Utilization of Information and Communication Technology (ICT) for education in South Africa: An examination of the World Links for Development (WOrlD) programme

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Submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy (DPhil) in Information Science in the Faculty of Engineering, Built Environment and Information Technology, University of Pretoria, Pretoria, South Africa

May 2003

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DECLARATION

I, Hillar Addo, hereby declare that this thesis is a product of my own work, unless stated otherwise. I also declare that this thesis has not been submitted at any other university for the purpose of a degree.

Candidate:

Signed

Supervisor:

Signed

DEDICATION

This work is dedicated to my wife, Emily, and children, Mawuli, Edem and Kafui, for their understanding and support during the long and frequent absence of Pappa.

SUMMARY

South Africa was a recipient of the World Bank's World Links for Development (WorLD) pilot programme (1997-2001) as part of the bank's education projects in developing countries. The project sought to assist developing countries integrate information and communication technology (ICT) into their education systems and develop their youth to operate in a globalizing knowledge economy.

This study investigated concerns of WorLD project teachers in KwaZulu-Natal regarding the lack of achievement in project outcomes, and hence ICT impact in project schools in South Africa.

It was established by the study that ICT was not only an educational tool but also a driving mechanism for socio-economic development in a globalizing knowledge economy.

The study found that though educators in the WorLD schools in South Africa were adequately trained in computer application programmes and collaborative school projects, learners were not provided with such skills due to educators not having time to do so. Lack of technical training also inhibited computer access, hence the project from proceeding to the levels of integrating ICT into the curriculum.

This study established that, WorLD school project educators in South Africa were not familiar with, trained in and do not use most teaching methods that support integration of ICT in education. A preponderance of a *chalk and talk* pedagogy existed as the popular model in rural South African schools where this study was conducted.

The study found a strong correlation between ICT and other information resources for teaching and learning. In spite of this, the majority of WorLD schools in South Africa during the project phase had less than the minimum requirements of the pre-requisite information resources, namely computer networked laboratories, Internet access, libraries, media teachers and multimedia centres, to effect an ICT education. Marginalization of the school librarian created difficulties in the integration of ICTs into the curriculum in WorLD schools.

There was hardly time for educators to deliver on WorLD projects, even though teachers had acquired the skills and confidence to do so. Where educators braved the situation, project activities had a negative impact on their normal teaching duties.

The majority of WorLD learners could read, that is access information from books, and write without assistance. Reading problems were acute where they existed and only a few learners could read and access information from the Internet without assistance.

Though many WorLD educators and learners had used a multimedia system and are positive that the tool can assist in ICT education, none of the schools had the minimum ICT requirements to utilise such a system.

A positive spin-off of the project was that educators and learners in WorLD schools have been equipped with new skills and modern insights into education. Learners have been exposed to new learning methods and have been equipped with skills which they will utilize in work situations and for further education. WorLD educators have also been equipped with modern teaching methods and tools.

A model was proposed as a basis of evaluating the WorLD project outcomes and impact. This could be used in evaluating other ICT in education or e-learning projects in Africa.

Keywords: Computer-based pedagogy; disadvantaged communities; education; evaluation; ICT; information and communication technology; project; technology-enhanced learning; E-learning; World links for development (WorLD) programme.

ABSTRACT

South Africa was a recipient of the World Bank's World Links for Development (WorLD) pilot programme (1997-2001) which is part of the bank's educational projects in developing countries.

In 2000, at the end of the pilot phase of the project, some teachers in a number of WorLD schools in KwaZulu-Natal, one of the provinces in which the projects were sited, expressed concern at the lack of achievement in project outcomes, and hence ICT impact in their schools.

This study investigated whether concerns of WorLD project teachers in KwaZulu-Natal prevailed in other WorLD project schools in South Africa or not. An evaluative research method was used to investigate benchmarks developed as possible indicators to achieve project objectives.

The study found that despite the key role of ICT in improving the quality and delivery of education globally, imperatives to achieving educational outcomes, such as access to computers and Internet networking, training of educators and learners, and a supportive working environment were still unavailable to education role players in disadvantaged community schools in South Africa.

The study concluded that educators in WorLD schools have been equipped with new skills and modern insights into education. Learners have been exposed to new learning methods and have been equipped with skills which they will utilize in work situations and for further education. However the project failed to achieve a great proportion of its outcomes and impact.

The study recommended that the issues that have impeded achieving the objectives of the WorLD project be addressed through a national ICT education policy to achieve future outcomes and impact.

A model was proposed as a basis of evaluating the WorLD project outcomes and impact, which could be used for other ICT education projects in South Africa and in other African communities on the continent.

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to a number of people who made it possible for me to undertake this study.

My very special thanks goes to my supervisor, Prof. Dr. Johannes Cronje, for his academic support, direction and guidance.

I would like to express my profound thanks to Dr Mike Van de Linde, who personally guided the data processing aspect of the study and developed a computer system that literally counted and apportioned the research data. I also wish to thank Miss Liebie Louw, for guidance in research methodology and a special thanks to all those teachers and students who took time to answer the questionnaires.

Finally sincere thanks to Randy Navunda and also to the staff of the Department of Information Science, University of Pretoria for the support and encouragement.

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List of Acronyms and abbreviations

CAI	Computer Assisted Instruction
CAL	Computer Assisted Learning
CD ROM	Compact Disk Read Only Memory
CK: P	Common Knowledge Project in Pittsburg
DOS	Disk operating systems
Etc	*Et Cetera* (and so forth)
E.g.	Example
GII	Global Information Infrastructure
ICT	Information and Communication Technology
IT	Information Technology
NCET	National Council for Educational Technology
NEPI	National Educational Policy Investigation
NGOs	Non Governmental organizations
OSF	Open Society Foundation
TELI	Technology-Enhanced learning Investigation
WorLD	World links for Development Programme
SACat	South African Cathalogue of thesis and Dissertations
SAIDE	South African Institute for Distance Education
SchoolNetSA	SchoolNet South Africa
SRI	Standard Research International
TV	Television
UCLA	University of California Los Angeles
VCR	Video Cassette Recorder
VGA	Video Graphics Array
VoIP	Voice over Internet Protocol
Windows NT	Windows New Technology
WWW	World Wide Web

Chapter 1

Introduction

1.1 The World Links for Development programme[1]

The World Links for Development (WorLD) programme is one of the World Bank's education projects. It focuses on the promotion of new and better ways of achieving effective learning through the use of technology. The programme started as a four-year (1997-2000) pilot initiative of the World Bank in developing countries. The programme came into effect in response to widespread requests from developing countries to assist them in preparing their youth to participate effectively in the global information economy.

The vision of the programme is expressed in the words of the President of the World Bank, James Wolfenson (1999), as:

> *"I want… a partnership for creating and sharing knowledge and making it a major driver of development. The challenge is to harness technology to link people together and to leverage its impact for development. Wherever people live… they have one thing in common… They want a chance. World Links for Development (WorLD) provides that chance."*

The work of the WorLD programme in participating countries is carried out with five major Objectives. These were to provide:

- Internet connectivity for secondary schools in developing countries;
- training and educational content to promote economic and social development;
- regional and global partnerships with public, private and non-governmental organizations;
- telecommunications policy advice for the education sector;
- monitoring and evaluation support.[2]

[1]Information on the WorLD programme is taken from the World Links for Development Website: http://www.worldbank.org/worldlinks/english/html/backgrnd.html, May 13 1999.

[2]The process by which the WorLD programme pursues its objectives is presented in Appendix 1.

1.2 Introduction

Chapter 1 puts the subject for research into context. It is an overview of the study, beginning with a general introduction and leading to a discussion of the background of the problem. The chapter then identifies the problem, examines the issues of the problem and establishes the aim and objectives of the study. It presents the research questions, a justification and the study's scope and limitations. The research is conducted using the evaluative approach. In summary, the study:

- investigates whether concerns of some WorLD programme teachers[3] in KwaZulu-Natal, regarding the non-effective utilization of Information and Communication Technology (ICT)[4] in education, prevail in other WorLD schools throughout South Africa;
- samples 19 teachers and 91 students[5] from 19 WorLD project schools in South Africa;
- conducts a focus study interview with project teachers, administers questionnaires to determine teachers' and learners' concerns regarding the WorLD programme and other factors contributing to the success or failure of the programme in their schools
- proposes an evaluation model for school ICT projects in South Africa

1.3 Background to the problem

1.3.1 Researcher's observations

Since the inception of the World Links for Development (WorLD) programme in South Africa in 1997, the researcher has followed its implementation with interest. He has held informal discussions with the project co-ordinator in South Africa (Kotsokoane 2000) and with the WorLD programme manager (Hawkins 2000), from the programme head office in Washington D.C. The researcher also participated in training sessions with project teachers in KwaZulu-Natal, where he made a number of observations and noted of teachers' concerns. The WorLD programme in South Africa presents, in its implementation, a number of issues:

[3]Educators and trainers are used interchangeably in this thesis to refer to formally trained personnel engaged in providing knowledge and skills to learners.

[4]The terms information and communication technology (ICT), microcomputer, computer and computer system are used interchangeably in this thesis to mean tools or machines used for storing information, manipulating such information and facilitating communication via the Internet

[5]The terms students, learners and pupils are used interchangeably in this thesis to mean formal school-going persons generally, and specifically high/secondary school-going persons in South Africa.

