation. It should, however, be borne in mind that perception, as an abstract concept, cannot be represented along some incremental scale that begins at zero and ends at ten. Nor can it be put on a continuum that ranges from non-discernible, at one end, to high, at the other end.

This research study was initially conceptualised as a typical knowledge, skills and attitudes (KSA) study. One of the assumptions that this research study drew on was the possibility of the existence of a typical South African elementary school learner. The profile of such a learner would be determined in terms of the

learner's socio-economic background; the typical school that the learner attends; the type of educator that teaches the learner; the curriculum that the learner is exposed to; the classroom environment in which the learner received his/her lessons in; the learner's age and his/her level of development. The questionnaire that was designed for the study was intended to collect data on this typical learner. However, the level of disparity and the extent of disadvantage in South Africa both militate against the identification of such a learner. The analysis of data in Chapter 4 (*cf. Chart 4.1, p.105*) reveals that these elementary school learners are differentially exposed to computer technology in the home environment. Furthermore, classroom observations that were conducted in all six participating schools revealed that the manner in which the same learners used computers in the classroom (*cf. Charts 4.2 and 4.3, pp.109-110*) differed markedly.

Knowledge, skills and attitudes studies are conducted under controlled conditions where the researcher has an experimental group and control group. In her correspondence with the researcher, Professor Solomons (*cf. p.149*) confirms this. To create these conditions requires resources. It was for this reason that the researcher tried, to no avail, to raise funds and/or obtain resources (computers) from corporate donors. For this reason, the researcher was forced to change the approach from experimental to descriptive ethnographic.

On reading Chapter 4, the reader will have noticed that neither cluster nor factor statistical analysis was presented, as is usually the case with research studies on perception (or attitudinal surveys) and, as Professor Metzer (*cf. p.149*) had

advised. Again, the analysis of the data and observations during classroom visits did not provide conclusive evidence indicating that elementary school learners, in the schools that participated in the research, had negative perceptions towards computers. However, within the confines of a limited budget and the context of the absence of a typical South African elementary school learner, this research study has provided valuable information that may, in future research, be used to conduct a survey on perceptions of South African elementary school learners on computers under controlled conditions. The following discussion is an account of some of the insights on learner perception of computers that this research study brought to the fore. This researcher intends to further investigate these issues and hopes that other researchers will take on the challenge.

Furthermore, the analysis of data and observations during classroom visits did not provide evidence of any gender bias, in which boy learners were favoured over girl learners. In the absence of any evidence indicating a negative attitude to computers, it is reasonable to assume that most learners had a positive attitude towards computers as a technology. In fact, what came up during classroom observations was that, for most learners, computers still have a novelty which, if used appropriately, could be exploited to achieve far-reaching educational outcomes. One of the principles of the draft National Curriculum Statement for Further Education and Training (FET), and the approved National Curriculum Statement for General Education and Training (GET) is the development of high-level knowledge and skills in learners. The novelty that computer technology still enjoys among both learners and educators could, in association with a suite

of well-designed and properly structured learning programmes, be used to provide these learners with both sound knowledge and skills.

Chapter 2 dealt extensively with the effect of prior exposure to computer technology in shaping a learner's attitude towards computers. This was also perceived quite clearly in the research study in terms of the differential use of computer technology in disadvantaged and well-resourced schools, as well as, between learners from poor and upper middle-class backgrounds. Clear proof that there were any significant educational gains that could be attributed to the use of computers in the disadvantaged schools was not evident. This may well be a possible research topic for other researchers with an interest in this field of study.

The fact that access to a computer outside a school, or its availability in the home has a significant influence in shaping learners' attitudes towards the technology will be central in the deployment of computer technology in South African society. It is a fact that an education authority has the responsibility to provide and maintain teaching and learning resources in schools. However, this should not be seen as the responsibility of only an education authority. Other sectors of society should collaborate with an education authority in providing learners with access to computer technology, even outside the classroom. Corporate South Africa has a responsibility to invest in this country's most important resource, that is its human capital.

This research study did, to a great extent, deal with some of the issues relating to three of the six outcomes above. These would be:

- ***to identify economically disadvantaged elementary school learners' perceptions (and attitudes) towards computer technology;***
- ***to ascertain the extent to which economically disadvantaged learners are comfortable/uncomfortable with computer technology; and***
- ***to isolate those factors that will directly influence learners' perceptions and attitudes to computer technology.***

In terms of the three above outcomes, the study found that learners from disadvantaged schools (initially Ikusasalentsha and Ekukhuleni, and subsequently St Wendelins and Nizam Road) did not have negative perceptions to computers. On the contrary, these learners compared favourably to their counterparts from well-resourced schools (Crawford Preparatory and Lyndhurst Primary). Also, learners from economically disadvantaged backgrounds were comfortable with computers but it should, however, be mentioned that this was within the context of what the educator had the skill to accomplish with the technology. In other words the experiences of the learners in the classroom were limited to the skill of the educator. It was also observed that prior experience with computers was the main determinant in influencing learner perceptions and attitude to computer technology. Learners from Lyndhurst Primary and Crawford Preparatory were more adventurous that their counterparts from St Wendelins Primary and Nizam Road Primary.

The remaining three outcomes, which are:

- ***to expose learners to different applications of computer technology;***

- *to demystify computer technology for these learners;*
- *to develop and, possibly, validate an instrument that will reliably assess elementary learners' perceptions (and attitudes) towards computer technology;*

would have been addressed during the process of the construction and programming of a robot arm in the classrooms at the schools that participated in the study. This learning activity had been planned as part of the research study and was intended to ***"expose learners to different applications of computer technology"*** and also to ***"demystify computer technology to these learners".*** The researcher was advised by experienced researchers to treat this as a separate research project. This advice came particularly from Professors Benson and Solomons.

It is intended that the investigation into these remaining three outcomes will be achieved by the pilot study on the use of LEGO Dacta materials that is planned for the schools which participated in this research project. The pilot study will provide each participating school with over R15 000,00 worth of LEGO Dacta material and software (*cf. Addendum*). In choosing these schools, the researcher has shown his appreciation and indebtedness to them for having participated in this research project.

Finally, there are a number of projects, initiated by corporate establishments in South Africa, that aim to put reconditioned computer equipment into classrooms in poor schools. There are, nonetheless, a number of obstacles that these initiatives come up against. The most common obstacle is the lack of security in these schools. Another critical factor that, regrettably, has not been investigated

by individuals who intend to supply schools with reconditioned computer hardware is the efficacy of the hardware and how cost-effective it is to choose reconditioned, rather than new hardware. The deployment of computers in South African society should be multi-faceted. This researcher is of the opinion that the deployment of reconditioned computers in schools is far from being cost-effective. Firstly, the maintenance of reconditioned computers soon detracts from their cheap price and, usually, maintenance costs increase the costs beyond making them practical. Secondly these computers have limited use due to the fact that their configuration and architecture sometimes fail to cope with the demands of current software, particularly educational software. Very few people realise that most educational software (in particular, computer-assisted design (CAD) programmes) demand high memory and high processor speed in order for them to function optimally.

The reconditioned computers that were donated to both Ikusasalentsha and Ekukhuleni are a good example. These computers could only support DOS-based software, even though most of the software (both educational and commercial) that is currently in circulation, can only be supported by a Windows-based operating system. It is the researcher's opinion that reconditioned computers should rather be used as an incentive for high performing individual learners. Rather than placing these computers in school laboratories, they could be used as prizes for those learners, who have performed well in their academic work.

Another creative way for corporate South Africa to contribute towards the country's human resource development strategy would be to provide affordable schemes through which parents can purchase computers for their children. This would go a long way towards countering negative perceptions such as the computer-phobia to which Jay (1981) refers.

In concluding, the researcher wishes to leave the reader with this thought.

> **When I began the research ... I laboured under the naïve belief that it would have a fairly well defined end. I would produce a substantial report that would have conclusive things to say on the research question. The deeper I delved into them, the more I realized that many of the findings would be contingent and that they opened up further avenues of enquiry as much as they enabled final conclusions to be made. I became far more modest about the impact the research would have, as I began to realize that its value lay in the contribution it made to a fairly diffuse body of professional knowledge rather than specific problems on which I had no power to act. This was ... but a piece of scholarship that would become part of the body of literature that future generations ... would come across in their professional training. Whether [those with responsibility for policy] acted as a result depended on their freedom to manoeuvre and the short term exigencies of their jobs, as much as it did on how convincing the findings of the research were.**
>
> *Keith Lewin, 1990, p. 191.*

It is therefore critical to bear the following in mind about research in education. It is the fact that educational research has a human dimension. The wisdom, experience and curiosity that this dimension brings to the research context when one engages in the process, are undoubtedly most enriching and gratifying.

5.4 Summary

In this Chapter, the researcher drew on the analysis of the data in Chapter 4. He further discussed the extent to which the objectives of the research study were

realised and suggested explanations and possible reasons why those objectives that were not met, could not be met.

Finally, the researcher listed and discussed conclusions and recommendations, based on the interpretation of the results of the data analysis in Chapter 4.

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ADDENDUM

One of the intended outcomes of the research project, as per the research proposal that was submitted to, and accepted by, the Durban Institute of Technology's research committee was: "**to expose learners to different applications of computer technology**". This intended outcome was, in the researcher's opinion, the mainstay of the research study. Evidence to this fact is the number of funding proposals (*cf. Appendix E*) that the researcher wrote to funding agencies, and corporate houses in South Africa asking these organisations to support the research project. As the study was initially conceptualised as a comparative study, the intention was to set up state-of-the-art computer laboratories in the schools that were participating in the project in order to come up with informed opinions in respect of the role of computer technology in schools in South Africa.

The objective of the research project was to expose elementary school learners to alternative activities associated with computer technology over and above the training in keyboard and/or mouse skills and programmed instruction usually associated with computers at the elementary school. The intention was for learners to see computer technology beyond these narrow confines and, most importantly, as an information-processing control system in the manner that it is used in industrial processes and also in household appliances.

How do we begin to explain – in very simple and comprehensible terms to an elementary school learner– the concept of an on-board computer in modern automobiles, or the computer-controlled production process in an industrial environment like an automotive assembly plants. How do we show this learner

how, for an example, engineers operate computer-controlled robots in hazardous environments like spray painting booths and welding workshops in these automotive assembly lines?

font.

Figure LEGO.1

A car being assembled by computer-controlled robot arms in a vehicle assembly line (*photograph courtesy of ROBOLAB, LEGO Mindstorms Sets for Schools*).

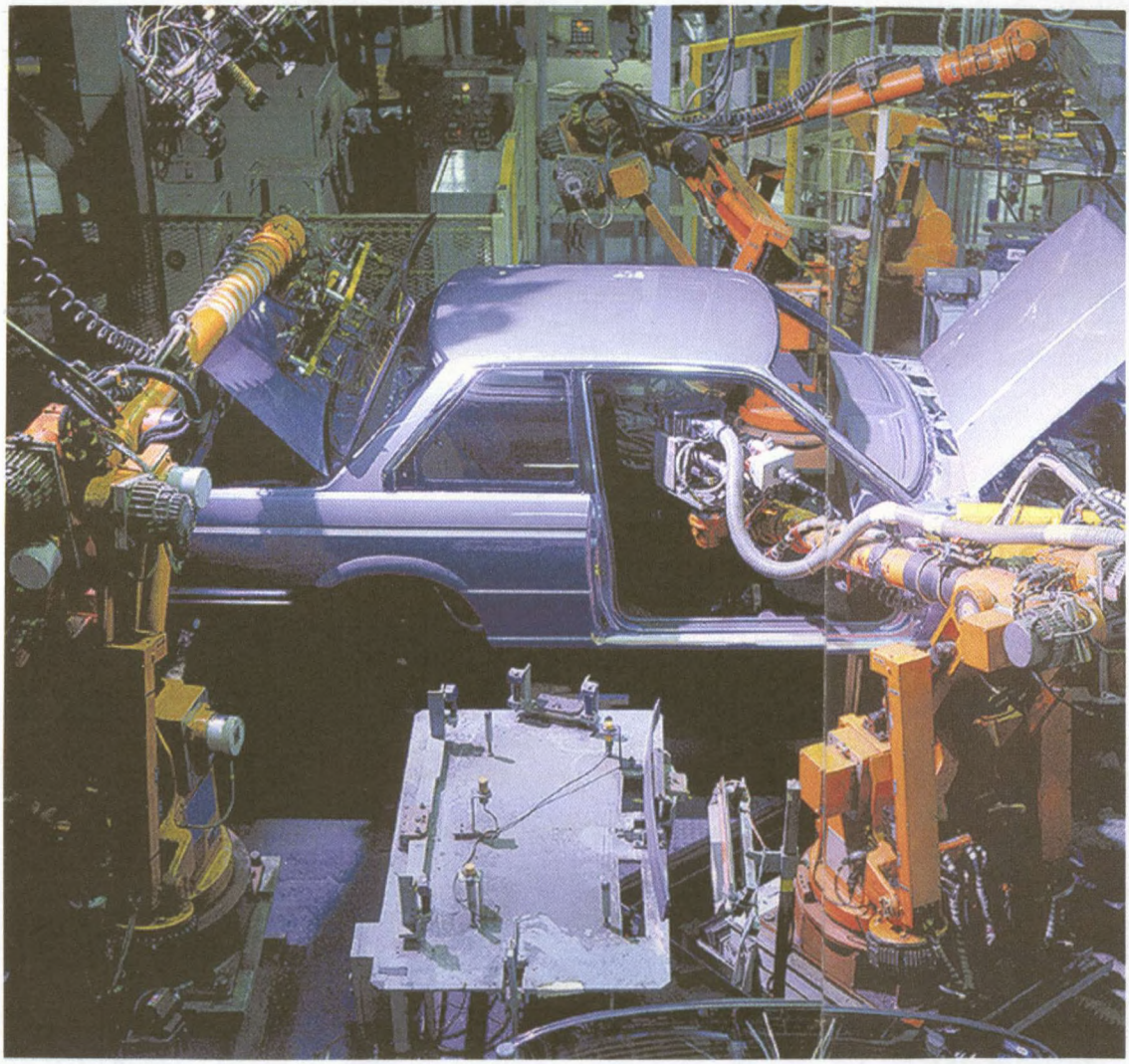

Figure LEGO.2

Examples of activities based on LEGO Dacta materials targeted at learners aged 11 and older. Activities encourage cooperation and team management when learners work together in joint projects. (*photograph courtesy of ROBOLAB, LEGO Mindstorms Sets for Schools*).