- Many teachers and pupils involved in the project have never been exposed to computers and the existing pedagogy in project schools is not known to support computer-based education.
- Project schools lack basic information resources such as school libraries, computer laboratories and media teachers.
- WorLD school projects are managed by teachers, who carry out teaching duties.
- Basic literacy, in terms of reading in the English language, seems a serious issue.
- Many WorLD schools seem to lack the drive for teaching and learning.

This researcher's observations, regarding the school environment and the low morale created by a lack of resources, are confirmed by Bouwer (1998: 225), who notes that, in South Africa, the redress and enhancement of education and the performance of African learners are hindered by factors such as:

- a gravely inadequate culture of learning in the schools;
- the shortcomings of poorly-trained teachers;
- emotional and motivational problems in learners;
- the absence of a culture of literacy.

1.3.2 The role of information and communication technology in education

Information and communication technologies (ICT) have become indispensable tools in today's information age, making a dramatic impact on the lives of people globally. This effect is most significant in education. The computer has become a motivating tool for teaching and learning in schools (Mossom 1986; World Bank 1999). The Internet allows cost-effective information delivery services, collaborative and distance education, more than has ever been imagined (Clyde 1995; Mbeki 1996; Todd 1997). A concept such as 'the knowledge revolution' has become a major feature in the literature in recent times (De Horowitz 1993; Menou 1993; Zulu 1994; Twine 1996; and World Bank 1999). De Horowitz (1993: 171), for example, reports on how technologies are inexorably integrated, creating new intellectual capabilities by assisting the human brain and thereby changing most aspects of people's lives.

Recent technological developments worldwide have ushered society into a multimedia age, "where children and adults are being asked to handle information from a bewildering variety of sources. These sources include video, CD-ROM, satellite television and a quiet but insistent multimedia revolution is slowly taking place in schools and colleges" (Thomas 1996: 4). Multimedia software stimulates different learning paths by offering information through pictures, text, sound, animation and video (Gates 1994: 170).

The present study comes at a time when government in South Africa (Mbeki 1996; Asmal 1999) has questioned the preparedness of teachers and learners in South Africa to meet the demands of the information age. Authors such as Herring (1996) and Campbell (1996) emphasise the importance of computer and traditional information skills in achieving ICT education. Johnson (1995) and Karaliotas (1997) add that only certain teaching methods will make effective use of the computer and Internet resources in schools. Todd (1997) and Kafai and Bates (1997) emphasise that the role of the media teacher is paramount in creating a successful ICT project in schools.

1.3.3 ICT for education in South Africa

ICT has been an integral part of education in certain schools in South Africa for some time (Mosson 1986; Overduine and De Wet 1987). However, many schools still do not have computers or information resources with which they can provide resource-based education. This has led to concerns (Carrol 1998) about the need for providing South African schools with ICT tools, thereby enabling students to function effectively in a global information economy. A new resource-based education policy, which emphasises the use of ICT (Musker 1997) has been put in place.

A lack of information resources in most schools (Bot 2001), and the slow pace of policy implementation regarding the provision of ICT in schools, create inequity in the education system. Utilizing new technologies in education will not only encourage pupils in previously disadvantaged schools,[6] but will enable them to engage in collaborative school projects with historically better-equipped schools. It will also enhance skills and build bridges of communication and understanding among a youth divided, in the past, by segregation policies.

1.3.4 Efforts to equip South African schools with ICT

A number of organizations,[7] particularly SchoolNet SA (Carroll 1998), seek to address, on a national level, the issue of providing ICT to schools. The pace of resourcing is slow. There is a great need for other providers of resourcing in South Africa. The emergence of the unique and revolutionary World Links for Development (WorLD) global education networking programme gives hope for an expanded national utilization of ICT in the South African schools where it is needed most (Eastern Cape, North-West Province and KwaZulu-Natal).

The WorLD programme seeks to resource, network and train teachers in selected schools in developing countries,[8] including South Africa. The project is revolutionary, as it seeks to transform not only the curriculum in project countries, but also the purpose of education globally. The programme seeks not only to network developing countries but to link them with developed and industrialized countries for collaborative distance education. It is unique, as it is an undertaking of a multinational lending institution – the World Bank. The WorLD programme also aims to monitor and evaluate performance to ensure progress in service-delivery and value for money.

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[6]Disadvantaged schools refer to schools historically under-resourced, as indicated in the NEPI Report (1992) and by Radebe (1997). The WorLD programme would assist such schools in South Africa.

[7]Discussions held by the researcher with officials involved in the implementation of school ICT projects in KwaZulu-Natal (Thompson 1999; Roos 1999) reveal that other efforts in the province include: Telkom 1000 project; The Valley Trust; Reach and Teach; Futurekids; District Development project and the McCarthy projects.

[8]The WorLD programme began with 13 developing countries. At present 15 countries are active. These are Brazil, Cape Verde, Chile, Colombia, Ghana, Mauritania, Mozambique, Paraguay, Peru, Senegal, South Africa, Turkey, Uganda, West Bank/Gaza and Zimbabwe.

1.4 Problem statement

After four years of implementing the WorLD programme in South Africa (1997-2000), some teachers from participating schools in KwaZulu-Natal expressed concern about the inability of students to retrieve and use information from computers for collaborative school projects. They argue that students' problems stem from their slow pace of attaining the required computer and information skills. The teachers claim that they spend more time than they should in assisting students with the new technology (KwaZulu-Natal Respondents 2000).

The teachers maintain that they had to attend to frequently non-functioning computer systems and were thus unable to adequately fulfil their roles as subject teachers. They attribute their problems to:

- learners' lack of literacy skills;
- a lack of a computer-based pedagogy in their schools;
- a school environment deprived of information resources.

The teachers see a multimedia computer system as a possible remedy to their situation.

The concerns of KwaZulu-Natal teachers confirm observations made by the researcher. It has, however, not been established whether such concerns are unique to the few KwaZulu-Natal WorLD schools, or whether these concerns are shared by other WorLD schools in South Africa. The teachers have raised specific issues, which require investigation and verification in WorLD schools throughout South Africa. These issues, as inferred from the problem statement, are:

- a lack of information literacy on the part of the WorLD school learners;
- learners' lack of computer skills;
- learners' lack of literacy skills;
- a lack of capacity (in terms of teachers' time and skill to implement WorLD projects);
- a lack of a computer-based pedagogy in WorLD schools;
- a lack of information resources;
- the need to utilize computer-based multimedia resources in South African WorLD schools.

1.5 Purpose of the study

The purpose of this study is to investigate the utilization of ICT in WorLD programme schools in South Africa and to provide theoretical strategies aimed at achieving or improving utilization to achieve school ICT educational outcomes and impact (See Figure 6.1).

1.6 Objectives of the study

Based upon the purpose, the objectives of the study are to:

- assess teachers' and learners' training received during the WorLD programme;
- determine the information resource capacity of WorLD schools;
- investigate the capacity of WorLD project teachers to implement projects;
- assess the level of literacy skill of learners in WorLD schools;
- assess the need to utilize multimedia resources in WorLD schools;
- determine other factors that contribute to the success or failure of the WorLD programme in South African schools;

1.7 Research questions

The central question to this study is whether or not concerns of the non-effective utilization of ICT in WorLD project schools in KwaZulu-Natal prevail in other WorLD schools in South Africa. Specific questions that need to be addressed are:

- How successful was the training provided to teachers and students in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?
- What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?
- To what extent are South African computer teachers able to handle school computer projects, attend to computer systems and attend to their normal school lessons?
- What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?
- How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?
- What other factors contribute to the success or failure of the WorLD programme in South Africa?

1.8 Justification of the study

This study is undertaken, not to re-invent the wheel by determining the impact of ICT on teaching and learning, but to establish whether the researcher's observations (viewed as challenges to the implementation of the WorLD programme) prevail throughout WorLD schools in South Africa. This will, in a sense, be an evaluation of the WorLD programme regarding the provision of ICT tools and skills for teachers and learners. The researcher will determine whether the project's objectives[9], outcomes and impact (Figure 6.1) have been achieved.

Stakeholders, such as users, planners, funders and managers of projects (an example being

[9]The WorLD programme has since published its first and second evaluative reports of the programme (Kozma *et al.*, 1999, McGhee and Kozma 2001). Some of the issues raised in this study form the basis of those reports. Whereas this study dwells mainly on training, adequacy of resources and pedagogical issues, the other reports consider, in addition, developmental issues such as job opportunities after school and the impact of the project on the community.

the WorLD programme) involved in service-provision often ask whether a project has achieved its set objectives and outcomes or made an impact. This question demands a performance evaluation and a measurement of impact. Evaluation, therefore, forms an important part of the WorLD programme. It is a means of checking input against output (Bawden 1990: 13).

A number of factors in modern-day service provision and ICT performance have led to increased pressure for performance evaluation. Wyley (1996) lists some of these factors:

- growing competition for funding;
- political and financial pressure of publicly funded services and programmes;
- accountability to tax-payers;
- the need to justify the spending of public funds.