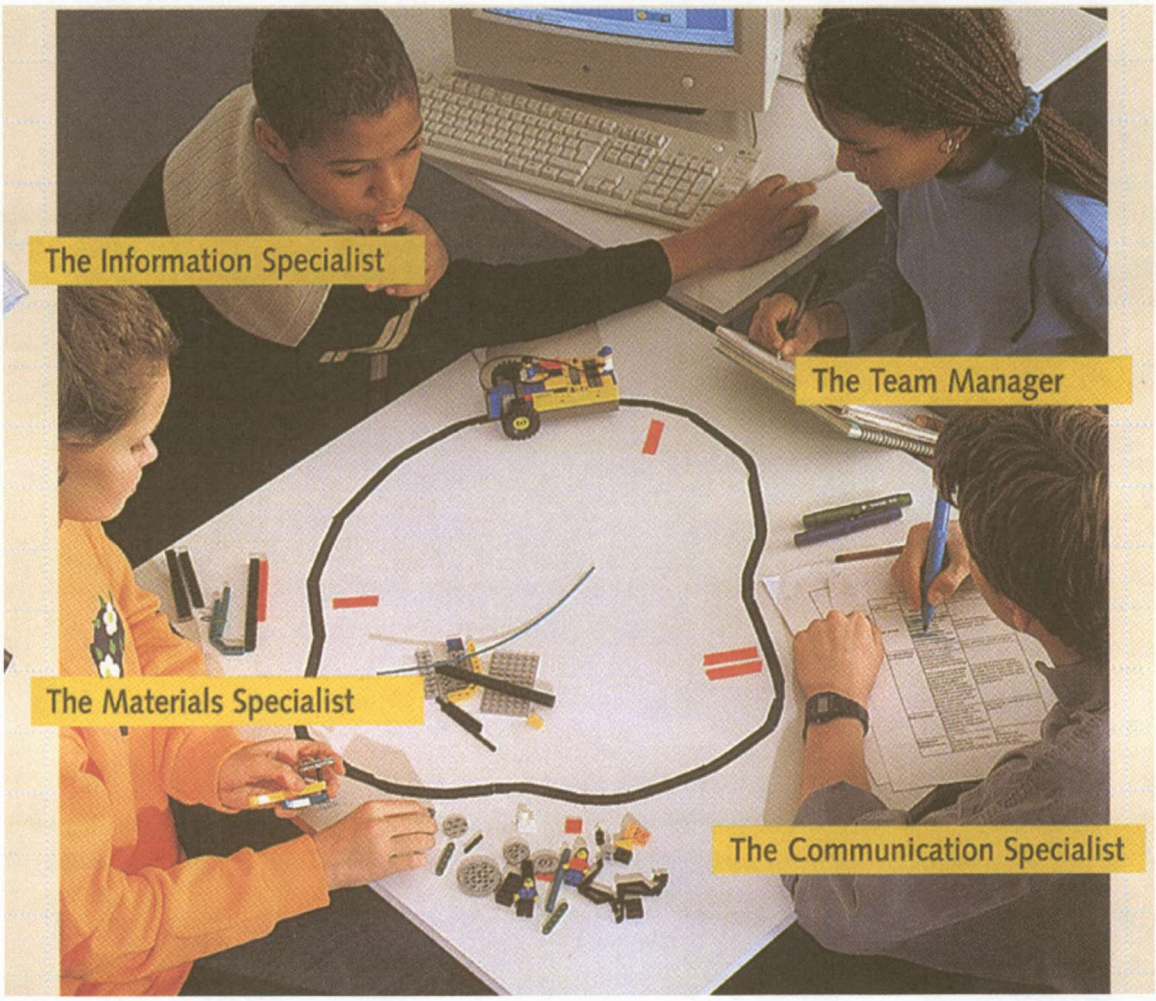

Figure LEGO.2 (a)

Figure LEGO.2 (b)

The learning area Technology has eight areas of knowledge i.e. content areas. Among them are **systems and control** and **structures**. Learners involved in the research project would construct a robot arm using LEGO Dacta materials. The learners would further write a simple LOGO or ROBOLAB program that would be used to control the robot arm simulating the industrial process shown in *Figure LEGO 1*. This would be a simple programme that would make the robot arm perform basic movements like swing to the left, swing to the right, move up, move down etc. and thus provide these learners with first-hand experience on the use of computer technology in one of the largest economic sectors in South Africa.

A number of issues militated against this process. Among these was the fact that all the educators who were involved in the research study, with the exception of Crawford Preparatory, had never before used LEGO Dacta materials and the programming language, ROBOLAB, which is similar to LOGO. The process of first having to train educators would therefore have been long and costly. The computer systems at Ekukhuleni and Ikusasalentsha were DOS-based and ROBOLAB which is the software that is currently associated with educational activities based on LEGO Dacta materials is Windows-based. There were problems in the supply of LEGO Dacta kits locally as the manufactures of LEGO Dacta in Denmark were involved in a protracted legal process of trying to protect their patent in Southern Africa. There were many companies that were importing LEGO Dacta materials illegally and also many that were distributing fake imitations of the original patented pieces. It would have, therefore, been

prohibitively expensive to import genuine LEGO Dacta pieces directly from LEGO Dacta in Denmark in order to try and avoid all these pitfalls. However, discussions with colleagues and the consultation of related literature (Hawkins et al., 1982; Noble, 2001) all pointed out to the fact that:

1. this was an important area for research; and
2. the process deserved to be a study all of its own.

Further face-to-face and e-mail discussions with experienced researchers, particularly Professor Clare Benson, director of the Centre for Research in Primary Technology (CRIPT) in the School of Education, at the University College of Education in London, confirmed that this process deserved to be a separate study. It can now be confirmed that the process will continue as a separate pilot study at the five state schools that were used as research sites. The researcher was able to source the required funding for the research study from the KwaZulu-Natal Department of Education and Culture.

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APPENDIX A

Street maps showing locations of the schools that participated in this study.

Figure A1

A street map of the Durban Metro showing the location of Ikusasalentsha Combined Primary School (courtesy of **MapStudio**)

Figure A2

A street map of the Durban Metro showing the location of Ekukhuleni Senior Primary School (courtesy of **MapStudio**)

Figure A3

A street map of the Durban Metro showing the location of Crawford Preparatory School (courtesy of **MapStudio**)

Figure A4

A street map of the Durban Metro showing the location of St Wendelins Primary School (courtesy of **MapStudio**)

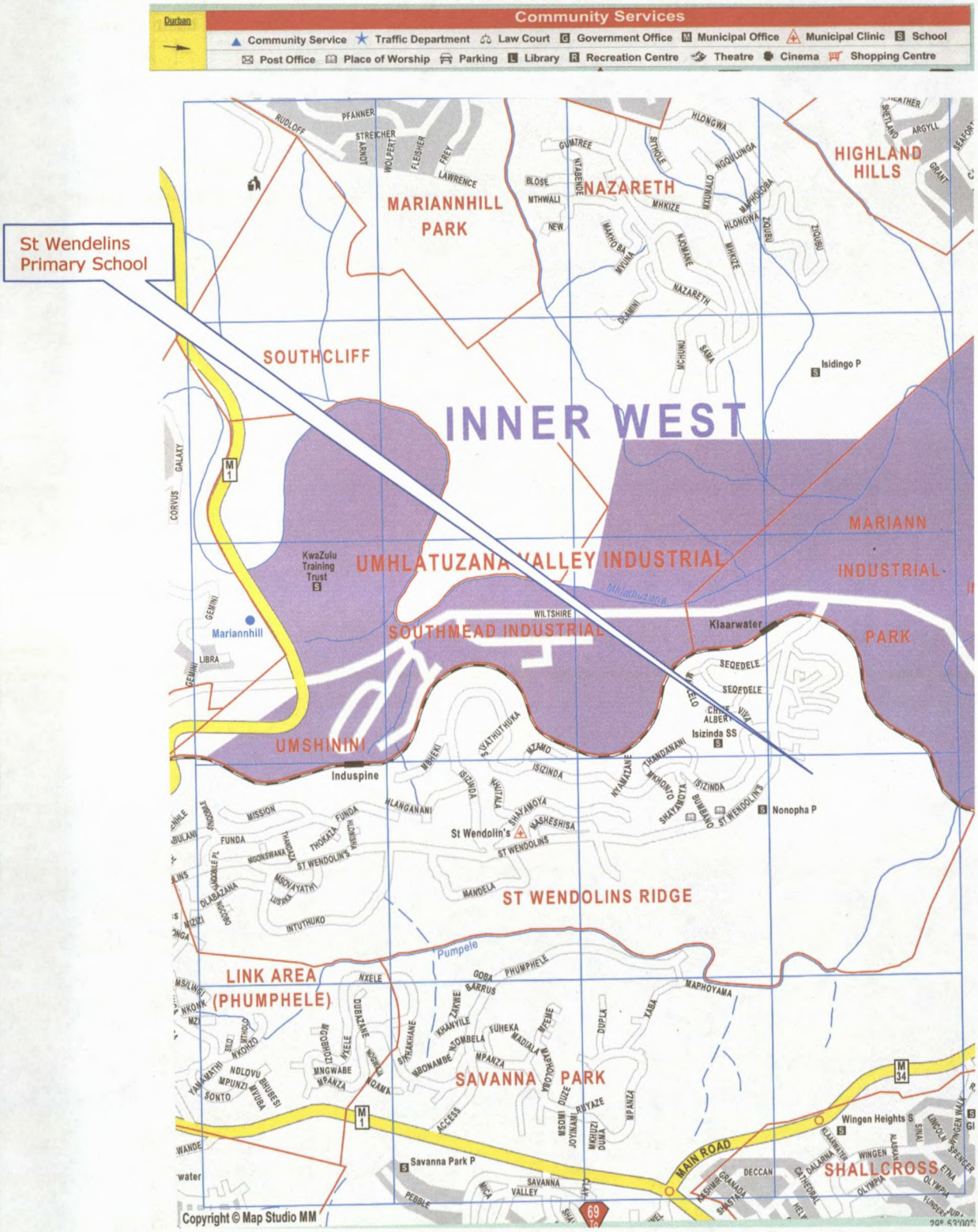

Figure A5

A street map of the Durban Metro showing the location of Nizam Road Primary School (courtesy of **MapStudio**)

Figure A6

A street map of the Durban Metro showing the location of Lyndhurst Primary School (courtesy of **MapStudio**)

APPENDIX B

Minutes of a meeting held with the research team of Ikusasalentsha Combined Primary School and copies of letters that the researcher wrote to the principals of the schools and educators who were involved in the project.

MINUTES OF A MEETING OF THE RESEARCH TEAM

HELD IN THE DEPUTY PRINCIPAL'S OFFICE ON THURSDAY 15 MAY 1997

PRESENT:	Hintsa Mhlane	- researcher
	Mr W.V. Khathi	- deputy principal
	Mr O.S. Mzoneli	- head of department
	Mrs N. Ndlovu	- teacher (grade 4)
	Ms N.P. Hlozi	- teacher (grade 4)
	Ms T.B. Ntetha	- teacher (grade 4)

The researcher had established from the principal, Mr Khumalo, just before the meeting that the school had been awarded 20 computers by the Daily News-McCarthy Retail -Coopers and Lybrand Computech Consortium, which were to be set up in a laboratory. The researcher asked the members of the team whether there could be implications for the Project regards this. The consensus was that although this development and the Project were not mutually exclusive, the philosophy on which the two were based was not the same. It was agreed to continue with the project regardless of this development.

It was decided that the Project would not be compatible with the learning program of grades 5-7. Because of specialisation, no one teacher was responsible for teaching all the learning areas in a class. It would be cumbersome to consult with all teachers affected and again with parents of the learners, particularly those in the experimental group. It was therefore decided to implement the Project with the grade 4's on the proviso that

1. all the four teachers in grade 4 will be involved.
2. an experimental group would be set up, comprising one group of the four in the grade.

As there are implications for learners' participation in the experimental group, it was agreed that parents of grade 4 children would be invited to a special meeting and be briefed on Sunday the 24th May 1997. The meeting adjourned.

The Principal
Ikusasalentsha C. P. School
Private Bag X065
KWAMASHU
4360

19 February 1999

Dear Mr. Mzoneli

RE: RESEARCH - USE OF THE COMPUTER IN THE CLASSROOM

I visited your school sometime in 1997 and requested to be allowed do a research study on elementary school learners' perceptions of computers as a technology. Two of your teachers volunteered to join the research team.

I have just completed a literature review of the study and would like to meet with you to discuss a way forward, i.e. to commence with the project. I further request a meeting with yourself to find out whether I am still welcome to use the school as a research site, and again whether the school's facilities are still available. I would appreciate if we could meet before the end of February. Please contact me on **2611390** or **082 8558201** to set up a meeting.

Yours sincerely

Hintsa Z. Mhlane.

cc: Dr. John Gardner Associate Director: School of Education
Dr. Kopano Taole Foundation for Research Development

Mrs. N. Ndlovu
Ikusasalentsha C. P. School
Private Bag X065
KWAMASHU
4360

19 February 1999

Dear Mrs. Ndlovu

RE: RESEARCH - USE OF THE COMPUTER IN THE CLASSROOM

I visited your school sometime in 1997 and requested to be allowed do a research study on elementary school learners' perceptions of computers as a technology. You were introduced to me as someone who was interested in taking part in the study.

I have just completed a literature review of the study and would like to meet with you to discuss a way forward, i.e. to commence with the project. If you are still interested in being part of the research team, please contact me on **2611390** or **082 8558201**. I would appreciate if we could meet before the end of February.

Yours sincerely

Hintsa Z. Mhlane.

cc: Dr. John Gardner Associate Director: School of Education
Dr. Kopano Taole Foundation for Research Development

APPENDIX C

The isiZulu and English Versions of the Questionnaire

LEARNER QUESTIONNAIRE[21]

TECHNOLOGY IN THE HOME & LEARNER OPINION ON CLASSROOM ENVIRONMENTS

The purpose of this questionnaire is to gather data about the learners' demographic information, technology in the learners' home environments, learners' opinions about their classroom environments and learners' opinions about their teachers.

Please read through the following questions carefully. Answer the questions as accurately as possible by circling the most suitable answer.

EXAMPLE: The statement reads "**I enjoy playing with my friends**"

		Almost always	Often	Some-times	Seldom	Almost never
1	I enjoy playing with my friends.	5	4	3	2	1

If you enjoy playing with your friends almost all of the time, then put a circle around **number 5, 'Almost always'**.

Please Note:

This is NOT a test and the results will NOT affect the learner's grade. Their name SHOULD NOT BE WRITTEN on the questionnaire. We are not interested in their individual answer, but rather in the average answers given by the whole group.

Please indicate the **age**, the **gender** and the **grade**, as provided below and then continue to fill out answers to the questions.