Schools and libraries are turning to ICT in the hope that its use will improve services and make life easier. A performance evaluation will not only determine whether these technologies deliver the services they are intended for, but also whether they can offer better services in the pursuit of excellence (Lombo 1998: 61).

Many evaluations are undertaken to change activities and allocate resources. Evaluations result in re-planning, shifting focus, expanding or downsizing operations, or even terminating them altogether. As pointed out by the *National Survey of ICT in South African Schools* (Lundall & Howell 2000: 50), evaluation research is critical, not only to understand and direct the ICT arena globally, but to promote equity by bridging divides, addressing social and economic demands and aiding informed decision-making.

This study assumes that if issues identified are addressed, the WorLD programme and future ICT projects in schools will achieve greater success. Utilization of ICT among teachers and learners will improve and provide learners with the skills needed in an information economy. The researcher argues that a successful WorLD programme in South Africa will be a pointer to other countries on the African continent. A model upon which the WorLD programme evaluation has been conceptualized is presented in Figure 6.1.
As developing countries rely on donors to fund projects, studies conducted on such projects

will encourage project participants to manage projects properly and to mobilize local resources to sustain the projects. These projects will thus develop further after the donors' initial assistance and, it is hoped, will eventually break the donor dependency cycle of developing communities. The information that will be generated (in the form of research) will provide literature for further debate on the issue of donor funding in the ICT sector in developing countries.

South Africa has been chosen for this study, as it has much to offer the rest of Africa in terms of resources. It has expertise in the management of computer-assisted education. South Africa has a mixture of First World schools, where ICT is fully integrated into the curriculum in some schools, and Third World schools, with no resources at all.[10] Figures concerning communication and information of WorLD countries in Africa (World Development Indicators 2001) place South Africa in the most advantageous position (see Table 1.1).

Table 1.1 Communication and information resources of WorLD programme African countries per 1000 people

Countries	Information and communication resources (per 1000 people)						
	Daily newspapers 1996	Radios 1999	Television sets 1999	Telephone main lines 1999	Mobile phones 1999	Personal computers 1999	Internet host per 10,000 people 2000
Ghana	14	680	115	8	4	2.2	0.06
Mauritania	0	151	96	6	0	27.2	0.20
Mozambique	3	40	5	4	1	2.6	0.12
Senegal	5	142	41	18	9	15.1	0.51
South Africa	32	333	129	125	120	54.7	43.12
Uganda	2	127	28	3	3	2.5	0.07
Zimbabwe	19	390	180	21	15	13.0	2.61

Source: World Development Indicators (2001: 302-308)

Table 1.1 shows the ICT advantage of South Africa over other African countries participating in the WorLD programme. South Africa has a strong political will for integrating ICT into its

[10]Information on the WorLD programme in South Africa is provided in the 23 February 1999 edition of *Computing SA*, in an article entitled *WorLD programme brings computer access to disadvantaged schools*.

entire education system (Mbeki 1996). The country has a number of First World rated academic and research institutions engaged in teaching and researching information science. South Africa has a comparatively sound economy, appropriate infrastructural capacity, a good non-governmental school network organization (SchoolNet SA)[11] – the backbone of the WorLD programme in South Africa – and a large rural, resource- deprived school setting, similar to many other African countries. A study of the WorLD programme targeted at the developing rural South Africa will provide encouragement for the rest of Africa.

1.9 Scope and limitations of the study and its context in relation to other studies

1.9.1 Scope of the present study in relation to the WorLD programme

The present study is limited to the WorLD programme conducted in WorLD schools in South Africa.[12] The study is limited to the investigation of the following objectives of the WorLD programme only:

- the provision of computers and Internet connectivity for secondary schools in developing countries;
- training of teachers and learners to integrate computers into the school curriculum.

1.9.2 Context of the present study in relation to others

The present research is placed in the context of other related ones. Its uniqueness is also determined. A NEXUS search was conducted, including a search of the South African Catalogue of Thesis and Dissertations (SACat) and international databases, including Library Literature. The search was done to make sure that no one has submitted a thesis of the same nature at any other university or institution of learning.

The results of the NEXUS search, conducted in September 2001, showed that there was no research that bore a resemblance in content and context to the present research. The reasons

[11]The Website for SchoolNet SA is: http://www.school.za. Also see http://www.teacher.co.za.

[12]The list of schools that participated in the WorLD pilot project in South Africa is provided in Appendix 3.

could possibly be:

- Utilization of ICT in education is a new area of study, with unique implementation procedures in many developing countries.
- The present research is very specific to the management of the WorLD programme and uniquely limited to South Africa.
- As this study covered a developing area of activity, it is observed that research organizations and a few academic institutions conducted almost all the related research encountered and is relied upon extensively in the study. These research studies are used to provide information for this study. They include:

Research institution: The South African Institute for Distance Education (1998)
Title: Exploring the use of Internet and satellite technologies to support the professional development of educators: Developing appropriate learning and teaching models
Correlation with this research: Both studies discussed the use of ICT in education and the role of the teacher in the process. The former study was exploratory, while the latter is an evaluation of a specific project undertaken by a specific organization.

Researchers: Kozma, R. McGhee, R. Marder C. Valdes K; Lewis A. and M. Agreda (1999)
Research institution: Standard Research International (SRI)
Title: The World Links for Development: Accomplishments and challenges, monitoring and

evaluation Annual Report

Correlation with this research: This research report measured educational efficiency by tracking student achievement indicators in key subjects and learner attitude with the use of ICT. It also considered qualitative indicator levels of the use of computer application programmes, communication and collaboration, in WorLD schools in five countries. Kozma *et al.* further considered the effect of ICT on subjects, which did not feature in the thesis under discussion. A major unrelated aspect is that, while this thesis is specific to South Africa, the research by Kozma *et al.* considered five different countries, which did not include South Africa. The present thesis was specific to schools and did not consider the impact of ICT use in schools' communities, while the research by Kozma *et al.* did. The related aspect is that both researches assessed the computer literacy of teachers and learners and perceived barriers to utilization of ICT in education

Researchers Co-ordinators: Lundall and Howell (2000)

Research institution: Education Policy Unit, University of the Western Cape

Title: Computers in Schools; A national survey of Information and communication Technology in South Africa

Context and correlation with the present research: The research by Lundall and Howell is the first in-depth analysis of the extent and manner in which computers are being used in schools in South Africa. Though the study covered all schools in South Africa, but in many instances relate to the more privileged schools, it provides impetus for the present WorLD study. The research by Lundall and Howell focused on the following objectives:

- Mapping what ICTs are being used for in schools in South Africa
- Determining the organisational arrangements used to facilitate their use
- Determining the factors enabling or hindering conditions to the use of ICTs in schools

Almost all the issues explored in the thesis are covered in the WorLD research. The differences are that, while the WorLD study is a global project specific to three provinces in rural South Africa, the other has national focus on a variety of issues, including the role of NGOs and the private sector in ICT in schools.

Researcher: McGhee, R. and Kozma, R. (2001)

Research institution: Standard Research International (SRI)

Title: World Links for Development Country Reports.

Correlation with this research: The study by McGhee and Kozma was assessed under nine implementation benchmark themes. These include: teacher training support received, nature of use of technology, student centred pedagogy and complex learning strategies that encouraged learner centred learning models or effective collaboration with ICT. Gender participation, time or duration of the use of technology and student-to-computer ratios were not assessed in the present WorLD thesis. Also, the present thesis is detailed and specific to schools in South Africa, while the SRI research considered reports on all the WorLD country projects. Again, exogenous factors which impact on ICT use in schools and job opportunities for learners with ICT skills featured in the WorLD Country report, while the present thesis considered the extent to which two principal WorLD issues, access and training, had achieved their objectives in South Africa.

1.9.3 Limitations of the study

The present study is undertaken in an environment where issues such as, ICTs, the knowledge economy and digital divide and their implications for education and development are not well known and understood. This context is amplified in the literature (Mbeki 1996; Bouwer 1998; Overduine and De Wet 1987; Asmal 1999 and Bot 2001). Such circumstances limited access to information from respondents during the study. The implications were restricted sample sizes, limited response rates resulting in reduced generalisability. This limitation is compensated for by an inclusion of an extensive literature review which contextualised the study and grounded findings and conclusions in the literature.

Another limitation of the study was that the researcher was not able to visit all schools to verify at first hand what the resource or training situation was. The study relied more on feed back from teachers and learners. This could be a limitation to some of the findings.

1.10 Product

The outcome of the present study is a research thesis.

1.11 Organization of thesis

The present work consists of six chapters:

- Chapter 1 is a general overview of the study. It includes a background to the problem statement, the purpose and objectives of the research, research questions, a justification of study and the significance, scope and limitations of the study.
- Chapter 2 is a review of the literature relating to issues raised by the study.
- Chapter 3 entails a detailed description of the methodology used for the study.
- Chapter 4 presents and analyses the collected data, based on the research objectives.
- Chapter 5 is a discussion of the findings.
- Chapter 6 summarizes the findings and makes recommendations and conclusions, based on the findings of the study.

1.12 Summary

Chapter 1 introduced the thesis with a background to the WorLD programme. It then provided a general overview of the study through an introduction, the problem statement, the aim of the study, objectives set for the study, research questions, significance of the study, limitations within which the study was conducted and an overview of how the thesis is organized.