1. AGE (*tick appropriate box*)

8 years or younger	☐1
9 years	☐2
10 years	☐3
11 years	☐4
12 years	☐5
13 years	☐6
14 years or older	☐7

2. GENDER female ☐1 male ☐2

3. GRADE ☞.....

[21] Adapted from Fraser, B.J. (1995) A Constructivist Perspective on Monitoring Classroom Learning Environments under Transformation, Key Centre for School Science and Mathematics, Curtin University of Technology, Perth.

CATEGORY A

TECHNOLOGY IN THE HOME ENVIRONMENT		Almost always	Often	Some-times	ieldom	Almost never
At your house, you do ...						
4	...have a telephone. YES / NO You are allowed to answer the telephone when it rings.	5	4	3	2	1
5	...have a radio. YES / NO You are allowed to operate & listen to it without supervision.	5	4	3	2	1
6	...have a TV set. YES / NO You are allowed to operate and watch it without supervision.	5	4	3	2	1
7	...have a personal computer. YES / NO You are allowed to use it without supervision.	5	4	3	2	1

CATEGORY B

TIME SPENT IN CLASS		Almost always	Often	Some-times	ieldom	Almost never
In our class, we ...						
8	...listen to the teacher talk.	5	4	3	2	1
9	...copy work off the chalkboard.	5	4	3	2	1
10	...work together in groups	5	4	3	2	1
11	...do exercises from a worksheet or textbook	5	4	3	2	1
12	...work on our own	5	4	3	2	1
13	...have whole class discussions	5	4	3	2	1

CATEGORY C

CLASSROOM COMMUNICATION		Almost always	Often	Some-times	ieldom	Almost never
In our class, ...						
14	I get the chance to talk to other learners about the work we are doing	5	4	3	2	1
15	I talk with other learners about how to solve the problems we are working on.	5	4	3	2	1
16	I explain my ideas to other learners.	5	4	3	2	1
17	I ask other learners to explain their ideas.	5	4	3	2	1
18	other learners ask me to explain my ideas.	5	4	3	2	1
19	other learners explain their ideas to me.	5	4	3	2	1

CATEGORY D

ABOUT THE TEACHER		Almost always	Often	Some-times	ieldom	Almost never
In our class, the teacher ...						
20	...seems to enjoy teaching us.	5	4	3	2	1
21	...wants us to be silent.	5	4	3	2	1
22	...is willing to explain things more than once if we do not understand.	5	4	3	2	1
23	...explains things clearly.	5	4	3	2	1
24	...allows us to talk about the work that we do not understand.	5	4	3	2	1
25	...is concerned when we have not understood her.	5	4	3	2	1

CATEGORY E

GENERAL SOCIO-ECONOMIC BACKGROUND

		YES	NO
26	Does your mother have a job?	☐1	☐2
27	If **YES**, what job does she do? ☞		

		YES	NO
28	Does your father have a job?	☐1	☐2
29	If **YES**, what job does he do? ☞		

		YES	NO
30	Your parent(s) do(es) own a house?	☐1	☐2

31 Where do you live?

Newtown A, B or C	☐	☐1
eMawoti	☐	☐2
eBhambayi	☐	☐3
Besters	☐	☐4
eNhlungwane, eZimangweni or kwaMawula	☐	☐5
kwaMashu	☐	☐6
eKuphakameni, eNhlanzini or Ohlange,	☐	☐7
Other residential area not mentioned above	☐	☐8

Thank you for filling in this questionnaire.
Please hand it to your teacher as soon as you have finished.

LEARNER QUESTIONNAIRE[22]

TECHNOLOGY IN THE HOME & LEARNER OPINIONS ON CLASSROOM ENVIRONMENTS

The purpose of this questionnaire is to gather data relating to demographic information on learners, technology in the learners' home environments, learners' opinions about their classroom environments and learners' opinions about their teachers.

Qaphela:

Lena akusiyona itest. Uma uphendula lemibuzo uvikelekile ngoba awuzulibhala igama lakho, ngakhoke ngisho nothisha wakho ngeke azi ukuthi iphendule wathini. Futhi awuphoqelekile ukuba uyiphendule lemibuzo uma ungathandi. Kodwa uma ukhetha ukuyiphendula, kubalulekile ukuthi izimpendulo ozinikezayo kube ngezakho hayi ozibukele noma, ozibuze kumngane wakho.

Gcwalisa ngezansi ukuthi **uneminyaka** emingaki, ukuthi **uyintombazane** noma **ungumfana** nokuthi ufunda yiphi i**Grade** (standard). Yenza itick (✓) ebhokisini eliqondene neminyaka yakho, uphinde wenze enye itick (✓) ebhokisini eliqondene nobulili bakho bese ubhala iGrade yakho esikhaleni (*phezu komugqa*).

1. IMINYAKA YAKHO (*thikha ebhokisini eliqondene neminyaka yakho*)

uneminyaka engu 8 noma ngaphansi ☐ 1

uneminyaka engu 9 ☐ 2

uneminyaka engu 10 ☐ 3

uneminyaka engu 11 ☐ 4

uneminyaka engu 12 ☐ 5

uneminyaka engu 13 ☐ 6

uneminyaka engu 14 noma ngaphezulu ☐ 7

2. UBULILI BAKHO (*thikha ebhokisini eliqondene nobulili bakho*)

uyintombazane ☐ 1 ungumfana ☐ 2

3. BHALA IGRADE OYIFUNDAYO LAPHA ☞ .....

[22] Adapted from Fraser, B.J. (1995) A Constructivist Perspective on Monitoring Classroom Learning Environments under Transformation, Key Centre for School Science and Mathematics, Curtin University of Technology, Perth.

Lemibuzo ezolandela uzoyiphendula njengoba uzoboniswa ngalesiboniso esilandelayo. Uma ungaqinisekile ngokufanele ukwenze, buza **kumiss** noma **kuthisha** ukuze akucacisele.

Funda lemibuzo elandelayo ngokucophelela, bese uyiphendula ngokuthi wenze indilinga (circle) ezungeze inumber engaphansi kwempendulo oqinisekile ukuthi iyona mpendulo **yakho** embuzweni obuziwe.

ISIBONISO:

"Ekhaya banginika imali yokudla, uma ngiza esikoleni."

Uma ekhaya bekunika imali cishe **njalo**, uzokwenza indilinga (*circle*) ezozungeza unumber **5**.

	Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Ekhaya banginika imali yokudla uma ngiza esikoleni.	(5)	4	3	2	1

Uma **kuvamile** ukuthi ekhaya bakunike imali yokudla, uzokwenza indilinga (*circle*) ezozungeza unumber **4**.

	Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Ekhaya banginika imali yokudla uma ngiza esikoleni.	5	(4)	3	2	1

Uma kungukuthi **kuyenzeka nje** ekhaya bakunike imali yokudla, uzokwenza indilinga (*circle*) ezozungeza unumber **3**.

	Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Ekhaya banginika imali yokudla uma ngiza esikoleni.	5	4	(3)	2	1

Uma kungukuthi **akuvamile** ukuthi ekhaya bakunike imali yokudla, uzokwenza indilinga (*circle*) ezozungeza unumber **2**.

	Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Ekhaya banginika imali yokudla uma ngiza esikoleni.	5	4	3	(2)	1

Uma kuwukuthi **akwenzeki** ukuthi ekhaya bakunike imali yokudla, uzokwenza indilinga (*circle*) ezozungeza unumber **1**.

	Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Ekhaya banginika imali yokudla uma ngiza esikoleni.	5	4	3	2	(1)

CATEGORY A

TECHNOLOGY AT HOME		Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Ekhaya ...		(*uma uphendule wathi* **YEBO** *qhubeka ukhethe ngezansi*)				
4	...ikhona itelephone? $YEBO_1$ / CHA_2 Uvunyelwe ukuyiphendula uma ikhala?	5	4	3	2	1
5	...ninayo iradio? $YEBO_1$ / CHA_2 Uvunyelwe ukuyivula uyilalele noma kungekho muntu omdala.	5	4	3	2	1
6	...ninayo iTV? $YEBO_1$ / CHA_2 Uvunyelwe ukuyivula uyibuke noma kungekho muntu omdala.	5	4	3	2	1
7	...ikhona icomputer? $YEBO_1$ / CHA_2 Uvunyelwe ukuyisebenzisa.	5	4	3	2	1

CATEGORY B

TIME SPENT IN CLASS		Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Usuku lwakho eklasini ubuningi besikhathi uluchitha... (*khetha impendula ngezansi*)						
8	... ulalele uthisha efundisa.	5	4	3	2	1
9	... ukopisha umsebenzi uthisha awubhale ebhodini.	5	4	3	2	1
10	... usebenza nabanye abantwana njengendlenye yegroup.	5	4	3	2	1
11	... ubhala umsebenzi (exercise) ophuma kuworksheet noma encwadini.	5	4	3	2	1
12	... ufunda incwadi noma ubhala umsebenzi wakho wesikole wedwa.	5	4	3	2	1
13	... nixoxa ngesihloko enisinikezwe nguthisha, uthisa usuke ekhona enilalele.	5	4	3	2	1

CATEGORY C

CLASSROOM COMMUNICATION		Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Uma nifunda eklasini...				*(khetha impendula ngezansi)*		
14	... uyalithola ithuba lokuxoxa nabanye abantwana ngesifundo leso enisuke nisifunda.	5	4	3	2	1
15	... uthisha uyanivumela ukuba nibonisane nabanye abantwana mayelana nezinkinga ngesifundo enisuke nisifunda.	5	4	3	2	1
16	... uyavunyelwa ukuthi utshele abantwana ofunda nabo eklasini lokho okucabangayo ngenkathi nifunda.	5	4	3	2	1
17	... kuke kwenzeke ucele omunye wabantwana ofunda nabo ukuba akuchazele ngento ayishilo noma engumbono wakhe ngesifundo.	5	4	3	2	1
18	... kuke kwenzeke abanye babantwana ofunda nabo bakucele ukuba ubachazele ngento engumbono wakho, oyisho ngesikhathi nifunda.	5	4	3	2	1
19	...kuke kwenzeke omunye wabantwana ofunda nabo akuchazele okusemqondweni wakhe ngaphandle kokuthi kunguwena omcelile ukuba enje njalo.	5	4	3	2	1

CATEGORY D

ABOUT THE TEACHER		Njalo	Kuvamile	Kuyenzeka nje	Akuvamile	Akwenzeki
Uma nifunda eklasini, ...				*(khetha impendula ngezansi)*		
20	... kubonakala sengathi uthisha uyakujabulela ukunifundisa.	5	4	3	2	1
21	... uthisha ufuna nihlale nithulile.	5	4	3	2	1
22	... uthisha akadinwa ukunichazela, noma kungaba izikhathi ezingaki inqobo nje uma nithi animuzwanga ngesikhathi efundisa	5	4	3	2	1
23	... uthisha uchaza kucace uma efundisa.	5	4	3	2	1
24	... uthisha uyanivumela ukuba nixoxe ngalokho eningakuzwanga kahle ngenkathi nifunda.	5	4	3	2	1
25	... uthisha uyakhathazeka uma ethola ukuthi animuzwanga ngenkathi efundisa.	5	4	3	2	1

CATEGORY E

SOCIO-ECONOMIC BACKGROUND

		YEBO	*CHA*
26	Umama wakho uyasebenza?	☐ 1	☐ 2
27	Bhala ukuthi mama wakho wenza msebenzi muni?	☞	.....
28	Ubaba wakho uyasebenza?	☐ 1	☐ 2
29	Bhala ukuthi ubaba wakho wenza msebenzi muni?	☞	.....
30	Ubaba benomama banawo umuzi?	☐ 1	☐ 2

---

31 Kukuphi ekhaya? (*thikha ebhokisini eliqondene nendawo lapho umuzi wakini ukhona*)

eNewtown A,B noma C	☐ 1
eMawoti	☐ 2
eBhambayi	☐ 3
kwa Bester	☐ 4
eNhlungwane, eZimangweni noma KwaMawula	☐ 5
KwaMashu	☐ 6
KwaShembe, eNhlanzini noma Ohlange	☐ 7
Kunoma iyiphi indawo ngaphandle kwalezi ezingenhla	☐ 8

Thank you for filling in this questionnaire.
Please hand it to your teacher as soon as you have finished.

APPENDIX D

An example of a Funding Proposal that was sent to corporate sponsors, requesting financial support for the research project and also copies of correspondence that the researcher exchanged with those corporate sponsors

PROPOSAL

from the

TECHNOLOGY EDUCATION

SUB-DIRECTORATE

of the

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION AND CULTURE
UMNYANGO WEMFUNDO NAMASIKO
VAN DEPARTEMENT ONDERWYS EN KULTUUR

to

IBM SOUTH AFRICA

Signed by Project Director: _____
Hintsa Z. Mhlane

Date:04 May 1999

CONTENTS

PROPOSAL TO IBM SOUTH AFRICA

EXECUTIVE SUMMARY

"The concept of capacity building covers both institutional and individual capacity. Institutional capacity building in South Africa will certainly involve significant investment in infrastructure development. Such investment would focus on key resources and facilities needed to support the research and development environment such as education infrastructure, science parks, museums, libraries, as well as on "soft' infrastructure such as information flow, intellectual property issues, and other crucial elements in the commercialisation and application of research and development products."

Section 9.1, Chapter 9 of the White Paper on Science & Technology

The purpose of this proposal is to secure resources from IBM South Africa that the **Technology Education** sub-directorate of the KwaZulu-Natal Department of Education and Culture will use to support the research and development of a Technology curriculum in the school system. The state's financial resources are over-stretched and even if there were funds available, it would be tedious to try and acquire these particular resources via the state procurement process because of the bureaucratic nature of this process; and again the revolutionary nature of computer technology is such that computer hardware has a very the limited shelf-life.

These resources will form the core of the infrastructure that the Department of Education is setting up to train, develop and support teachers of Technology in the Province. The resources that the Department of Education requests from IBM South Africa include:

5 x notebooks (Model Type 2647-9AG, Part No. TT19AXX)

1 x server (IBM *e*server x Series150)

30 x NetVista A60i desktops (Model Type 6848-41G, Part No. K941GXX)

The Technology Education sub-directorate is setting up a **TECHNOLOGY CENTRE** that will be used in the training of Technology teachers for the whole province. This centre will be based at the former Durban College of Education in Umbilo, Durban. This TECHNOLOGY CENTRE will be the nucleus of a network of technology centres that will eventually be established throughout the province. These centres will be the mainstay of teacher development and teacher support infrastructure for science and Technology in the Province. The KwaZulu-Natal Department of Education and Culture is responsible for the provision, support and quality maintenance of education in over **5600** schools.

The Department is proud to be associated with IBM South Africa, not only because of the company's cutting edge leadership in technological innovation; but also because of IBM's responsive social responsibility programmes amongst the poor communities of South Africa. It is hoped that this will be the beginning of lasting and enduring partnership between IBM South Africa and the KwaZulu-Natal Department of Education and Culture, in the quest for building capacity and developing the human resources of our country.

DETAILS OF THE ORGANISATION

Name: **Sub-directorate: Technology Education**
Directorate: Education Programmes
KwaZulu-Natal Department of Education and Culture

Postal Address: Private Bag X04
ULUNDI
3838

Physical Address: 2nd Floor Administration Building
King Dinizulu Highway
ULUNDI

CONTACT DETAILS

Telephone: 031 2055341 Ext 136
035 8743454

Mobile Telephone: 082 8558201

Facsimile: 031 2051704
035 8743600

email: mhlane@iafrica.com

web site: under design

CONTACT PERSON: Hintsa Z. Mhlane

AREA OF OPERATION: Technology Education Research, Development and Evaluation

MISSION STATEMENT

TO PROVIDE QUALITY EDUCATION WHICH WILL FULLY DEVELOP THE POTENTIAL OF EACH LERANER IN A DEMOCRATIC ENVIRONMENT

INTRODUCTION

A number of major issues have influenced the development of this proposal viz.:

- the economic and educational needs of the country in general, and the province in particular;
- the evolving outcomes-based curriculum, and the importance and position of the Technology and the need to maximise the scarce resources available to develop, implement and support this curriculum;
- a recognition of the developmental nature of the curriculum;
- aspects of Technology education already taking place in the Province and the need to ensure that these initiatives can be successfully delivered in ALL schools; and finally
- the potential role of, and the need for overt curriculum development leadership in Technology, which means the establishment of a dynamic Technology teaching force that is both self and mutually supportive.

South Africa needs to produce a technologically educated and advanced citizenry in a short space of time. There are a limited number of ways in which this can be achieved. One of these is through a carefully structured programme of professional development courses for teachers of Technology. Further, the curriculum development process in Technology should lead directly to an improvement of education in schools.

RATIONALE

There is yet to be a national consensus in respect of Technology content and pedagogy

The **importance** and **position** of Technology within the school curriculum has been formalised through the establishment of a learning area called Technology. However there is yet to be a national consensus in respect of Technology content and pedagogy. Current teaching methods, particularly in secondary schools, are largely didactic; teaching and learning facilities are poor and a large number of previously disenfranchised learners fail the matric examination. There is therefore a need to provide quality in-service training and development for practising teachers.

A range of Technology-related teaching and learning activities are already taking place in the country. These vary in scale, age, phase and levels of sophistication. It is therefore necessary that these activities are co-ordinated and their quality closely monitored.

The Superintendent-General has tasked the Technology Education sub-directorate with the responsibility leading Technology curriculum development research; training and development of existing and potential Technology teachers; controlling the quality of Technology education; support for Technology teachers and the evaluation of the Technology curriculum development process.

MOTIVATION

The KwaZulu-Natal Department of Education and Culture has embarked on a programme of developing sustainable and viable infrastructure for the support of Science and Technology education in the Province. Research has shown that **Science** and **Technology Centres** that are strategically positioned throughout the Province would be the most cost-effective way of meeting the Science and Technology needs, and demands of this unique province. This proposal begins the process of the establishment of state-of-the-art, multi-functional **TECHNOLOGY CENTRES** throughout the Province.

It is nonetheless critical that before the concept of these Technology Centres is brought to scale, that a pilot study is done to establish how these Centres can be used and administered such that they function optimally. These Science and Technology Centres have been modelled along such successful concepts as the **ONTARIO SCIENCE CENTRE** in Canada and **TECHNOQUEST** in the United Kingdom.

Political instability and crime

Socio-economic trends the world over, show that an improvement in the quality of education results in an increase in the quality of life of the citizens of a country, and that this is reciprocated by a decrease in crime (violent or non-violent) and political and economical instability. This can only happen if the economy of the country is able to absorb most of the employable section of the population. There exists evidence, internationally, to show that technological literacy leads to entrepreneurship and job creation. Technology-related enterprises have been able to absorb up to 60% of the employable population in countries like Taiwan and Japan.

Why five notebooks?

The Technology Education sub-directorate has a staff of five – **1 Chief Education Specialist** and **4 Deputy Chief Education Specialist**. These members of staff will be responsible for the development and presentation of professional development courses for Technology teachers. These notebooks will be critical in making presentations during training workshops, and also to assist members of staff with their work in the field as they will be working and travelling throughout the Province.

Why the server and 30 desktop computers?

A state-of-the-art local area network (LAN) comprising a server and 30 desktop computers will be part of the infrastructure that will be based at the proposed TECHNOLOGY CENTRE. This LAN will be linked digitally via a satellite disc to the world-wide web. The Centre will be used for the training of Technology teachers, research and development, and the support of Technology teachers in the Province.

CONCLUSION

The fact that this project is based on an existing, working and extremely successful model under relatively similar conditions is very important. This has the potential to revolutionise and galvanise Technology education. The South African education community is grappling with a working model for Science, Engineering and **Technology** education and awareness. In order that a degree of relative success is achieved in respect of the implementation of Technology education, there are three hurdles that will need to be overcome; which are:

- the lack of suitably trained Technology teachers;
- the absence of infrastructural support for Technology education; and finally
- the enormous cost factor in putting equipment in individual schools.

15 May 1997

Colleen Dewar
IBM South Africa
P.O. Box 1339
WESTVILLE
3630

Dear Colleen

REQUEST FOR SPONSORSHIP TOWARDS AN EDUCATIONAL RESEARCH PROJECT

As per our telephonic conversation, Wednesday 14 May, attached is a proposal for a research project entitled: **Elementary School Learners' Perceptions of Computers as a Technology**. I have highlighted parts (*see pp. 3,4,5,6&7*) of the proposal, which I feel will be of particular interest to you, i.e. if you do not intend reading the whole text.

Basically I would request that IBM contribute computer hardware and software towards the setting up of a laboratory classroom at the school. This laboratory classroom will be used, daily, by the experimental group at the school until the conclusion of the Project. Thereafter the equipment will be officially handed over to the school (*see p.3, 1st paragraph of the proposal*).

The Project requires **NINE (9)** computers - **EIGHT (8)** for the class and **ONE (1)** for the teacher - so that at any particular time a maximum of **SIX (6)** learners use one computer (learners average 50 per class). This is important as previous research has shown that this would be the optimum number one could have, for any educationally acceptable activity to be possible. We however are mindful of the economic realities of the country, i.e. that at this stage, the government will NOT be able to equip ALL schools with computers at the ideal pupil : computer ratio of 2:1.

The Project requires a computer that is able to run WINDOWS™-based software and has a Compact Disc Read Only Memory (CD ROM) drive. It also requires a reasonable quality printer. The Project is supposed to have commenced at the beginning of April 1997.

For any further information please do not hesitate to either contact me or my supervisor, **Dr John Gardner**, on the telephone **031 2042516**. I wish to thank you in anticipation.

Yours sincerely

HINTSA MHLANE.

IBM South Africa
54 Norfolk Terrace Westville 3630
P O Box 1339 Westville 3630 South Africa

Telephone: 27 (031) 204-3111
Fax: 27 (031) 204-3196

06 April 2001

Mr H Mhlane
KwaZulu-Natal Department of Education and Culture
Private Bag X04
ULUNDI
3838

Dear Mr Mhlane,

I would like to acknowledge receipt of your letter and proposal dated 03 April 2001, your reference IBM/Res/Prop.

I have forwarded your request to those responsible for administering IBM South Africa's corporate social responsibility programs, for consideration.

Once a decision is made either the corporate social responsibility department or myself will contact you directly.

Yours sincerely

Nigel Noble
Regional Manager, East Coast
IBM South Africa

Proposal to be reviewed this afternoon

IBM South Africa (Pty) Ltd
(Reg. No. 52/00308/07)
Directors: M.J. Harris(Managing)
D.J. Nyamane
F. Steiner

** TOTAL PAGE.02 **

10 May 2001

The Chief Education Specialist
Department of Education and Culture
Private Bag X04
ULUNDI
3838

Attn.: Mr Hintsa Mhlane
Fax No.: (035) 874-3600

Dear Mr Mhlane

Thank you for your proposal, received 24 April 2001.

Your request will be reviewed by the Vodacom Foundation and we will revert to you shortly.

We hope that we will be able to be of assistance to you. Please note that Vodacom receives hundreds of requests for assistance every month and it is regrettably not possible to support every one, no matter how worthwhile.

Yours sincerely

MONDE MAMA
MANAGER
VODACOM FOUNDATION

Ref No. Ack/May.04

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REG. NO. 1993/003367/07

TOTAL P.001

14 June 2001

The Chief Education Specialist
Technology Education
Department of Education and Culture
Private Bag X04
ULUNDI
3838

Attn.: Mr Hintsa Z Mhlane
Fax No.: (035) 874-3600/3687

Dear Mr Mhlane

We thank you for your request for assistance with funding for your project.

Vodacom does its best to be a responsible corporate citizen, and has an active social investm
ent program in place. The Vodacom Foundation was formed recently to manage and co-ordinate this program. The Foundation funds many projects, from soup kitchens in underprivileged areas to the construction of a school and clinic in a remote Transkei location. We assist several charitable organisations and community projects within categories we have defined for ourselves and within the constraints of our budget. Wherever possible we involve Vodacom staff and people from the communities to implement the projects we fund.

We appreciate your needs and would like to be of assistance to you, but very much regret that this is not possible at this stage. There are so many needy organisations and individuals seeking help in our country, and we trust that you will understand that it is just not possible for Vodacom to support every cause, no matter how worthwhile.

We wish you success with your endeavours.

Yours sincerely

MTHOBI TYAMZASHE
EXECUTIVE HEAD
VODACOM FOUNDATION

Ref No.Jun131

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TOTAL P.01

PROVINCE OF KWAZULU-NATAL
ISIFUNDAZWE SAKWAZULU-NATAL
PROVINSIE KWAZULU-NATAL

DEPARTMENT OF EDUCATION AND CULTURE
UNYANGO WEMFUNDO NAMASIKO
DEPARTEMENT VAN ONDERWYS EN KULTUUR

HEAD OFFICE INHLOKOHHOVISI HOOF KANTOOR

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Adres:	Ulundi	**Posadres:**	3838	**Fax:**	(035) 874 3600
Enquiries:		**Reference:**		**Date:**	
Imibuzo:	H.Z. Mhlane	**Inkomba:**	resp	**Usuku:**	02 July 2001
Navrae:	082 8558201	**Verwysing:**		**Datum:**	

The Executive Head
Vodacom Foundation
Private Bag X9904
SANDTON
2146

Dear Mr. Tyamzashe

I acknowledge receipt of your letter dated 14 June 2001.

I admire the charity work that your Foundation does in funding 'soup kitchens in underprivileged areas' and constructing 'a school and clinic in a remote Transkei location.' Nonetheless I wish to put it on record that in my earlier discussions with your manager, Mr. Mama, I thought I had explained quite abstemiously that I was not looking for charity. I also would like to believe that Mr. Mama was aware of 'the categories that you have defined yourselves' and the 'constraints of your budget' when he spoke to me; as he presented himself as a very senior official in your organisation

I perceive charity and sustainable human resource development as two distinct concepts and would like to believe that your organisation does the same. I put it to Mr. Mama that I did not wish to waste his, and my, time by sending in a proposal that was going to be turned down anyway. The core of my job is not about writing funding proposals, but it is to support the teaching and learning of Technology in the classroom. I am therefore not surprised that 'Vodacom receives hundreds of requests for assistance every month'; since it would appear to me that you deliberately invite these requests in order that you may turn them down. I am therefore a bit irritated because of the time I had to invest in writing the proposal.

Vodacom operates in a technology-based industry. It would therefore make a lot of business sense for Vodacom to invest in human resource development in technology, as much as it invests in sport and charity.

Inasmuch as I do not wish to challenge your Foundation's decision of not wishing to support the KwaZulu-Natal Department of Education and Culture, I nonetheless wish to suggest that the manner in which some of your staff do business could be improved. Having worked in a corporate environment myself I am aware that the image of a company will be enhanced by the professionalism of its staff.

As a Department of Education, we also wish your Foundation well in its endeavours.

Yours sincerely

HINTSA Z. MHLANE
Chief Education Specialist
Technology Education

APPENDIX E

The Sheffield Hallam University Report – Educational Impact of LEGO Dacta Materials.

Sheffield Hallam University

The Educational Impact of LEGO Dacta Materials.

Executive Summary

LEGO Dacta materials were introduced to the curriculum of a large English junior school in order to examine the educational impact of the resources [The age range of learners in an English junior school is from 7 years to 11 years]. A team of four teachers, one from each year group, was established to manage and implement the project in their own classes. The study took place over the spring and summer terms of 2001

The main areas for the research were

- Learners' achievement
- Learners' motivation, engagement with and attitudes to learning
- Teachers' expectations and attitudes to the above.
- Teachers' motivation

Results indicate that the introduction of LEGO Dacta resources to the school has proved to be very successful. Learner and teacher motivation is high and learners have demonstrated good levels of engagement and achievement. Their achievements have exceeded those of learners taught in previous years using different media. The National Curriculum areas in which learners have been shown to have made progress and to have achieved are:

- **Design and Technology**
- **English**
- **Mathematics**
- **The National Curriculum key skills and thinking skills**

LEGO Dacta provided training at the start of the project. Peer support ensured that the initial impetus was sustained. The teachers identified training and support as prime factors in ensuring the success of the project.

The team members decided that in this initial phase they should focus upon the provision of continuity and progression for learners from year 3 to year 6 within one subject area. They would then look at the possibilities for the use of LEGO Dacta resources in other curriculum areas. The LEGO Dacta resources, therefore, were introduced to the school through the existing Design and Technology blocks of work. This proved to be successful. The material is now securely located in the curriculum and will provide continuity and progression within Design and Technology. The team has identified other curriculum areas for the next phase.

A notable feature of the study was the quality of the collaboration between the learners that was engendered by the use of the LEGO Dacta materials. The learners worked in pairs when using the kits and in small groups when using

RoboLab and the LEGO tiles. This proved to be both motivating and productive and led to successful outcomes in the areas identified above.