Chapter 2

Literature review

2.1 Introduction

Chapter 2 reviews literature on the utilization of ICT in education. The objectives of the WorLD programme are the main focus. Literature on the following aspects of the project was reviewed, in addition to factors influencing the use of ICT in schools:

- computer access and Internet connectivity for secondary school education;
- teacher training for school ICT projects.

The literature review concentrates on previously deprived communities in South Africa and the rest of the world – areas covered by the WorLD programme. The literature review also focuses on the problem of this thesis, seeking answers to the research questions presented in Chapter 1. The research questions are:

- How successful was the training provided to teachers and students in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?
- What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?
- To what extent are South African computer teachers able to handle school computer projects, attend to computer systems and attend to their normal school lessons?
- What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?
- How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?
- What other factors contribute to the success or failure of the WorLD programme in South Africa?

The literature review begins with determining the relevance of ICT in education.

2.2 How relevant is information and communication technology

(ICT) in education?

A number of authors (Hawkridge 1990; Tinsley and van Weert 1995; Bigum 1997 & World Bank 1999) state why it is necessary to incorporate ICT into education systems. Hawkridge (1990) proposes four rationales for the utilization of computers in schools. He notes these as social, vocational, pedagogical and catalytical. The social and vocational rationales point to the increased use of ICT in all spheres of human activity. The pedagogical and catalytical rationales relate to the effects of technology on students and schools.

According to Bigum (1997), arguments for using computers in schools stem from technological and socially determined points of view. His standpoint is that the school system, within which the computer is used, is driven by computers. He argues that a change occurs within the education system using the computer and that change is a result of the effect of technology.[13] Bigum (1997) argues that the social context sees computers as neutral technology – technical means of achieving a defined purpose in education (Bigum 1997: 251). The contexts of utilizing computers, expressed by Hawkridge (1990) and Bigum (1997), underpin rationales for the implementation of the WorLD programme. The primary goal of the programme was to provide technology-based education for social and economic development in developing countries.

Two contexts emerge and are used in this study: the social context and the pedagogical context. The social context runs along the line of Hawkridge's (1990) social and vocational rationales, while the pedagogical context agrees with Hawkridge's pedagogical and catalytical rationales. The pedagogical context also agrees with the views of Bigum (1997).

2.2.1 What is the socially determined rationale of utilizing ICT in education?

Computer technology today spans all spheres of social and economic activity, making

13 Examples of technologically driven systems in schools, according to Tinsley and van Weert (1995:8), include automating the school library, teaching Logos in computer science or teaching mathematics using Maple Derive.

significant impacts on the lives of people (Hawkridge, Jawuski and McMahon 1990: 3). The Chinese education policy, for example, states that if the country is to develop into a first rank industrialized nation, it must have computers in its schools. Similar reasons are given for incorporating computers into the education system of many other developing countries (Beauchamp 1995: 197).

The computer enhances and makes organizational structures in modern societies possible. Similarly, the integration of ICT into local and global networks empowers individuals in business processes and allows information to appear simultaneously in as many places as possible (Tinsley and van Weert 1995: 5).

Information and communication technologies are central to global socio-economic advancement. Countries in the vanguard of the world economy today have shifted emphasis to knowledge from production resources. Such countries have adopted computer technologies to enhance their education systems, thus allowing the generation of wealth and power faster than the slower economies of the developing nations (*World Development Report* 1999:16). The WorLD programme, therefore, has as its ultimate goal the social and economic development of countries participating in its projects through the use of ICTs in their education systems.

Davidson and Rees-Mogg (1997) predict that a revolution was eminent, in which sovereign individuals will compete only in cyberspace, which is the world's largest economy. Twine (1996) demonstrates using the labour statistical method in Tables 2.1 and 2.2 showing that information and knowledge enhanced by the utilization of ICT were, and will be, the requirements that will fuel development trends globally. Twine cites trends in the United States of America and South Africa.

Table 2.1: Labour distribution trends in the United States between 1880 and 2000.

Labour distribution (%) in the United States of America: 1888-2000					
	1888	1920	1955	1975	2000
Agriculture & extractive	50	28	14	4	2
Manufacturing, commerce and industry	36	53	37	29	22
Information, knowledge and education	2	9	29	50	66
Other services	12	10	20	17	10

Table 2.2: Labour distribution trends in South Africa between 1880 and 2000

Labour distribution (%) in South Africa: 1880-2000					
	1880	1920	1955	1975	2000
Agriculture and extractive	90	75	57	32	30
Manufacturing, commerce and industry	8	17	20	36	33
Information, knowledge and education	1	3	5	8	15
Other services	1	5	18	24	22

Source: Twine (1996: 17)

Tables 2.1 and 2.2 show the percentage labour force per economic sector in the United States of America between 1880 and 2000 and South Africa within the same period. The Tables demonstrate not only the trend in socio-economic development impacted by IT, but provide impetus for the training of labour in developing countries, including South Africa.

Hawkridge (1990:15) concludes that in view of the accelerated rate at which computers are pervading society, it was necessary to de-mystify their use by preparing students to be aware and unafraid of them as social tools, have control over them, know how they work and be able to use them for productive causes.

2.2.2 How relevant are computers in schools?

Literature abounds which provides practical relevance of computers in schools (Mossom 1986; Hawkridge, Jaworski and McMahon 1990; Tinsley and van Weert 1995; Bigum 1997 and *World Development Report 1999).* Hawkridge, Jaworski and McMahon (1990:15), for example, have advanced four reasons why computers should be part of the schooling system. Students should:

- become aware, at a basic level, of the uses and limitations of computers
- learn computer programming in order to understand how computers function
- learn the correct use of application programs
- learn topics from school subjects, right across the curriculum, with the computer either complementing or temporarily replacing the teacher.

Desired changes in modern education concentrate on new computer-based management systems. Automation of the education process is aimed at enhancing teaching and learning (Bigum 1997:249; Tinsley and van Weert 1995:5). Computers in schools facilitate the preparation of educational material. They are also used for examination purposes and in the provision of skills to pupils (Tinsley and van Weert 1995:5). ICT serves in many instances to market schools, as parents believe that the technology will assist in improving learning and the life chances of their children after school (Tinsley and van Weert 1995: 5; Bigum 1997:248)[14].

Mossom 1986, supported by *The World Development Report* (1999), emphasises that computers motivate students to learn. On the state of computers in schools in KwaZulu-Natal, South Africa, Mossom (1986) relates his personal experience of pupils' eagerness to attend computer lessons. He reports, of schools he visited during computer lessons that "pupils were eager to attend these classes, were at the door before teachers and reluctant to leave at the end of the lesson". According to the *World Development Report* (1999:53), many studies report increases in attendance, motivation and attentiveness with the use of computers in education.

14 Collis and Carleer (1993:1&2) provide other justifications for using computers in schools. According to them, computers produce increased attention span, increase positive attitudes about technology, enhance performance on standardized tests, reduce writing errors, increase enthusiasm for writing, increase co-operative learning, increase spelling skills, increase problem-solving ability and serve as a deeper motivation for learning, a spontaneous contact for discussions and an effective use of technology as a tool.

2.2.2.1 How do computers enhance teaching and learning in schools?

It has been argued (Heinecke *et al.*, 1999) that if one defines student learning as the retention of basic skills and content information, as reflected in standard tests, then evidence suggests that there is a positive relationship between computer-assisted instruction or computer-based learning and standardized tests.

According to Hawkridge (1990:5), computers as pedagogical tools in Computer Assisted Learning (CAL) or Computer Assisted Instruction (CAI) offer advantages over other methods of teaching and have revolutionized education in advanced countries. Tinsley and van Weert (1995:6) concurs with Hawkridge (1990) that computers are useful tools for pupils' drill and practice, tutorial activities, guided discovery learning, building intellectual structures, data retrieval and data manipulation.

The computer serves as a cognitive tool. Its software programs are able to amplify, extend or enhance human cognition (Kozma 1994). They are designed to aid users in task relevant, cognitive components of a performance, leaving the performance open-ended and controlled by the learner (Fouche 1995:13). Zulu (1994:79) points out that IT has a qualitative edge over the human muscle as it leverages the brainpower. The importance of computers in education has prompted Todd (1997:11) to declare that a real learning revolution has started, in which educators use information technologies to provide learning experiences that are qualitatively different from their predecessors.

Despite the advantages that computers offer in education, Bigum (1997:252) recommends that computers should not be seen as the only educational tool, but as one of a number of possible tools which could be used to teach content and skills. Kirkpatric and Cuban (1998:1) caution that studies spanning thirty years found evidence of only moderate, minimal and sometimes non-effectiveness when it comes to the academic performance of students using computers.

2.2.2.2 How do computers enhance access to information for education?

Neuman (1997:687) suggested that the advent of the computer has revolutionised learning related to accessing, evaluating and using information resources in a digital library environment today in schools. Todd (1997:12) therefore recommends that "a sound understanding of computers and information technology with a pedagogy centering on developing students' knowledge and skills is required." Todd's (1997) recommendation is "to manage, process and utilise the enormous variety, quantity and variable quality of information that IT provides".[15] He believes that teacher librarians could be key role-players in this regard.

Hawkridge (1990:14), considering the relevance of computers in schools, is of the opinion that computers have become catalysts for teaching, helping students to be less dependent on teachers and enhancing collaborative learning. Thapisa and Birabwa (1998:49), however, state that evidence shows that to innovate and create stocks of information and knowledge by utilizing IT, developing nations need telecommunication networks that can support electronic data exchange.

2.2.2.3 Do computers contribute to distance and collaborative education?

According to Kalinowski-Jagau (1998:20), one of the hallmarks of ICT is its creation of a global village, in which people can communicate and share ideas. Educational innovations present networks of students, who participate in the building of knowledge under the direction of teachers, and collaborative learning in multi-disciplinary teams is enhanced (Tinsley and van Weert 1995:9).

15 He presents findings of a 1996 study of 500 students in 28 fourth grade and sixth grade classes in the United States of America. The study shows that students with online access to information performed better than those without such access. The study is available at the Website http://www.cast.org/stsstudy.html

Distance learning, facilitated by computer technology, affords learners at any location the opportunity to interact with teachers and faculty members through satellite video conferencing and online instruction (Ryan 1998:235). Through globalization, countries are able to facilitate and transform education with computer-based multimedia (Raseroka 1997:487). With computer technology, knowledge is diffused across the globe, enlightening the lives of people *(World Development Report* 1999:1). Voice over Internet Protocol (VoIP) is the latest resource with which lectures are conducted globally, using ICT. Hence the *World Development Report* (1999:1) notes that with the aid of computer technology, distance education reaches and is able to train more teachers than conventional methods, using the same volume of resources. The report points to increased access to education, the emergence of open universities and life-long education, as some of the recent additions to computer-technology-aided education.

Pupils from countries participating in the WorLD project are afforded distance collaborative learning and curriculum development opportunities, as distance education is one of the key objectives of the project. Linn's (1996) argument that students who take an autonomous stance towards learning succeed in most distance learning courses requires serious consideration.

The important role of computers in schools and in education has not been limited to researchers and academics. Available literature presents views of heads of state and governments, which in some cases has helped shaped policy and legislation.[16] Silva (1995:244) reports that the connection of all sectors of the United States society, business, education, research, government, public schools and libraries, are explicitly legislated. In South Africa, Mbeki (1996: 37) stated that technology-enhanced learning could make education more interesting and targeted on the individual. He added that the Internet and the World Wide Web (WWW), in particular, "offer an immediate and inexpensive opportunity for schools".

16 Former President Clinton and Vice-President Gore called on parents, teachers, business people and volunteers on **http://www.netday.org** (an annual day set aside by the United States' Government for voluntary connections of schools) to help connect at least one classroom, media centre or library to the Internet.

Kirkpatrick and Cuban (1998:1) conclude that the effectiveness of computers in schools is of value where they elaborate the children's ages, the subjects, the software used and the kinds of outcomes that were sought.

2.2.3 Barriers to utilizing ICT in the social context in developing countries[17]

The WorLD project targets developing countries, including South Africa. This section identifies some of the structural barriers likely to frustrate the objectives of the project in Africa and in rural South Africa, where the South African projects are situated.

The issue of information-poor nations and information-rich ones is a reality and will continue as the gulf between the former and the latter widens (Cawkell 1998:56). According to Hall (1994:113), 95% of computers are located in the developed world. Zulu (1994:80) outlines a number of factors which act as barriers to the utilization of IT in developing countries, particularly Africa. These include:

- the lack of a good, reliable and adequate infrastructural system, including the supply of electricity, a conducive computer environment and good telecommunications;
- a non-literate population, compounded by the low status of information intermediaries;
- lack of finance (foreign exchange);
- a multiplicity of languages;
- a lack of national information policies and
- rapid technological advances and changes.

A number of authors (Menou 1993; Zulu 1994; Mbeki 1996; Raseroka 1997) reiterate the

17 Developing countries, especially those in Africa, are referred to repeatedly in this study, as they are the countries targeted by the WorLD project. Rural South Africa, where these projects are located, reflects many communities in other African countries.

lack of infrastructure as a major challenge, if developing countries, particularly those in Africa, are to become part of the global village. Menou (1993:31) indicates that, due to the high cost of information infrastructure, IT services, notably concentrated in the major cities restricted instead of enhancing the flow of information. They were thus serving a narrow group of people. Raseroka (1997:489) agrees with Menou (1993) that telecommunication infrastructure in Sub-Saharan Africa, excluding South Africa, is poorly developed. Telephone access in the region was as low as 8 per 1000 in Chad. One of the highest is 31 per 1000 in Botswana, with the major access points located in urban areas, mostly capital cities. Mbeki (1996:37) acknowledges that South Africa has a very skewed information infrastructure, which was very advanced in the cities, but totally lacking in rural areas.

With Africa's lack of financial resources, technical expertise and the absence of information policies, the continent, *including widespread rural areas of South Africa*[18], runs the risk of being turned into the dumping ground for obsolete technology from the developed world (Zulu 1994: 83). The challenges of lack of access and the fear that Africa may be turned into a dumping ground of obsolete equipment reinforce the need for a study of the WorLD project.

Developing countries, especially those in Africa, are vulnerable when it comes to globalization and distance learning. This is because:

- the majority have a poorly developed electronic environment and lack the finance to achieve inter-connectivity on their own;
- computers in many instances are obtained as part of project funding[19] through donor agencies and inherent in the project are the limited use to which computers are put, as well as a limited skills base, geared only to the project;
- technological infrastructure is selective with donor funding, with inherently questionable sustainability, and a cycle of dependency results, rather than the facilitation of creative partnerships, and
- many developing countries are not able to benefit from the lowering costs of technology because of their weakening domestic currencies (Raseroka 1997:489).

18Author's comment

19A very good example of such project funding is the WorLD project, which is at the centre of this study.

2.3 How successful was the training provided to teachers and students in WorLD schools to enable them to utilize computers for collaborative school projects?

To determine the extent of success of training provided to teachers and learners during the WorLD project in South Africa, the present study established theoretically the pedagogy, training and skill benchmarks required by schools to effect computer education.

2.3.1 Pedagogical skills for utilizing computers in education

In view of the profound educational changes brought about by the integration of computer technology into schools, teacher professional education and in-service training have taken a position of prime importance (van Weert 1995:10). This is more so because, in black African communities in South Africa, education systems devoid of resources and appropriate pedagogy are largely characterized by a *chalk and talk* mode of imparting knowledge (Stadler 1991:21; Bouwer 1998:225; Hayman 1999:45; Bot 1999:6). While many teachers lack the expertise and means to deal effectively with the unique cognitive needs of black African learners, most of the learners are faced with a critical lack of exposure to learning experiences, which Western curricula require for cognitive development and skills of self-learning[20] (Bouwer 1998: 225).

According to Johnson (1995:10), only certain teaching models were applicable in the utilization of computers in education. These, he notes, are the constructivist approach to resource-based learning, authentic teaching and learning and project-oriented education, using authentic assessment. The resource-based method of teaching, for example, defines the position of a teacher as a facilitator in the learning process, rather than a source of knowledge (Karaliotas 1998:4). The student team model has also been used mostly in school computer projects, with the teacher librarian playing a dominant role (Arnall 1995:21).

Writing from a South African perspective, O'Kennedy (1995:8) points out that in using the computer as a technological tool, teachers will act more as facilitators, giving purpose to the learning experience. The implication is that much learning will be outside the teacher's

20 It is significant that the WorLD programme is located in black schools in South Africa and a study is

sphere of influence. Lundall and Howell (2000: 43) state that when computers are used in schools for the first time it is in a very rudimentary fashion, usually in the form of drill and practice, and a development period follows during which teachers and students become familiar with the technology. Goldman *et al.* (1999) observe:

> *"In case after case we see that when computer technologies are adopted, the learning about the technology often takes over, and it is only after several rounds of integrating technology with content that content emerges in strong ways. The technology learning curve tends to eclipse content learning temporarily – both kids and teachers seem to orient to technology until they become comfortable."*

2.3.2 Training required to effect computer-assisted education

Training is one of the critical objectives of the WorLD programme. The project provides for training in a wide range of educational applications of information technology. It stipulates, "Students and teachers will be trained in educational applications of information technology, as well as in the use and maintenance of the information technology itself".

De Villiers (1998:204) states that a successful application of the computer in education is directly dependent upon instructional design ingenuity, backed by a solid foundation in learning theory and research. He also points out that powerful current pedagogical directions regarding the utilization of ICT include constructivism, cognitivism, schema theory and problem-based learning. These are key concepts in an information age education, thus supporting the views of Karaliotas (1998).

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imperative to explore issues which will impact on the project.

Govender (1999:79) notes that educational technology, a discipline and a way of providing solution to educational problems, is viewed through the systems approach, which sees education as a way of thinking. He indicates that it was a teaching method or strategy, which involves learning outcomes, curriculum planning and restructuring. He concludes that South African schoolteachers do not understand the concept of educational technology. O'Kennedy (1995:8) concurs with Govender (1999) that many South African teachers argue that the use of computers in assisting learning has little advantage over the traditional teaching methods in schools. Such teachers regard the computer as a threat, complaining "we have to finish the syllabus and don't have time to play with computers... pupils have to write examinations and our evaluations depend on results".