The LEGO Dacta materials made a useful contribution to the further development of an inclusive curriculum within the school. The materials were equally motivating and effective for boys and girls. There was a positive shift in the attitudes of the girls towards the LEGO Dacta resources over the time of the study and a noticeable increase in the perseverance of the boys. The resources were challenging for all ability groups. All the learners, when using the kits, were able to work at a level they had previously been unable to reach. Learners of low ability in numeracy and literacy were also able to demonstrate their potential in a way denied to them before. This led to an increase in the self-esteem and standing of many children.

The LEGO Dacta materials proved to be supportive and stimulating for both learners and teachers but there are changes that could be made to increase their effectiveness. Progression could be mapped against the National Curriculum and more support could be given to children using the instructions and materials for the first time.

The project team members are confident that this introductory phase of the initiative to introduce LEGO Dacta materials to the school has been very successful. The team will now provide training and support for the other teachers in the school and will introduce the LEGO materials to other areas of the curriculum.

The team gives the following suggestions based on their experiences.

- Training is essential and if possible it should be funded.

- Support with planning, through training or by the provision of printed or electronic materials, would be useful in assisting in the uptake of LEGO Dacta resources in other schools.

- It would be helpful if LEGO Dacta provided an outline scheme showing the possible routes for progression from Year 3 to Year 6, mapped onto the National Curriculum.

- Better support could be provided for learners using the instructions and the LEGO Dacta materials for the first time.

- Schools would be advised to identify one curriculum area initially and to develop expertise and ensure progression in that area before using the LEGO Dacta kits in other subjects.

- The relatively high cost of the resources could be an inhibiting factor. A school might consider buying resources for one year group each year, beginning with the youngest learners. This would allow the school to budget for the eventual resourcing of all year groups and would provide continuity and progression for those learners as they progressed through the school. The team advises that enough kits should be purchased to provide for one kit between two learners.

- Teachers should assign value to the materials, establish the learners' ownership of the resources and help them to establish good working practices.

- The materials should be used in blocked periods of time to maintain the children's motivation by avoiding over familiarity.

At the start any initiative there will always be an element of novelty for all the participants and this should be taken into account when reading the report. At this early stage in the project the results are very positive and encouraging. As work with the LEGO Dacta materials becomes a more accepted part of the curriculum it will be both interesting and worthwhile to monitor how the school ensures that the motivation, of both teachers and learner, is sustained and developed.

The Educational Impact of LEGO Dacta Materials: Southey Green Junior School, Sheffield.

The background to the Sheffield project

The INFOESCUELA pilot project began in Peru in 1996. It was initiated by the Peruvian Ministry of Education, with the objective of introducing technology to primary schools through the use of LEGO Dacta materials. Over the course of the next three years [1996 to 1998] the project was expanded to cover 130 schools throughout the country.

In order to examine the impact of this initiative, and the work arising from it, a large scale research study was proposed and approved by the Massachusetts Institute of Technology in Boston, USA. The research was carried out from October 1998 to January 1999.

The study aimed to discover the educational impact and the pedagogic effects of using LEGO Dacta materials. The research showed that children participating in the project demonstrated greater levels of achievement in mathematics, language and technology than did those in the control groups. It was also shown that the resources had a positive effect upon children's attitudes to learning.

The results of this research were so encouraging that LEGO Dacta was keen to research the effects of using their products in the United Kingdom. In consultation with the DfES LEGO Dacta UK decided to go ahead with a small scale research project involving one English junior school. The company provided the school with LEGO Dacta resources and funded the training of the teachers and the research. Sheffield Hallam University carried out the research.

The LEGO Dacta project was carried out in a large inner city junior school in Sheffield. The catchment area of the school is recognised as an area of high social deprivation. The study took place over the spring and summer terms of 2001

The objective of the study

To monitor and measure the impact of using LEGO Dacta resources in an English junior school. [The age range of learners in an English junior school is from 7 years to 11 years.]

The main areas that were identified for the focus of the research were

- Learners' achievement

- Learners' motivation, engagement with and attitudes to learning
- Teachers' attitudes and expectations to the above.
- Teachers' motivation

The scope of the study

It was intended that the study should

- be cross-curricular with a focus upon all relevant areas of the curriculum, i.e. primarily design and technology [including control technology], ICT and Science [including data-logging]
- involve classes in each of the 4 year groups at Key Stage 2, from Year 3 [7yrs+] to Year 6 [10yrs+]
- monitor and measure girls' and boys' achievement, motivation, attitude and engagement in the learning process in the areas listed above
- monitor and measure changes in teacher's perceptions, attitudes and expectations of the above
- cover management issues within the school in order to make the best use of the resources available in delivering the curriculum across all year groups

The management of the project in school

The school management team saw the project as the initial phase of a much longer initiative. The team decided that a small project team would pilot the use of the materials in this first phase of the introduction of the LEGO Dacta resources to the school.

Four teachers were appointed to the project team. The team members were asked to evaluate the resources by using the LEGO Dacta kits with their learners over a period of two terms and reflecting upon the outcomes. In addition each team member would have the opportunity to become familiar with the resources, to acquire new skills and knowledge, to develop their ability in teaching learners effectively using the LEGO Dacta resources, and to identify further areas of the curriculum that might be supported by the materials. The project team would then be able to act as an advisory and training resource in the next phase of the initiative.

At the end of this initial stage the project team and the school management team would consider how best to proceed. They would look at the possibility of the use of LEGO Dacta kits in all classes and at how the kits might be used across the curriculum.

The provision of resources to the school by LEGO Dacta

- The school carried out an initial audit of existing resources and of teacher skills. LEGO Dacta provided the school with both the resources and the staff training required for the project. LEGO Dacta allocated the resources to the school. The project team determined to which the classes these would be allocated.

The allocation of resources over the time of the study.

- Year 3 /4 SEN [learners with special educational needs] [ages 8 and 9yrs] Early and Simple Machines, LEGO Dacta tiles
- Year 4 [age 9 yrs] Mini kits - levers
- Year 5 [age 10 yrs] Mini kits - levers and RoboLab.
- Year 6 [age 11 yrs] Simple and Powered Machines.

Training

- The members of the teaching team and the student researchers were provided with one day's training on the use of the kits and of Robolab in preparation for the project
- Once the project was underway a further half day of training or classroom support was provided at an individual level for each project team member.

Organisation of resources and the location of the project in the curriculum.

- The LEGO Dacta resources were allocated to the school. The project team decided that the resources would be placed in the Year 3/4 SEN class, in a Year 4 class, a Year 5 class and in a Year 6 class [see ages of learners above]. The team members decided which resources would be allocated to each class and upon the most appropriate place in the curriculum for the project. This would be within the school's programme of craft activities.
- The craft activities are run as short blocks of work. The subjects covered are cookery, art, music and CDT. Each subject block runs for eight weeks, providing one afternoon session each week for each group of learners. The kits would be used in the CDT block of work.
- For the duration of the project the learners in Year 3 / Year 4 SEN, Year 4 and Year 5 were taught the block of work by their class teacher. In Year 6 the pattern was different.
- The Y6 children were taught in groups drawn from different classes. Each of the groups rotated through the programme of blocks of work. These groups of learners were taught by teachers who have particular strengths in the subjects rather than by their class teachers. The Year 6 teacher, therefore, worked with

children from across the year group. She taught the sessions once a fortnight, with another teacher teaching the alternate sessions. This teacher was not a project team member and worked to the project team leader's brief.

- During the project the Year 6 teacher worked with two different groups of year 6 learners. The first group spent three weeks on the project and the second group had eight weeks. This gave her an opportunity to contrast the learners' learning and her teaching between the two groups.

- With the exception of Robolab and the LEGO Dacta Tiles the teaching was carried out as an activity with the whole class. The children worked in pairs sharing a kit between them. Robolab was used with a small group of Y5 learners and was used during the support session provided by the trainer. The LEGO tiles were used by the classroom assistant with small groups of learners in the Year 3/4 special educational needs class.

Those involved in the project and their roles

The project team drawn from the staff of the Southey Green Junior School

• Y3/4 SEN learners	Mrs. Zoè Hennessy
• Y4 learners	Mrs. Claire Loveday
• Y5 learners	Mr. Steven Fripp
• Y6 learners	Mrs. Linda Coulson, Deputy head and Project Team Leader.

Roles

- To teach the activities
- To monitor changes in learners' achievement, motivation and attitudes
- To measure learners' achievements.
- To monitor any transferability from the LEGO Dacta activities to other areas of the curriculum
- To identify the use of LEGO Dacta materials across the curriculum.
- To provide feedback to the research organiser and the project manager.
- In addition to the above, the Project Team Leader 's role included the organisation of the work in school and liaison with the project manager and trainer and with the research organiser

Student teacher researchers,

Sheffield Hallam University

The student teachers carried out this study as part of their dissertations. Each student focused upon the motivation and the attitudes of both teachers and learners. In addition the students looked at other issues arising from the use of construction kits in the primary classroom.

- Mr. Andrew Krabbendam — Internal and external motivators [Y3 / Y4 SEN]
- Mr. Adam Leivers. — LEGO Dacta instruction cards [Y4]
- Mrs. Christine Quinn. — Gender [Y5]
- Ms. Rebecca Morley. — Collaborative group work [Y6]

Roles

- To monitor any change in both learners' and teachers' motivation and attitudes over the course of the project.
- To observe learners during the activities and report upon the outcomes
- To identify other issues arising when learners and teachers are engaged in the activities.
- To report back to the research organiser and the project manager.
- To write up the results of their individual inquiries.

Research organiser, Sheffield Hallam University

- Ms. Margaret Noble

Role

- To supervise and organise the student researchers.
- To liaise with the project team and the project manager.
- To collect data from all those involved.
- To write the report

Project manager and trainer

- Dr. Alex Wright

Role

- To liaise with LEGO Dacta
- To initiate the project in the school.
- To train the project team and the student researchers in the use and the potential of LEGO Dacta resources.
- To provide support to the project team
- To liaise with staff from the school and from the university.

The Research Methodology

This was a qualitative study conducted in the initial phase of a longer initiative. There has been no attempt to quantify the data as this was considered by the project team to be inappropriate at this early stage.

THE PROJECT TEAM MEMBERS

- The staff involved kept diaries or wrote commentaries for submission to the research organiser. The research organiser and the project manager conducted semi-structured interviews with the project team at the end of the school year.

THE STUDENT RESEARCHERS

- The students conducted semi-structured interviews with both learners and staff before the training began and again in the summer term

- They carried out non-participant observational studies of groups of learners engaged in the LEGO Dacta activities. They made use of both audio and video recording and of observation recording sheets.

- At the end of their study each student researcher completed his or her dissertation. The dissertations included reports on the observations of the learners, interviews with both staff and children and a discussions of the findings arising from their own particular aspects of research. The dissertations were submitted to the research organiser.

- The research organiser and the project manager conducted joint semi-structured interviews with the student researchers at the end of the university year.

THE PROJECT MANAGER

- The project manager provided reports for the research organiser on the staff training sessions and the support sessions in school.

The research organiser

- Collected and collated the above data, analysed the results and wrote the report.

The Results of the Study

1. The impact of LEGO Dacta materials on learners' achievement

There is evidence that there has been a positive effect on learners' achievement in many areas. This is a qualitative study, however, and there has been no attempt to quantify the achievement of the learners against expected outcomes. There appear to be two major factors that have contributed to the development of the children's achievement. The first factor is the motivating effect of the LEGO Dacta kits, the second is the collaborative work that was a feature of the project.

1.1 Knowledge and understanding

There was evidence to be found in each year group of learners extending their knowledge and understanding of mechanisms. Not only could they explain how the mechanism functioned but in many cases could apply their understanding.

Year 3 / Year 4 [Special Educational Needs]
Over a comparatively short period of time the children began to gain in confidence and in capability with some of them building increasingly complex models.

- '*Children made use of their experiences with simple models to build much more complicated models using imagination and creativity*' [Class teacher]

Year 5
Learners in Year 5 were observed to have increased their technical understanding of levers and associated machines.

- '*The children have gained technical knowledge of levers and pivots*'

- '*After working with the intelligent brick the learners were able to carry on programming the brick unsupervised.*' [Class teacher]

Year 6
Two groups of Y6 learners took part in the project. Group 1 had three sessions and Group 3 had eight sessions.

The kits provided a quick access to the exploration of mechanisms. In previous years learners had had to construct their own card and wood models. The time taken to do this and the construction problems encountered by the learners meant that most of the available time was taken up by making. This left very little time for the investigation of the mechanisms. By comparison the kits were very quick to assemble. This resulted in a noticeable and welcome shift in the focus of the lessons. Using the LEGO Dacta kits the learners were able to spend most of the lesson time developing their knowledge and understanding of levers, pulleys, gears and mechanical control.

The teacher was also able to present the children with much more demanding work. Consequently she reported that compared with learners of similar abilities she had taught in earlier years, these learners clearly demonstrated that they had achieved at a much higher level.

- '*The use of kits helped children to explore and learn about the mechanisms. In the past they spent most of the time making, with all its difficulties, with little time left for knowledge and understanding.*'

- *Group 1 'In a short period of time [three weeks] I would say that their knowledge and understanding of levers as a mechanisms increased considerably compared to previously, when I had used other methods to teach the principles.'*

- *Group 2. Session 4. ' Certain pairs found for themselves that they could change pulley wheels, add other gears or add more connector pegs to change the speed and rhythm of the machine. I found that many pairs needed very little teacher input to solve the problems and to work out the principles behind the results they were getting. Through class discussions we summarised our findings and I was quite amazed by what the children had observed and learnt through exploration. Their knowledge and understanding was at a much higher level through using the LEGO Dacta kits than that of similar ability children who had covered work on mechanisms – levers, without the support of LEGO Dacta.'*

- *'They could go to a higher level using kits...I can say, without a shadow of a doubt, that the children attained a* ***much higher*** *level of knowledge an understanding of mechanisms through using the kits compared to previous groups who had to build their own models from card etc.'* [Class teacher]

- When interviewed *the children all said that working with mechanisms had helped in their understanding of the mechanisms.* [Student researcher]

1.2 Speaking and listening and the development of technical vocabulary
Both teachers and observers made particular reference to the development of speaking and listening. It became evident that children were enhancing their skills and experience in this area.

In classes where the teacher introduced the learners to the correct technical vocabulary, and expected the children to make use of it, the children quickly adopted the technical language, using it and extending it.

Year 3/Year 4 [Special Educational Needs]
The LEGO Dacta kits provided the learners with the motivation to use attributes when describing the pieces. The learners were increasingly confident in using technical terms. This was particularly satisfying for the teacher who found that the children's talk was focused and was of good quality.