Sagahyroom (1995:168) found that in Sudan the greatest barrier to the spread of computer education is the shortage of trained personnel. He felt that the success or failure of using information technology in schools depends more on the effectiveness of the teacher than the nature of the hardware or software used. Beauchamp (1995:199) supports the view of Sagahyroom (1995), and notes that one of the main conclusions drawn, not only from the Kenyan experience but with larger initiatives from developed countries, is that the quality of the in-service training is crucial to the successful utilization of ICT in education. Writing on the limitations pertaining to the different approaches to ICT training in South Africa, one agrees with Falkenberg (2000:2) that South Africa as a developing country requires a method midway between the traditional and the newly imported approaches, while keeping standards in place.

The *Skills Development Act, Act 97 1998,* and The *Skills Development Levies Act, 1999,* bodes well for South Africa and provides a framework for computer skills development for teachers. This is in spite of Gordon (1997:39) pointing out that it was yet to be unequivocally proven that computers are better at imparting knowledge than any of the known teaching techniques.

2.3.3 Computer skills

A computer, as is the case with every machine or tool, requires skills to operate and use it effectively. Borman (1995:31) argues that the schools of thought that computer science and programming were synonymous with computer literacy, would be like saying that driving a motor vehicle should be preceded by a course in mechanical engineering and carpentry by a course in wood technology. The present study relies on the simple definition of computer literacy by Carbo (1997:395): "the techniques needed to use computers effectively."

According to Holland (1999:1)[21], new technology can be intimidating and perfectly capable people "turn to mush" in front of a computer. He points out, however, that computers are not hard to work with, when given the required basic skills.

Clyde (1997:48) notes that, to be able to use a computer, one requires "the knowledge and skills ... which are related to the hardware, the system, the software, the information source and the information itself." She categorizes these skills as:

- Hardware or equipment-related knowledge and skills, including the ability to use a mouse and keyboard.
- System knowledge and skills, including knowledge of network procedures, and of the DOS or Windows system interfaces.
- Application software knowledge and skills, including word processing, electronic mail software and Internet software
- Knowledge and skills associated with the use of the information system itself-storage and search procedures, as well as access techniques.
- Knowledge and skills associated with using the information that is contained in the source or service.

2.2.3.1 Technical computer skills

21 A University of Utah training Course developed by Neil Holland. The course can be accessed at

The suggestion by Clyde (1997:48) namely the need for knowledge and skills regarding the computer network procedures, and of the DOS or Windows system interface, requires some background information regarding the extent of such knowledge and skill.

According to Lundall and Howell (2000:43), information infrastructures require constant maintenance and frequent upgrading. Technical personnel that look after the ICT, including the workstations and file servers, require an understanding of the hardware and software they are installing. They need to know the ways in which the technology is going to be used in the short and medium terms. They will also need to know whether certain applications or software will run on a school's system. They should be able to advice on the optimal use of a network and sensible upgrades for long-term planning. These functions are extensive and could include user and network administrator functions, such as the creation of user identities, i.e. login names and e-mail addresses, advising on licensing agreements, etc. To address these very real service requirements, schools will have to make a decision on the following:

- outsource some of the work
- share staff with other schools in their area
- combine certain roles, e.g. technical support staff could also perform training of user-support functions
- it is important for managers to recognize that the best plans come undone if there is lack of articulation between technical and educational functions.
- cost considerations should include the fact that technical staff need constant upgrading of skills, which can be very expensive.

It is therefore justified that the WorLD project requires technical training for teachers who will man the computer networks in their schools. Johnson and Eisenberg (1996:13) point out that computer skills in most schools are taught as isolated subjects and limited to students choosing certain courses. They advise teachers and school administrators to recognise that computer skills taught in isolation in separate computer classes do not help pupils. Instead they must be taught in integrated and meaningful ways across the curriculum.

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http://www.uen.org/utahlink/train/manuals/basic/index.html

2.3.4 Information skills

Information literacy[22] has been defined to include computer literacy, as the latter is a function of the former. Information literacy thus receives extensive coverage in the present work. Carbo (1997:396) emphasises that an information literate person must recognize the need for information, know how to access it, understand how to evaluate it, how to synthesise it and be able to communicate it. Clyde (1997) believes that information literacy must begin with identification and definition of a problem, since the objective is to use information to solve problems.

Information literacy is becoming a condition for playing a meaningful role in today's world. According to Clyde (1997:48), "**the reality is that any quality of life beyond mere survival will depend on these skills in the future."** Campbell (1996:14) points out that learning environment are now dominated by computers and curricula have changed in response to the new means of accessing information. She notes that classroom-based, textbook-oriented and teacher-directed learning cannot prepare students for the sort of future dominated by technology and the proliferation of information.

The views of Beswick (1989) are very relevant in discussing issues related to an Internet project. She notes that as technology brings about a heavy saturation of information systems, old and new, the problem of rejecting the unnecessary and manipulating the essential will be more profound. Beswick (1989:7) adds that:

> *...the problems would surely not be different. Pressing the button is the least of them. One needs to know what buttons to press and in what order, using what terminology, and having found the page on the screen, there is still the problem of decoding, determining the different kinds of and levels of meaning, (some of which may use languages that are different from our home).*

22 The United States Department of Education uses the word *technology literacy*, instead of information literacy

With information expanding at an exponential rate, Campbell (1996:14) is of the opinion that students need a new *electrographic literacy* to assimilate, digest, absorb and express the huge quantities of information that are now available through the emerging electronic technologies.

According to Sprainger (1997:27), students need to understand that a computer screen is more complex than a page in a book. A screen, unlike a page, has, in addition to the text, instructions and navigational aids. Students, he notes, would need to become familiar with such conventions as icons, menu bars, outlines, bookmarks and coloured hypertext, used to navigate among the screens. He states that considerable explicit instruction needs to be provided in using category menus, online indexes and simple and advanced keyword searching and "cut and paste" from the Internet to word processing to discourage useless print-outs.

The essential skills of information retrieval, which have been examined by many writers, including Beswick (1989); Eisenburg (1992); Nahl and Harada (1996); and Herring (1996), are transferable skills, which can be used in both paper-based and electronic format. These include skills to conceptualise a search problem, analyse the problem, identify the source and locate the information, synthesize and process the information, evaluate and use the information for the relevant purpose. Information skills have been noted by writers to be high-level thinking skills, which can only be acquired through systematic training and application.

Herring (1996:17-24) examines the works of the influential seven models of information skills. These are the Marland model, the Exit model of Wray and Lewis, the Big Six models of Eisenberg and Berkowitz, the United States National Council for Educational Technology (NCET) model, Irving's model, the 1980's model by Tabberer and the Australian model. Reviewing the models, Herring (1996:24-25) concludes that:

- information skills must be regarded as a number of interrelated skills which should not be isolated from each other;
- information skills are thinking skills and not technical skills, and irrespective of the type

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(Carbo 1997:398), thus shifting the emphasis from books to computer systems as information sources.

of information resources being used (print, audiovisual or electronic) there was little difference in the skills needed by pupils for effective use of resources.

With the information revolution firmly in place, Eisenberg (1992:103) writes on the guidelines for school library media programmes *Information Power*, set in motion by the American Education Authorities[23] in 1989. These guidelines, he noted, had a mission:

> *To ensure that students and staff are effective users of information that would provide intellectual access to information through systematic learning activities which develop cognitive strategies for selecting, retrieving, analysing, evaluating, synthesising and creating information at all age levels and in all curriculum content areas (Eisenberg 1992:103).*

Herring (1996:26) reports on a project conducted by the United States National Council for Educational Technology (NCET), which examined the impact of using multimedia and the Internet in schools. It was found that planning online searches was vital. In terms of finding information, the project reported that:

- the same retrieval skills are used with new electronic sources as with print;
- planning and refining searches was critical with electronic media;
- pupils in some projects combined retrieving from electronic and print sources ;
- retrieving information from the Internet was time-consuming and often difficult;
- the type of information retrieved from the Internet was often unsuitable for curriculum use.

As pointed out by Behrens (1995:254-255), in the United Kingdom and the United States of America pupils are equipped with these skills, which are considered life skills, while they were a captive audience in the formal learning system. It is imperative that these skills are made part of the curriculum in all schools, as South African education is ushered into the information age.

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23 A leading role was played by *The American Association of School Librarians* and *The Association of Communications and Technology* in the preparation of this document.

2.4 What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the WorLD schools and do the schools have media teachers?

2.4.1 Direction regarding school resource situation for ICT education

As working environments in Africa, schools are heavily influenced by previous socio-political developments in such communities. With IT changing the nature of subjects, teaching into learning and empowering the individual student, the organization and infrastructure of schools will have to be reconsidered, to keep schools as good places to work in (van Weert 1995:10). Silva's (1995:244) report of the legislation of IT connection of all sectors of the United States' society means that the integrated use of computer technology in schools, as envisaged by van Weert (1995:10), is in place in the United States. Canada, on the other hand, has not enacted such legislation. It has relied on federal initiatives, provincial projects, or private efforts[24]. The result of the Canadian approach, according to Silva (1995:245), is that there was far less equitable distribution than was found in the United States.

Findings by the World Bank concerning educational interventions in developing countries suggest that the provision of good educational material is the most cost-effective way of improving educational quality (Linddell, Masilela, Rapodile & Strydom 1990; *World Development Report* 1999). With the classroom IT setup, and models of the WorLD programme (Appendix 1), there is an assumption that some infrastructural and logistical provision exist in selected pilot schools in South Africa.[25] The interest of the local communities' options[26] for the provision of computer technology to pilot schools also

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24 Such an approach is presently being pursued in South Africa

25 Criteria for the selection of WorLD pilot schools include:

- existing schools should have telecommunications infrastructure;
- opportunities for long-term self-sustainability, social and economic equity

26 The options for the provision of computer technology, which, for example, requires the availability of libraries, are in Appendix 1.

confirms the assumption that enough infrastructure and logistics prevail in such schools.

2.4.2 What is the school resource situation for ICT education in South Africa?

In South Africa, the NEPI report (1992:31) notes that the proliferation of education departments under the previous political dispensation, managed and financed by 18 different ministries, resulted in gross discrepancies and inequity in the providing of resources. Hence a backlog exists in the education system in terms of resources, including IT. A catalogue of some of these backlogs (NEPI 1992; NCHE 1996; Radebe 1997) suggests that computers do not feature as a factor in education in South Africa. School buildings, school libraries and electricity, telephone and retraining of teachers need priority and urgent redress (Radebe: 1997:224). As South Africa represents ***two Worlds in one,*** with some schools very well resourced, Gordon (1997:40), puts it, interestingly that, "looking at wealthy schools with sophisticated computer networks, motivated teachers and bright students, and believe that every school in the country is simultaneously blessed can be described as parochial fallacy and a terrible illusion".

The problems in South African schooling, according to Gordon (1997:40), are schools without walls, teachers without teaching skills and full knowledge of the subjects they teach and the need for students to read, write and reason, thus confirming the views of Radebe (1997), that computers are not critical on the shopping list of any education system in South Africa.

On the cost of computers, Gordon (1997:39) warns that though the rewards of computers are great, they are expensive, needing constant care and network maintenance in terms of hardware and software upgrades, such that "the initial costs of computers are just down payments and paying for the fix breaks you".

The adequacy of infrastructure and logistics in schools is also a condition to the availability and use of ICT. The critical requirements include a school computer laboratory, a school library; electricity, a telephone and security for the safekeeping of the expensive computer

systems (Addo 1999:86). A recent survey of schools by Bot (2001) provides comparative data for 1996 and 2000, as shown in Table 2.3.

Table 2.3 Total number of schools in South Africa, number of schools with libraries, telephones, electricity and computers.

Province	Total number of schools		Number with libraries		Number with telephones		Number with electricity		Computers	
	1996	2000	1996	2000	1996	2000	1996	2000	1996	2000
Eastern Cape	5879	6260	421	597	1117	3691	1316	2474	205	281
Free State	2877	2500	332	368	745	1471	1207	1348	154	214
Gauteng	2173	2204	954	1137	1985	2110	1876	2056	594	913
KwaZulu-Natal	5174	5734	910	1160	1788	3871	1953	2485	381	572
Mpumalanga	1879	1810	284	276	735	935	956	921	114	157
Northern Cape	527	482	175	175	403	442	426	425	105	122
Northern	4157	4261	208	311	1561	2095	885	2175	131	198
North-West	2365	2304	334	422	879	1321	1053	1486	126	174
Western Cape	1703	1593	884	926	1606	1562	1502	1521	525	720
Total	26734	27148	4502	5372	10422	17498	11174	14891	2335	3351

Source: Bot (2001: 2-5)

The number of schools in South Africa, indicated in Table 2.3, has increased by 4% between 1996 and 2000. The condition of school buildings, however, according to (Bot 2001:1), appeared to be worse. Despite their importance for learning and for cognitive development, there was little improvement in the number of schools with libraries. The increase has been a mere 16% over four years. In all, only one out of every five schools has a library. The situation is worse in the Eastern Cape and the Northern Cape. The number of schools with telephones has increased by 24%. This has largely been due to increase in cell phones, as 7210 schools indicated that they had cell phones, compared to only 13 in 1996 (Bot 2001:2). Though the number of schools with electricity had increased by over 3000, as many as 35% of schools remain without electricity. Very few schools, that is, only 12 %, have computers for teaching and learning. Considerable differences exist among the provinces. While one in every 20 schools in the Eastern Cape and Northern Province has computers, one out of two schools in the Western Cape has a computer.

Table 2.4 Computer network, Internet connectivity, access and costs per province

Province	Number of Schools	Computer Network	Computer teacher	Internet Access	School with file Server	Telkom Cost	Cost of ISP
Eastern Cape	6260	57	19	38	53	355	315
Free State	2500	68	28	30	59	127	208
Gauteng	2204	70	104	49	61	566	393
KwaZulu-Natal	5734	54	97	38	43	558	543
Mpumalanga	1810	50	18	30	39	190	155
Northern Cape	482	41	6	12	32	419	389
Northern	4261	16	8	21	13	145	400
North-West	2304	52	18	26	44	88	759
Western Cape	1593	56	78	49	44	350	364
Total/Average	27148	52	42	36	43	299	391

Source (Lundall and Howell 2000: 68-71)

Table 2.4 presents Internet connectivity, access and costs of using ICT per province. It also presents the number of computer teachers per school in South Africa. Only 14% of schools with computers for teaching and learning seem to have a computer network (compare Tables 2.4 and 2.5). It is not surprising that a mere 9.7% of schools with computers have Internet access and only 0.12% schools in South Africa have access to the Internet. A paltry 0.17% of schools in South Africa have dedicated teachers who teach Computer Studies. Provincial disparities exist with Gauteng and the Western Cape, which enjoy higher access, while the Northern Province, the Northern Cape and the Eastern Cape are the provinces with least access. The high cost of Internet access, in terms of Telkom and service provision in KwaZulu-Natal, is a cause for concern.

The national survey of Information and Communication Technology in South African schools, conducted by Lundall and Howell (2000), found that:

- The biggest problem with utilising ICTs in schools was the lack of available staff trained to use computers;
- Schools' priorities for the use of computers relates to management, administration and user support, and ignores the role of the teacher;
- Obsolete equipment and limited classrooms for computer use have been cited as the hindrances to computer use, and
- Costs of Internet access have been cited as the most important factor for limiting Internet use.

In summary, considerable backlogs exist, in spite of the progress made between 1996 and 2000. Backlogs exist because 9650 schools remain without telephones, 21776 schools have no media centres and 23797 schools have no computers (Lundall and Howell 2000:71). The data in Tables 2.4 and 2.5 have not, in any way, changed the statement by the South African Institute of Distance Education (SAIDE) Report (1998:36), to the effect that:

> *... only 43% of schools have electricity and only around 38% have telephones. Further, it estimated that 82 percent of schools have no media equipment, 72 percent no media collections, 73 percent no learning equipment, and 69 percent no materials.*

The SAIDE report concludes that programmes seeking to exploit and implement ICT educational projects are likely to be of marginal or of no value, unless they are explicitly located within strategies to broaden meaningful access to the technologies themselves. Schools affected by the policies of the past, and most resource deprived, are therefore the beneficiaries of the WorLD programme in South Africa to broaden meaningful access.

2.4.3 What role can the teacher librarian play in ensuring the use of ICT in schools?

Authors such as Campbell (1996); Eisenburg (1996); Todd (1997) and Kafai and Bates (1997) expressed the view that teacher librarians could play meaningful roles in the overall implementation of ICT education and ICT related projects in schools. Campbell (1996:14) was of the opinion that teacher-librarians could take the lead in developing the new information technology literacy, especially among teachers, arguing that when teachers were effective and informed users of information services and technologies, they would influence the information-related learning outcomes of students. Johnson and Eisenburg (1996:12) indicate that teacher librarians must not only provide the knowledge, vision and leadership to the critical area of physical access to computers but also the intellectual access. They add, "teacher librarians could also provide information on the integration of computer and information skills for information problem solving in the school environment".

Shoolbred (1990:44), writing on *IT and the school librarian*, notes that IT could make the teacher-librarians' work more interesting and demanding, raise their profile, but marginalise them if they fail to take a lead. Todd (1997:12) pleads with teacher-librarians to have a clear understanding on how search engines are indexed and operated and to communicate this to classroom teachers and students through carefully designed learning activities.

Discussing an Internet Web-searching project, Kafai and Bates (1997) emphasise the role of the school media specialist. They point out that the media specialists were likely to master the technology and have a higher and more comfortable level of expertise with computers and their use than most other teachers in the school. The use of the Internet in schools was a natural source for media specialists to provide the missing link between teachers and information resources to engage in incorporating the resource into the curriculum.

2.5 To what extent are computer teachers able to handle school computer projects, attend to computer systems and attend to

their normal school lessons in South Africa?

2.5.1 What is the situation regarding computer teachers in schools in South Africa?

The situation regarding computer teachers in South Africa does not look very encouraging. This can be attributed to the fact that computer technology in the majority of schools is a recent phenomenon in South Africa, due to the problems of lack of basic facilities (Refer to Tables 2.3 and 2.4). The figures in Table 2.4, for example, show that only 0.17% of schools in South Africa have dedicated teachers who teach computer studies.