- *'Children were explaining to each other how to build the models. The talk was very productive and led to further making.'*

- *'Talk was of good quality... children using terms such as 'vertices'. They developed vocabulary for pieces and for the structures. Many learners, expressing themselves and word finding, could say 'Pass the thingy' but then began to describe through attributes. When they did not know what a piece was it led to discussion and naming'* [Class teacher]

Year 5
There was no evidence of learners using and extending the correct technical language.

- When observed *the learners were given the technical vocabulary by the trainer but this was not reinforced by the teacher. There was no evidence of learners developing a technical vocabulary.* [Student researcher]

Year 6
Both the teacher and the observer reported that the development of technical language and of speaking and listening were notable features of the Year 6 learners' development. The children quickly acquired the correct vocabulary

- '*They acquired the technical language. I spent time looking at specific vocabulary and children were quickly using the correct terminology and they understood the meaning of the vocabulary.*' [Class teacher]

- When the learners were observed *the resources were shown to improve the skills of the children in terms of speaking and listening.*

- In the final interviews '*the learners showed a more confident discussion of their work and that they had improved their technical language*' [Student researcher]

The use of the kits within collaborative group work gave the children the opportunity to apply the technical language in a meaningful context.

- '*Speaking and listening really moved on. The children's need to share tasks with a partner meant that they had to be involved in discussing the elements needed, how to construct the model and to discuss how well it was working.* [Class teacher]

The LEGO Dacta kits also motivated those learners who had previously been reticent in discussion to demonstrate their abilities in speaking and listening.

- '*Also noticeable, was that certain children who are not usually the ones to take a more active part in discussions, were doing so.*' [Class teacher]

1.3 Skill development

There was evidence, in each year group, of the learners' development of a range of skills. These included both the National Curriculum key skills - communication, application of number, improving own learning and performance, working with others, problem solving and, for those working with RoboLab, information technology; and the National Curriculum thinking skills - information processing, reasoning, enquiry, creative thinking and evaluation. Teachers commented particularly on the improvements made in children's social, organisation, observation and manipulative skills, and in the increase in learners' spatial awareness and their ability to follow instructions.

Year 3 / Year 4 [Special Educational Needs]
The teacher was particularly enthusiastic about the learners' development of a range of skills. Most remarkable was their growing ability to work in pairs and the progress they made in the development of manipulative skills. These were areas that previously had proved difficult for the learners. The outcomes exceeded the teacher's initial expectations.

- '*The children improved their social skills*'

- '*They had to follow instructions, sort by colour and size, had to count. All this was done through close observation and they had to succeed. The development of manipulative skills was fantastic!*' [Class teacher]

Year 4 and Year 5

The learners made noticeable progress in understanding the diagrams and relating 2D representation to 3D models and following instructions.

- Year 4 *Their spatial awareness improved.'*

- Year 5 *The children are learning to follow instructions'* [Class teacher]

Year 6
The LEGO Dacta kits were instrumental in developing the problem solving and organisational skills of the learners and in developing their perseverance and logical thinking. There was evidence that the combination of these led to the children becoming more independent learners.

- *'Their problem solving skills and organisational skills also showed a big improvement. Their ability to solve problems has definitely increased and the children are **very** keen to make adjustments with little teacher input , in order to complete the task.''*

- *'The children were involved in problem-solving skills, for example, when they had to work out how to change the model from a constant to a variable speed.'*

- *'The problem solving aspect became enjoyable to the children - if something wasn't working, they **wanted** to solve the problem and put it right, often without wanting teacher input'* [Class teacher]

- When the children were observed *it was evident that the resources improved their organisational skills and their logical thinking.* [Student researcher]

2. Learners' motivation, engagement with and attitudes to learning.

2.1 Learners' motivation

One of the philosophies of the LEGO Dacta division is that motivation emerging from the enjoyment of learning will encourage children to keep wanting to learn. All the teachers and the observers reported that learners' motivation levels were noticeably raised through the use of the LEGO Dacta kits. However, teacher confidence and motivation appeared to have an effect on the learners' motivation. [also see 3.3 below]. At this early stage it was not possible to say if the motivation had transferred to other curriculum areas or if it had raised learners' motivation in school generally.

Year 3/Year 4 [Special Educational Needs]
The nature of the learning difficulties experienced by these learners results in low self-esteem and motivation with the attendant behavioural difficulties. The LEGO Dacta kits made a beneficial contribution to the learners' motivation and consequently to their behaviour.

- *'Very motivating. You bring the LEGO Dacta out and you have every child's attention just like that! The learners were very enthusiastic.'*

It also had a significant impact upon the girls

- *'The girls who had shown no previous interest in the box of LEGO used during wet playtimes were enthusiastic.'* [Class teacher]

Year 4

Motivation was also reported as being a significant outcome.

- *'The LEGO Dacta proved to be an excellent motivator, all the children enjoyed using the kits'* [Class teacher]

Year 5
The teacher reported an high degree of motivation. When using the LEGO Dacta kits the learners demonstrated a much higher level of perseverance. The use of the kits improved behaviour.

- *'My children showed interest an enthusiasm for the tasks set. They were keen to have further experiences [of the intelligent brick] and exhibited good behaviour when they knew they might have another go.'*

- *'The boys were engaged for a good length of time and a lot keener to finish so that they could 'play', or experiment, with the LEGO Dacta bricks.' They mentioned the kits at other parts of the day and wanted to have another go.'* [Class teacher]

Five learners from this class were interviewed halfway through the project and at this stage there was still some resistance to the LEGO Dacta kits.

- *The children expressed a limited change in their motivation. Two out of the five children interviewed, a boy and a girl, said that they did not like LEGO Dacta.* [Student researcher]

Year 6
From the outset the children were highly motivated when using the kits. The children eagerly approached problems. They demonstrated a high degree of perseverance being willing to investigate difficulties and to take steps to redress the problems. The children appeared to be fully engaged in and excited by the tasks.

- *'When the children were introduced to the LEGO Dacta kits they were immediately enthusiastic and totally engaged in the tasks set for them. I found that the children remained enthusiastic and well-motivated during the remaining sessions with the LEGO Dacta.*

- *'The children got really excited when they actually finished their model and, having made the necessary adjustments, discovered that it actually worked! They also loved the problem solving aspect of how to make a different tapping pattern by changing the connector pegs. They were extremely motivated by having to attach a motor onto a model they had made. They did not seem to mind at all that they had to build the drumming machine again in order to add the motor.*

- *'I would certainly say that the children have **thoroughly enjoyed** using the kits and have remained **highly motivated** throughout the sessions. Interest levels remained high, so LEGO Dacta was a great motivator for them.'* [Class teacher]

The children supported the teacher's observations when the observer interviewed them.

- *The willingness of the children to talk about the work that they had done, and the detail into which they could go, weeks after the sessions, was also an indication of how much they had been stimulated by the sessions. From my observations I was impressed*

by the motivation created by the product, I could not stop learners talking about what they were doing.

- *All the children in the group stated that they had enjoyed the work and would like more. Given the opportunity they would like to continue with the use of the resources in their own time. They all agreed that the sessions had been enjoyable and motivating. Three of them thought that they would have liked more time for the investigational extensions.*

- *It was clear that the kits had contributed to the children's learning by providing them with a powerful and enjoyable medium through which to learn. There were various aspects of the LEGO Dacta work that they found motivating. The practicality of the sessions was a motivating factor as was the fact that they perceived the lessons as fun. Some of the children found part of the work difficult but felt that they enjoyed a challenge. However some aspects of the sessions were demotivating: the need to complete worksheets; the lack of time to build; and little opportunity for experimentation.* [Student researcher]

2.2 Learners' engagement with and attitudes to learning

Again a key feature of the project was the involvement shown by the learners of all ages and abilities.

Patience and perseverance

Many learners displayed greater patience and perseverance than they had shown previously. They were usually on task and focused. In many cases the learners' attention spans were longer than in other lessons. The children were proud of their work and keen to show their results.

Year 3/Year 4 [Special Educational Needs] '

- '*During the lesson all the learners were involved. It is highly unusual for these SEN learners to be so on-task. The only time that these children were so on-task and so co-operative is when they were working with the kits.*' [Class teacher]

Year 4

- '*The learners 'wanted to dismantle and rebuild the same model, they did not get bored with the kit*' [Class teacher]

Year 5

- '*The boys worked with a lot more application than the girls when it came to following the instructions, which is the exact opposite of what usually tends to happen.*'
- '*The pattern of attention [in the afternoon] was better than usual when they worked with the LEGO Dacta.*'

- '*The attention span and co-operation shown [when working with the programmable brick] was very impressive.*' *They were keen to show what they had done and were proud of their achievements.*' [Class teacher]

Year 6

- '*One boy who did not show perseverance at all, in the Literacy and Numeracy sessions, showed that he did have great perseverance when using LEGO Dacta. He was totally engaged in each of the tasks set, and when he came across a problem, he and his partner stuck with it until it was solved.*'

- *'Adding a motor proved quite a challenge for many pairs but they all persevered in the task until they had achieved a successful result.'* [Class teacher]

The provision of challenging tasks for all abilities

The Lego Dacta kits proved to be challenging for all learners. The kits provided the children with a different style of learning, one that was the preferred style for some learners. Some children were therefore able to demonstrate skills and abilities that had not been recognised before or were not required by other areas of the curriculum. Other learners were given the opportunity to begin to develop these skills and abilities. It did not therefore necessarily follow that children who were categorised as more able or less able in terms of numeracy and literacy would perform at the same level of ability when asked to work using this different learning style.

For learners achieving at a high level in numeracy and literacy this style of working provided them with many challenges. They were encountering situations in which they had to develop skills such as problem-solving and interpretation.

Year 4

- *'The 'more able' children were often on the same level as the rest of the class and found the kits challenging.'* [Class teacher]

Year 6

- *'The kits stretched the more able and they were an excellent confidence booster for many children - using them certainly raised self-esteem.'*

- *'It was an interesting observation that it was often some of the less able children who were better able to decode the pictorial instructions, as they were used to doing this in their other work. They are the ones who have to break things down step by step in order to gain understanding.* [Class teacher]

For some learners, categorised as of lower ability in numeracy and literacy, the activities allowed them to demonstrate capabilities that had not been evident before. In some cases these children performed at a higher level that the rest of the class. Teachers reported that this had a positive effect upon the standing and the self-esteem of those learners.

Year 4

- *'One of my most disruptive boys - SEN with a low reading age, loved the kits and was the most successful; for the first time he was 'centre-stage' and he showed us all how to alter the pivots on the dragon and was in demand from the rest of the class for help. The LEGO Dacta kit was a great self-confidence boost for this boy and improved his self-esteem greatly.'*

- *'C. [a child with a low R.A.] used to decoding language found following the diagrams easy, as did other children with low reading ages.'* [Class teacher]

Year 6

- *'The kits were a great source of great achievement for the less able.'*

- *'All the children, but especially the less able, were motivated by using the kits as opposed to building their own models from card etc. The less able children could reach an end result in a much shorter time that was as good as anyone else's model.'* [Class teacher]

The kits were equally motivating and challenging for children with special educational needs and the use of the LEGO Dacta kits had a significant impact on these learners

Year 3/Year 4 [Special Educational Needs]

- '*All the children have learning difficulties, especially in language and in literacy, many are dyslexic, all are reading at Y1/Y2 level. All the children were fully engaged and motivated.*'

- '*Children in this class have associated behavioural problems and the LEGO Dacta kits gave them very calming but worthwhile activities for 'time-out' periods, plus something to praise when brought back to the classroom.*

- '*Many of the learners are ego-centric and just beginning to develop co-operative skills, but in LEGO Dacta tasks they were helping one another. Talk was of good quality and 100% of the children were on task and this is very unusual in this class.*' [Class teacher]

3.0 Teachers' motivation and their attitudes and expectations of children's motivation, involvement and attitude to learning.

Each teacher was interviewed by the observers before the start of the project and halfway through. At the end of the project the research organiser interviewed the teachers.

3.1 The Year3 / Year4 Special Educational Needs [SEN] teacher

- Before the start of the Project

The class teacher, whose main curriculum areas are Science and Design and Technology, was quite confident in those two subjects. She thought that the use of LEGO Dacta kits would be useful for the eight weekly sessions of Design and Technology.

She hoped it would make a difference for her class. Her class is '*top-heavy*' with boys and they were already keen to use her box of LEGO at wet playtimes. '*I am hoping it will really motivate the class. I think it will motivate the children, bearing in mind that all of them have a lot of difficulty with literacy. I am hoping it can be linked to other subjects*'.

One of outcomes she most wanted to see was the involvement of the girls who until then had shown little interest. '*The boys see the LEGO we already have as theirs and the girls do not really get involved. I would like that to alter a bit.*'

She believed that it would have an effect upon attitudes to learning and was hoping that it would develop speaking and listening. '*These children have problems with word-finding, using 'thingy' a lot. I hope that they can extend their vocabulary. Maybe [doubtfully].. maybe.. even technical vocabulary?*'

- At the end of the project

It was apparent that the teacher's initial expectations had been met and had in some cases been exceeded. The effect upon speaking and listening was notable and the girls had made real progress, much more than was hoped for, and were taking ownership of the materials.

One of the outcomes that she did not fully envisage was what an effect it would have upon children who were not normally co-operative or on-task. When the LEGO Dacta kits were used the transformation was extraordinary. The children were almost 100% on task and moved very quickly to developing productive and harmonious co-operative skills. In the context of this class the co-operative work that LEGO Dacta engendered was exceptional. However this has not yet transferred to non-LEGO Dacta activities.

The resources have proved to be motivating for both her learners and herself. She was keen to move forwards with the resources and she is beginning to see the possibility of possible and effective links with other subject areas.

3.2 The Year 4 teacher

- Before the start of the Project

The class teacher demonstrated enthusiasm and motivation towards the use of LEGO Dacta materials as an integral part of her Design & Technology teaching.

She made it clear that her expectations of the resource and its effect upon the children were high.

- At the end of the project

She was confident that it had met her initial expectations well and was keen to make further use of the LEGO Dacta kits. '*I will definitely use the LEGO Dacta again, all pluses! even the fag of finding the little pieces was OK. as the children realised they needed every little piece to use the kit.*

3.3 The Year 5 teacher

- Before the start of the Project

Initially the teacher felt that he did not have sufficient training or experience in the area of Design and Technology to teach it with confidence. His subject is music. He believes that children's enjoyment of a subject is dependent upon the teacher's attitude and that his own lack of experience and motivation would be a factor in the outcomes of the project.

He suggested that the children would enjoy using the resources and he expected the boys to be on task and the girls more reticent. He thought that the project would have no effect upon other subjects. He was quite sceptical about the effect of LEGO Dacta on children's approach to work, attitude to learning and attainment within Design and Technology and other subjects.

- At the end of the project

The teacher said that he had gained confidence in the use of the LEGO Dacta products. Halfway through the project he had detected no change in children's motivation towards Design and Technology. At the end of the project, however, he was seeing a rise in motivation. He noted that the children's motivation grew with experience and confidence. He thought that the children's attitudes to D&T might have changed as they enjoyed the LEGO Dacta but this has not transferred to other subjects. He said that his first thoughts on the link between teacher motivation and the children's motivation were still relevant.

He stated that the children have gained more understanding of the processes of the subject. The materials also helped the children to think through the way things work. He noted that the children are learning to follow instructions. They have also gained technical knowledge of levers and pivots.

He suggested that the children found the tasks difficult mainly because they found it difficult to work with one another in general. He reported that the children work well as individuals but that it will always be a struggle for these children to work in pairs. He suggested that this lack of social skills was characteristic of the rest of the school but it was more evident in this class. However by the end of the project he observed that the children have made a tentative start on working together. The girls were still reticent and did better in single sex groups and that boys preferred to do their own constructions, the LEGO Dacta kept the boys more focused.

He was still sceptical about the effect of the LEGO Dacta products on attainment. He suggests that '*no product can have a lasting effect in this area*' and what the children need '*is love, care and attention as a social stimulus*'.

The experience had broadened his outlook on Design and Technology and he was looking forward to using RoboLab, preferring to work with that than with construction material.

3.4 The Year 6 teacher [also the deputy head and the project team leader]

- Before the start of the Project

The teacher had already used LEGO Dacta mini-kits and said that she would be starting the project with some knowledge and understanding of the positive benefits of the use of LEGO Dacta in the curriculum, especially in terms of children's motivation and learning. She was aware that if children had access to a wider range of kits their knowledge and understanding might be extended further.

She was enthusiastic and highly motivated by the school's involvement with the LEGO Dacta project '*This has now enabled us to have a wide choice of resources and it will be interesting to see the impact this has on children's motivation and learning.*'

- At the end of the project

The teacher reported that there had been so many positive outcomes from the LEGO Dacta project. The LEGO Dacta kits had given her the opportunity to cover certain teaching principles that she had not been able to teach previously. She was able to extend the learners' learning in a way that had not been possible before when she did not have the kits. She also extended her own knowledge.

She said that both her own motivation and that of her learners had been high. She observed that for many of her children it was their most enjoyable lesson of the week and that for her it also been one of the most enjoyable too.

She saw the project as the first phase of a much longer initiative. The other members of the project team were in agreement with this statement. This phase was one in which the teachers have begun to trial the resources and in which they have observed the initial impact of the kits, the tasks and the teaching strategies upon the children's motivation and learning. This phase was one in which they looked at the feasibility of using the kits within all classes of the school.

She was optimistic about the future in terms of using the LEGO Dacta kits across the school. '*Everything about using the LEGO Dacta so far has been a plus, and as more of the LEGO Dacta resources are used through more of the school in different ways and built more into the curriculum, then I am sure that we will see a wider impact on children's motivation and learning over time*'.

4. Cross-curricular subject links

During this phase there was little attempt to integrate the resources with the rest of the curriculum, instead the teachers focused upon making themselves and their learners familiar with the resources. However it became apparent that speaking and listening and cross-curricular skills were being developed [also see **1.** above]. Staff began to see the possibility of links with other areas and in one case there was a definite transfer of skills observed.

4.1 Mathematics

This was an area that quickly emerged as being closely related to the LEGO Dacta tasks. This was not planned for initially but the teachers soon began to see the links and the possibilities.

Year 3 / Year 4 [Special Educational Needs]

- *'I gave the children a limited amount of LEGO Dacta [12 pieces]. They had squared paper and they had to build a model and draw and colour the LEGO Dacta on the squared paper. They had to work to scale - one square for two studs. They than had to give these instructions to another child to see if they could be built. Many learners then extended this to more complicated models and plans.'* [Class teacher]

Year 4

- *'The children found it easier to imagine 3D shapes and we've built on this and they have produced excellent Tudor houses, treasure chests and are constructing their own 3D shapes.'* [Class teacher]

Year 6

- *'Maths Skills involved here as well - when looking at 2 x 8 bricks, for example, we were working out the total number of studs. Children were using tables without realising it. They were also working out the ratio of pegs to the number of taps [drumming machine]'*

- *'Spatial awareness really improved especially understanding 2D diagrams and translating into 3D models* [Class teacher]

4.2 Literacy support in the Year 3/Year 4 Special Educational Needs class

The LEGO Tiles provided a useful tool to help learners to form words. The learners were highly motivated by these and were observed to be much more adventurous in their work and more ready to take part.

- *'The LEGO tiles were used by the classroom assistant and learners worked much quicker than they would have on paper, highly motivated to make own words.'* [Class teacher]

4.3 The potential for using the LEGO Dacta kits across the curriculum

The Year 6 teacher and project team leader recognised the cross-curricular nature of the LEGO Dacta resources and will now begin to move the use of the kits into other curriculum areas in the next phase of the initiative.

- *'This is a tool to support current activity. It is not an 'add-on', not just a Design and Technology activity but also to support and develop numeracy, literacy, science, co-ordinates, 2D and 3D work, speaking and listening and co-operative skills.'*

The Year 5 teacher recognised the increase in motivation and achievement in Design and Technology but was sceptical that there would be any significant effect upon motivation elsewhere in the curriculum at the moment.

- *'As to whether there is any 'carry-over' into other areas of work I think that this area is a very subjective one and difficult to quantify. If there is to be an effect on the rest of the children's education then the project needs more time to be observed before an accurate assessment can be made.'*

5. Collaborative group work

All the teachers reported a shift in the children's ability to work collaboratively. This shift was greater in some classes than in others

5.1 Collaboration between learners with special educational needs

For this Year 3/Year 4 group of children the shift was particularly significant. During the project the children had moved from a position of non-cooperation to effective collaboration. However this has yet to spread to other lessons.

- *'It was good to see pair work, to see children improving their social skills. There was a great deal of interaction between the children, This was one of the main benefits to come out of this project.'* [Class teacher]

5.2 The development of collaborative group skills

This was observed in all classes along with the positive results of the collaboration.

Year 4

- When observed *the children were working collaboratively within their pairings and this improved throughout the sessions. There was a lot of negotiation and a much higher degree of communication between the groups. A lot more taking of turns and sharing of responsibility was observed. One group in particular began to make more careful observations and interpretations of the instructions. When interviewed one pair of children said that they had done well as they had not had to ask the teacher for help. They reported that they had worked together counting properly.* [Student researcher]

Year 6

- *'The learners' ability to work together showed a big improvement.'* [Class teacher]

5.3 The pairing of learners

The ways in which the groups were constituted raised issues that were noted by the teachers and the observers and were mentioned by the learners when interviewed.

Year 5

- When interviewed *the girls said that they did not like the partners that had been chosen for them and one girl said that she would have preferred to work with a girl. This appeared also to be linked to her expressed dislike of the activities.* [Student researcher]

Year 6

- *'The children were allowed to choose their own partners within certain parameters. In my experience this is not always the best grouping. However it had worked well and it appeared to have motivated the children in the use of the kits. In cases where children*

have not chosen to work together, though absence for example, the partnership was not as successful.' [Class teacher]

5.4 The individual roles within the groups.
In Year 6 both teacher and observer were aware of the roles played by the individuals in the pairs and of the range of collaborative partnerships and strategies.

- *'I did notice in some pairs that there was a dominant partner, but in these pairs the roles were still worked out by the children quite effectively according to what each child had to offer to the process.'* [Class teacher]

- When observed *it was noted that the learners used seven different ways of working together in pairs.* [see appendix A] [Student researcher]

5.5 Strategies for promoting collaboration.
Although all teachers had reported using a strategy for pairing the learners only the Year 6 teacher reported that she had begun to develop further strategies for promoting collaboration.

- *'I suggested that the children not only shared tasks but also alternated the various tasks involved in building a model. In this way they would need to rely on speaking and listening to each other in a controlled way in order to build the model correctly. The learners used many different methods with each other.'*

5.6 The learners' understanding of collaborative group work
When interviewed the Year 6 children demonstrated that they had some understanding of the roles and skills required for collaborative work.

- *The learners reported that none of them had thought about the roles they were going to take. They said that the ways in which they worked 'just happened'. However on reflection they were able to identify the characteristics of the roles they adopted. Five of the pairs thought that they shared actively with their partners, taking turns, co-operating and supporting each other. The partnership that failed [the child's opinion] was because his partner was not interested in the activity and showed little co-operation. One child thought that they had worked quickly because they were taking it in turns.* [Student researcher]

6. Gender

All the team members reported that both boys and girls accepted the kits. In some classes the motivation of one or both gender groups changed over the span of the project.

Year 3/Year 4 [Special Educational Needs]
The teacher had specified this area as one in which she waned to achieve a positive outcome

- *There was a very noticeable change here. I have a box of 'wet-playtime' LEGO [from home] and the girls were never interested in it . The boys monopolised it. After using the kits there were far more girls going to the LEGO and the amazing thing was that the boys accepted this, it had become normal. The girls were equally involved and motivated in the activities. It may also be interesting to note that the learners clearly differentiate between the use of the LEGO Dacta kits and the 'box of LEGO'* [Class teacher]

Year 4

- '*Boys and girls enjoyed the kits.*'[Class teacher]

Year 5

- '*The boys worked with more application than the girls when following the instructions which is the exact opposite of what usually tends to happen.*' [Class teacher]

Year 6

- '*Initially the girls were not interested but that changed*'

- '*Both boys and girls were equally motivated but the boys tend to be more vocal [when constructing and exploring models].*' [Class teacher]

7. The LEGO Dacta instruction cards

The teachers found that children with reading difficulties were much more adept at using the cards than were learners with more developed reading skills. For those who were more used to reading text the cards provided them with the need to develop skills in reading diagrams. Initially some children found the cards difficult to interpret but by the end of the project they were confident and capable in their use.

Year 3/Year 4 [Special Educational Needs]

- '*They all found the instructions easy to follow and were able to build using the pictures and diagrams. They found it helpful that the picture diagrams were related to real life as their parents use instructions to build things at home, from MFI for example.*' [Class teacher]

Year 4

- '*They found following instruction cards very hard at first, seeing 'behind' the model however those with low reading ages did not have so much difficulty.*' [Class teacher]

- When observed early in the project *the learners found it difficult to discriminate between the front and rear views of the diagrams*

- When interviewed *the learners said that this had led to frustration.*

- When observed *comparing the results of the first observation with the results of the second observation the children were more confident and more able.* [Student researcher]

Year 6

- '*The absence of written instructions gave the children the necessary confidence to build the models with less teacher input than perhaps expected. The children were able to build the model step by step. Some children, at this early stage, found that working out the positioning of the elements in the 3D diagrams and translating them into their own constructions to be a challenge, especially elements that fitted behind other elements. But, as the work progressed, the format of the instructions very much helped.*' [Class teacher]

8. Management issues

The project team members have identified the following issues arising from their use of the kits with their learners

8.1 Training

- The team members identified the initial training and support as a major factor in ensuring that the project went ahead and was successful. The practical experience of using the materials was invaluable, as was the time to look at how it might be used in the classroom and across the curriculum. In school use was made of peer tutoring and the sharing of experiences. The team members believe that they can now train and support other staff.

- They suggest that the initial training for a school should be funded.

8.2 Planning

- The training provided the team members with ways of planning effective activities using the LEGO Dacta kits.

- They indicated that support with planning, through training or the provision of printed or electronic materials, would be useful in assisting in the uptake of LEGO Dacta resources in other schools.

8.3 Progression

- The team members had to decide into which year groups the kits were to be placed and they had to find out how progression might be achieved.

- They suggest that it would be better if LEGO Dacta provided an outline scheme showing the possible routes for progression from Year 3 to Year 6, mapped onto the National Curriculum. They suggest that it is especially important to do this for RoboLab.

8.4 LEGO Dacta kits and their place in the curriculum

- The team members decided that they would focus upon one subject area initially. The most obvious one, for them, was CDT within Design and Technology. They believed that as they became more familiar with the materials they would begin to identify other meaningful curriculum links. They also wanted to provide progression within one curriculum subject from Year 3 to Year 6. At the end of the project they were confident that they had identified possible and effective curriculum areas in which they might use the kits. They had also begun to establish progression in D&T for the learners from years 3 to 6 [Knowledge and understanding of mechanism: KS2/PoS 4; and some of the process skills in KS2/PoS1,2 and 3].

- They advise other schools to identify one curriculum area initially and to develop expertise and ensure progression in that area before using the LEGO Dacta kits in other subjects.

8.5 Learners management of the LEGO Dacta kits

- The team members found that there were problems with learners not returning pieces to the boxes correctly. There is a need to check that each piece is in each box. The team members found that the learners' management of the kits is affected by the value they and their teachers put on the use of the kits; by the learners' sense of ownership of the resources; and by learners' motivation to build products successfully. The team developed various strategies in response.

- They suggest that teachers must assign value to the kit and to the way in which the learners work. Teachers need to help learners to build up good working practices and to put routines into place. Children should, for example, use the lid of the kit box as the work area to stop pieces falling to the floor. To establish ownership the kits can be numbered and the same kit allocated to a pair of learners for each of the sessions. Children will quickly realised they will not be able to build successfully if pieces are missing. Teachers can make 'hunt the missing pieces' a fun activity at the end of the session, celebrating finds and giving small rewards.

- The learners' high level of motivation will be better maintained if the LEGO Dacta kits are used in a blocked period of time. If the resources are used every day familiarity might reduce motivation. Similarly the LEGO tiles are better used in rotation with a variety of other resources

8.6 Collaborative group work

- The learners worked in pairs when using the kits. They worked in small groups when using RoboLab and the LEGO tiles . Working together, as indicated above, the learners developed both collaborative and speaking and listening skills .

- The team suggests that the pairing of children not only benefits the learners but that it is also cost effective.

9. The reasons the kits had not been used in the school before and suggestions about how these might be overcome in other schools.

The teachers reflected upon the inhibiting factors that had prevented them from using LEGO Dacta kits before. Using their experience gained from the project they then gave suggestions about what they believe is required to overcome these inhibitors in other schools.

Experience

- The teachers had little or no experience of working with LEGO Dacta kits before the project and they were not aware of the potential uses and outcomes.

- The training and support provided at the beginning of the project helped them to see the potential of the materials and gave them confidence through hands-on experience. The project period also further improved confidence and experience. The project team leader said that the a good beginning for the project was vital The 'getting it in and getting it started' period is a crucial time and determines the success or otherwise of a project. It was also important that each teacher was able to select something with which he or she felt comfortable. It was also recognised that the project members were at different stages and some need longer to build up skills and confidence than others. The project team will now act as trainers and facilitators for the rest of the staff.

- They suggest that training and support are motivating factors that leads to the uptake of the materials. There needs to be flexibility in the training and support to allow for teachers to work with aspects with which they are comfortable and to cater for different levels of need. After initial training it may then be possible for the training for other teachers to be provided by the trained staff in the school.

Cost

- Cost was a major factor and LEGO Dacta was considered a luxury item. The school could not have purchased the kits in one year as the cost far exceeded the Design and Technology budget for the year.

- The teachers also thought that to be worthwhile there needed to be enough resources to allow for whole class activities. As they had little understanding of the potential of the LEGO Dacta kits there was a reluctance to make such a large purchase.

- The teachers are now convinced of the value of the kits and find them to be well worth the expenditure. They also saw that although the kits were excellent as a whole school resource they were also valuable as a stand-alone class set.

- They suggest that continuity and progression should be seen as paramount by schools wanting to buy LEGO Dacta materials. A school would be well advised to resource one year group very well each year; buying for Year 3 in the first year, Year 4 in the second year, Year 5 in the third and for Year 6 in the fourth year. The Year 3 learners would acquire the initial skills and knowledge needed and would build on this as they moved through the school. Equally it would help staff to develop their own knowledge and skills.

10. The next step for the project team and the school.

- During the time of the project the textiles component was omitted from the CDT block to provide eight weeks for the use of the kits. The LEGO Dacta kits will now be run alongside the textiles unit and each unit, kits and textiles, will be four weeks long.

- RoboLab was initially seen as quite daunting. The staff needed to gain familiarity with the kits before moving to working with RoboLab. It is not a class activity so it needed '*more courage*' to run it alongside the other activities. It also needs intensive teaching and the use of the computer lab. However the high motivation of the learners to use the kit is an equally motivating factor for the staff. The team members will be addressing its use over the next phase and will identify the progression it provides within the National Curriculum.

- There has been a change of staff so another staff member will be brought into the team.

- The team will map out where they will use the LEGO Dacta kits in different curriculum areas. They will not be over-ambitious but will plan for a small but well focused input for each year group.

- The team will relaunch the project with the whole staff. The programme for the staff will be phased-in, with the LEGO Dacta kits being initially located in the craft activities curriculum slot as it was in the project.

- The staff will be given training by the team to give them practical experience. They will then be given further support by the team and through peer group support.

The discussion of the results

1. Learner motivation, engagement with and attitudes towards learning

It is evident from the study that the LEGO Dacta kits significantly increased the motivation of the learners within the CDT sessions. Learners' attitudes towards the tasks were on the whole very positive and there was a high level of learner engagement. This is concurrent with Ritchie's views [1995] of the motivational nature of construction kits. Johnsey [1998] suggests that the context of the task has an influence on learners' motivation and the project team made particular reference to the fact that the LEGO Dacta tasks presented the learners with relevant and meaningful contexts in which to work.

The supply of ready-made parts motivated the learners; it allowed the learners to develop and apply their ideas quickly and to achieve high quality products of which they were proud. The use of collaborative group work also contributed to learners' success and motivation. The changes in motivation, engagement and attitudes were particularly noticeable in the Y3 / Y4 SEN learners and in learners of low ability within other classes. This may suggest that the LEGO Dacta kits presented them with a learning style, kinetic, that allowed them to demonstrate their potential.

Some learners found elements of the tasks demotivating. Some did not like to have a writing element in the task; they were so motivated by the practical activity and so keen to proceed that they resented the time lost in writing. Some learners were frustrated initially by the LEGO Dacta instructions [also see 9. below] but this was overcome. For some learners the collaborative groups were not effective and proved to be demotivating [see also 6. below].

At the start of the project it was hoped that any change in the learners' motivation, engagement and attitudes promoted by the kits would prove to be transferable. Although it is evident learners are more motivated during LEGO Dacta activities, and that the self-esteem of some learners has risen, there is no evidence, at the moment, to show that they have transferred this motivation to other curriculum areas. For some learners there is still a marked difference between their engagement with the LEGO Dacta kits and their engagement with, for example, literacy.

It will be interesting to see what changes might occur as the kits are used in more classes and across the subjects. At the start any initiative there will always be an element of novelty for all the participants. At this early stage in the project the results in terms of motivation are very positive and encouraging. As work with the LEGO Dacta materials becomes a more accepted part of the curriculum it will be both interesting and worthwhile to monitor how the school ensures that the motivation, of both teachers and learner, is sustained and developed. The project team already suggests that the kits should be used in blocks of work to avoid the over-familiarity that might reduce learners' motivation.

2. Learners' achievement

Ritchie [2001] suggests that the use of construction kits allows learners to develop knowledge and understanding of mechanisms and structures more easily and more quickly than through the use of other media. This study would support his view. Teacher assessment indicates that, within Design and Technology, learners achieved at a significantly higher level, both in terms of subject knowledge and in their understanding of the design process, than learners taught in previous years without the LEGO Dacta materials.

The LEGO Dacta tasks provided meaningful contexts in which children were able to acquire and to apply the associated technical vocabulary. However where the teacher did not introduce and reinforce the vocabulary the potential of the resource was not realised. It would therefore appear to be advisable to support teachers in the use of the correct terminology with their learners.

Although this phase of the initiative focused upon Design and Technology learners there was evidence of learners' achievements in other areas of the curriculum: these were English and Mathematics, the National Curriculum key skills and thinking skills and in personal and social development.

The introduction of the LEGO Dacta kits as an aspect of Design and Technology appears to have been very successful in raising in raising achievement in subject knowledge and understanding of mechanisms and structures and in designing and making. In the next phase the project team will focus upon using LEGO Dacta resources to promote learners' achievement in other areas of the curriculum.

No attempt was made to quantify the achievements made by the learners in this initial phase or to compare it statistically with the achievements of earlier groups of learners. In any further study it would be advisable to collect assessment data relating to subject knowledge and skills set against the requirements of the National Curriculum. This would provide a more secure base from which to assess the validity of the claims made about the achievements of learners.

3. Teacher confidence and motivation

The members of the project team were at different stages in terms of skills and confidence before the project began. Some were already highly motivated, had some experience of using kits and were confident in teaching Design and Technology. Others had little prior knowledge or experience of kits but were confident that they could make good use of resources. One teacher had a high level of expertise within another curriculum subject but had little confidence or interest in teaching Design and Technology and was very sceptical about the likely outcomes for the learners.

There were several motivating factors for the teachers. The children were highly motivated and engaged and seemed to be acquiring both knowledge and skills. The learners were developing more effective social skills and there was a positive effect upon behaviour. The project and the materials helped the teachers to increase their own subject knowledge, their teaching strategies and their confidence. They felt supported by the training, the teacher guidance notes and the LEGO Dacta resources.

Although all the teachers reported an increase in their own motivation, and upon their learners' positive attitudes, motivation and engagement, it was noticeable that the increase was highest in those classes where the teacher was initially highly motivated and confident. The teacher who was quite sceptical about the project had said initially that both teaching and children's learning is dependent upon the

teacher's attitude to the subject. He is supported in this view by Mittel and Penny [1997]. However this teacher and the class did make steady progress and by the end of the project there was a noticeable shift.

4. Training and support

The wide range of confidence and experience displayed by the team members and their different curriculum interests [discussed above in 3.] is probably indicative of the picture in most schools. The provision of continuity and progression for the learners [identified as a key issue by the project school] relies on teachers in each year group being able to work confidently and capably with the materials. The pattern of training and support established in the project school appears to have been effective in catering for the different needs of the project team members. The teacher who showed the greatest scepticism and reluctance at the beginning of the project began to see the value of the LEGO Dacta resources and was contemplating the use of RoboLab in the following school year. Without the training and the support of his peers it is unlikely that this teacher would have begun to use the LEGO Dacta materials with his learners.

The initial training and the in-school peer support appear to be essential in ensuring that all members of the teaching staff are capable and comfortable when using the resources. Training and support may also be important factors in embedding the LEGO Dacta materials securely within the curriculum of the school.

5. Providing effective learning opportunities for all learners.

The LEGO Dacta materials provided appropriate challenges for learners of different abilities, including learners with special educational needs. The learners' responses to the materials appear to indicate that the resources provided a learning context and a learning style that other areas of the curriculum were not able to provide.

LEGO Dacta advocates that there are no significant gender issues relating to the use of their materials. However research evidence shows that gender is an issue where construction kits in general are concerned. Claire[1992], Cattan [1988] and Clegg and Mayfield [1999] suggest that boys dominate the resources and are patronising towards the girls. They also suggest that girls make better progress in same sex groups. Construction kits can foster spatial awareness and this is particularly important for girls as Shuard [1982] indicates that they, more than boys, experience difficulty with this area .

The team had identified gender issues connected with the use of construction kits before the project began. There is evidence to show that in most classes there have been significant changes during the term of the project. In most classes there appeared to be little difference in the level of motivation between boys and girls. In one class the girls took longer to become enthusiastic about the kits. There was no evidence by the end of the project that the boys were dominant or were patronising. There was evidence, however, that both sexes were happier in single sex groups [also see 6. below].

The dominant factor in the mixed or single sex pairs appeared to be the general disposition of the individuals rather than their gender. This seems to be linked with the ways in which the pairs of learners were constituted. When self-selecting the groups did tend to be mostly single sex pairs and, as discussed in 6. below, self-selecting groups appeared to be more effective.

The National Curriculum [1999] sets out three principles for the development of a more inclusive curriculum - suitable learning challenges, responding to learners' diverse learning needs and overcoming potential barriers to learning and assessment. There was evidence that the use of the resources had made a positive contribution to inclusion. The project team members would advise schools to consider the introduction of the LEGO Dacta materials in order to increase effective learning opportunities for all their learners.

6. Collaborative group work

Collaborative group work was a particular feature of the project. In earlier research Sutcliffe and Doyle [1993] proposed that children adopt differing roles within groups. The learners in all the project classes did take on roles within their pairs but, when interviewed, it became clear that they had adopted these roles unconsciously. The observer of the Year 6 learners identified a taxonomy of strategies that they used [see Appendix A.]. She observed that although the teacher discussed the general issues relating to co-operation the specific roles within the pairs were not. She suggests, therefore, that the roles the learners took on were most probably their natural and familiar working strategies. She was not able at this point to indicate which of the successful strategies were the most effective.

The team was aware of the benefits arising from the use of collaborative group work and began to introduce a range of strategies to promote a higher level and quality of collaboration. However from the observations and the interviews it appears that learners are not aware of the roles they adopt. Teachers would be advised to help learners to recognise the roles they play and to encourage them to try out different roles within the group.

It was noticeable, however, that some partnerships were much less successful, in terms of discussion and progression [also see 5 above]. These pairs did not exhibit the characteristics of an effective working group as defined by Smith, Cowrie and Berdondini [1994]. This is an area that teachers would need to address. As the use of collaborative group work was a significant motivating factor for both the teacher and the learners, and appeared to play an important role in learners' achievements, it may be advisable for LEGO Dacta to provide guidance on effective learner collaboration in the teachers' notes. The use of collaborative group work might also be considered as a constituent of a training package.

7. The LEGO Dacta instruction cards

The instruction cards with their lack of text and the use of diagrams were instrumental in promoting a high level of co-operation and discussion between the learners. This led to the development of both collaborative and speaking and listening skills. Ritchie [2001] suggests that making models from illustrations provides quite challenging tasks for children, which involve them in making close observations, and in explaining, persevering, discussing and predicting. Observation of the learners in the project school confirmed this.

However, initially, the LEGO Dacta instruction cards did prove difficult for some learners and caused varying degrees of frustration. The learners were not familiar with the format of the cards and lacked experience in interpreting the illustrations and they were also inexperienced in the use of the LEGO Dacta kit pieces. The children's problems were further compounded by the fact that the level of difficulty was not indicated on the cards and at times they were working well above their capabilities. There appears to be a need for learners to work initially with very

simple constructions and instructions in order to develop their interpretation and construction skills before moving on to making more demanding models. This view is supported by Makiya and Rogers [1992] and Ritchie [2001].

The frustration experienced by the children could be a demotivating factor for the teacher, especially for a teacher still developing his or her own skills, and might lead to the teacher rejecting the use of the LEGO Dacta kits. It may be worth considering how learners and teachers might be best supported in this initial stage.

In Conclusion

The research focused upon four main areas: the learners' achievements: their motivation, engagement with and attitudes to learning; the attitudes and expectations of the teachers to the above; and the teachers' motivation.

From the evidence presented by teachers, learners and researchers it would indicate that the introduction of LEGO Dacta resources to the school has proved to be very successful in three of the classes and reasonably successful in one of them. At the end of this first phase of the initiative learner and teacher motivation is high. The learners have demonstrated good levels of achievement within Design and Technology, English, Mathematics and National Curriculum key skills and thinking skills. Teachers' expectation of their learners' attitudes to and engagement with learning is also at a higher level than at the beginning of the project. The team has now identified other curriculum areas where the LEGO Dacta materials might be employed.

Reflecting upon the experiences gained over the time of the study the team recommends the use of LEGO Dacta materials to other schools and has provided suggestions about how this might be carried out both in terms of training and implementation.

The team members are now embarking upon the next phase of the project, confident in their ability to train and support their colleagues, while looking forward to developing further their own skills and knowledge.

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APPENDIX A.

Working methods employed by the Year 6 learners working in collaborative pairs with LEGO Dacta kits.

During the three observations of the Year 6 learners the observer identified the following categories of working methods employed by the pairs.

Method 1

- Child 1 interprets the instructions and gives verbal direction to Child 2 who finds the elements and builds.

Method 2

- Child 1 interprets the instructions and requests the element needed. Child 2 finds the element and passes it to Child 1 who builds.

Method 3

- Child 1 interprets the instructions, finds the elements and builds. Child 2 watches and makes comments.

Method 4

- Both children interpret the instructions, find the elements and build a part of the product. The children then join the two parts when necessary to complete the product.

Method 5

- Both children interpret the instructions, find the elements and construct the product as a whole together.

Method 6

- Child 1 holds the instructions, finds the elements and builds. Child 1 requests the teacher's assistance when problems arise, shielding the instructions from Child 2.

Method 7

- Child 1 interprets the instructions, locates elements and builds. Child 2 takes little part in the activity. Child 1 tries to involve Child 2 in the activity.

[Rebecca Morley, 2001]

'*The impact of LEGO Dacta resources on the motivation of a group of Year 6 learners and their teacher; and whether, for them, it is possible to identify a taxonomy of strategies as they work in pairs.* '

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