A distinction between computer skills and computer studies shows that that the former is a precursor to the latter. Computer skills have been dealt with extensively in Section 2.2.3 by Clyde (1997:48). Lundall and Howell (2000:74) see computer studies as the use of computers in the teaching and learning of specific subjects. This means that computer skills are required to be able to undertake computer studies. The computer skills subject area, as analysed by Lundall and Howell (2000:74), involves an enormous undertaking, which will be difficult for an educator teaching other subjects full-time to handle effectively, thus requiring a dedicated computer teacher in schools.

2.5.1.1 Teaching of computer skills in schools in South Africa

Lundall and Howell (2000) found that only 24% of schools with computers for teaching purposes in South Africa employ a dedicated computer teacher. Forty-two percent of schools with computers for teaching have a permanent staff-member teaching computer studies, but with other, added, responsibilities. Fifteen percent of the schools employ a full-time person contracted by the school governing body, or a permanent staff-member on a part-time basis, while very few teachers (3%) in schools work for commercial service providers.

O'Kennedy (1995:7), meanwhile, points out that maintaining a computer network in a school is an expensive undertaking, which requires a full-time job position. Teachers who man these systems are already inundated with work and the additional load of network manager will be too much to cope with.

2.5.1.2 Computer Studies as a formal school subject in schools in South Africa

Lundall and Howell (2000) found that computer studies as a formal subject is taught in grades 8-12 and can be chosen as a Matriculation subject. Computers in subject areas in schools feature more strongly in language, mathematics, natural sciences and technology. A number of factors found to prevent teachers from using computers for education in schools in South Africa include an insufficient number of computers, a lack of computer literacy among teachers and a lack of a subject-developed curriculum for teaching computer skills. Lack of computer literacy among teachers was listed as a major problem. Allocation of a greater amount of time was regarded as the most effective means of extending the teaching of computer skills to learners.

2.5.2 Time as a factor for teachers to deliver on WorLD projects

After evaluating two of SchoolNet South Africa's projects[27] in the Eastern Cape and the Northern Province of South Africa, one of the commonalities found in both provinces, by Tshenye and Perold (2000:15), was that there was insufficient training time. This, therefore, seems an important issue in the use of ICT in South African schools

2.6 What is the literacy level of WorLD schools pupils in terms of reading, accessing and using information in the English language?

In a situation where a learner's home language is not the language of learning in a school, the

27 The projects are the Open Society Foundation of South Africa (OSF)/SchoolNet projects in the Eastern Cape and the Northern Province.

phenomenon of language-cum-cognitive difficulty exacerbates existing learning difficulties (Heugh, Siegruhn & Plludemann 1995:46; NEPI 1992:72). The pressure on African learners to use English as their medium of learning has nevertheless increased, rather than decreased (Bouwer 1998:226). Though it could be argued that the English language provides a more universal access to information and knowledge, Bouwer (1998:226) points out that research demonstrates that it is virtually crippling to grapple with content in a language inadequately understood or mastered at the lower competence level of basic interactive communication skills.

2.6.1 Is the lack of resources a possible factor causing low language proficiency in English[28] in many South African schools?

The non-availability of education resources in schools, as evidenced in Table 2.3, and the absence of the culture of literacy in many black African families, creates problems for learners, with parents and guardians unable to assist (Bouwer 1998:226). This reflects in many such students having a lack of critical thinking skills, even at higher education, as observed by Blacquiere (1989) and Radebe (1994). While Blacquiere (1989:78) concludes that black students at tertiary institutions were unable to read as efficiently as their white peers because they were intellectually malnourished, Radebe (1994: 43) found that, in almost all tertiary institutions, the most noticeable concern in students' inadequacies, in terms of their preparedness, was information illiteracy, which was along racial lines. Both writers attribute the problems to the lack of reading resources in the schools. Many black learners in South Africa no doubt view their poorly developed skills in the language they use for learning as incapacitating (Macdonald 1990:48-49).

In the view of this researcher, pupils' ability to retrieve information from computers in the WorLD project will be impeded much more as a consequence of scarce reading resource provision and the lack of skills in many black schools in South Africa. Bouwer (1998:226) therefore recommends that to address the intrinsic barriers to learning, objectives for reading must be addressed.

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28 The English language has been singled out for study in this thesis because information that is accessed on the Internet by the WorLD schools in South Africa is in English. Illiteracy in therefore used interchangeably as lack of English language proficiency in this thesis and means the inability to fully access information in English.

The literature provides enough information to conclude that as previously disadvantaged schools and pupils bore the brunt of historical educational policies, scars still exist in terms of infrastructure and logistics, which reflect students' abilities in schools. Such students therefore lack the foundation to undertake rigorous computer-based education. An alternative computer system is required to provide further motivation to address the problems of illiteracy, inadequate teacher training and low learner morale, which is likely to be found in the WorLD schools in South Africa. Such a system, suggested by concerned WorLD teachers in KwaZulu-Natal, should be computer-based multimedia.

2.7. How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?

2.7.1 What is the educational relevance of multimedia?

A number of authors (Gates 1994; Thomas 1996; Sprainger 1997; Malapile 1996) have

emphasized that utilizing varying forms of media generated by the computer enriches the learning environment of both developed and developing communities.

Multimedia software stimulates all those learning paths by offering information through pictures, written text, sound, animation and video (Gates 1994:170). Sprainger (1997:27) writes, in an Australian setting, that multimedia texts are particularly attractive to many students who are used to the glamour of visual media products available through film and television. Thomas (1996:5) notes that as multimedia involves putting together different types of information in different formats in a computer linked to text, graphics, still pictures, animations, sound and video, the integrated environment created can be used to tell a story, play a game, present information, or do anything else suggested by one's imagination. Educators are thus keeping pace with technological evolution by empowering their pupils to develop media-rich interactive information structures (Michell 1994:111).

In disadvantaged, non-literate schools, typical of many African communities, utilization of multimedia can effectively make up for lack of facilities and lead to the development of technological skills (Malapile 1996:10). This is more so because traditional formal education in African communities has concentrated on students hearing the teacher and seeing the printed word. The result, which is passive learning, adds a dimension to the learning problem in such schools (Hubbard 1993:45).

According to Malapile (1996:10), multimedia utilization by disadvantaged students in South Africa will prepare them to adapt easily in a growing society where development is rapid and information technology (IT) is very sophisticated. She reiterates the fact that utilization of multimedia will help:

- sharpen students' abilities;
- equip them with independent learning attitudes;
- rekindle in them curiosity and the quest for knowledge.

Thomas (1996:4) notes that human beings live in a multimedia age and children and adults are being asked to handle information from a bewildering variety of sources such as video,

CD-ROM, satellite TV, “and a quiet but insistent multimedia revolution is slowly taking place in schools and colleges”. He points out that recent worldwide technological developments have ushered society into a multimedia age.

With high illiteracy in developing countries, as indicated by de Horowitz (1993:171), the utilization of computer-generated multimedia will best facilitate the knowledge process in schools. Local knowledge in graphic format is essential to the WorLD programme, through which students in developing countries can effectively share information and knowledge with their peers in developed countries.

Menou (1993) agrees with the need for a holistic approach to presenting knowledge in developing countries, noting that: “the oral tradition which has been overlooked by information scientists continues to be a vital component of many developing cultures, and definitions of communication must accommodate the importance of non-written traditions, in addition to structured technical information.” According to (Menou 1993:40) “a visual tradition was replacing the oral or written ones in many cultures, or heavily supplementing it and an entire generation is raised with television, videos and computer games and moving images rather than the printed word”.

With the advance of computer technology teachers bring the outside world into the classroom. Sound, images and video become information from which students construct media-rich knowledge structures (Michell 1994:111). Multimedia also allows the teacher to produce specialized resources, which will meet the needs and interests of students (Thomas 1996:5).

Large *et al.* (1995:24) found that the addition of animation to text in multimedia enhances student learning and also that multimedia was more effective among children. They found,

however, that where the intent of learning is for pupils to memorize facts, multimedia may have a negative effect. The study concludes that the design and use of multimedia must be such that the potential of multimedia is maximised.

2.7.2 What multimedia equipment is required to affect ICT education?

According to Edelstein (1995:44), multimedia is not cheap. Hubbard (1993:46) lists multimedia input devices as camcorders, page scanners, VCRs, microphones, graphic scanners, voice digitizers, CD ROM drives and laser disc players and output devices such as monitors, loudspeakers, VCRs and television receivers. Today, digital cameras, as well as video cameras, serve as effective multimedia input devices. Hardware, according to Edelstein (1995:44 should be at least a 486 PC with 540 megabyte of hard disk and a super VGA display monitor. With the ever increasing demand for disk space by software the specifications of Edelstein (1995) should be double the specifications if not triple today.

An issue that impacts on multimedia information is **download time.** Though the World Wide Web is capable of providing information in all formats, rich media, which comprise large files, take long and sometimes unacceptable and frustrating periods to download. For this reason, Web file sizes must be kept as small as possible.

2.8 Which other factors contribute to the success or failure of the WorLD programme in South Africa?

2.8.1 Lessons drawn from school ICT projects across the world and South Africa

2.8.1.1 Lessons from world case studies

In the Common Knowledge Project in Pittsburgh (CK:P) United States of America, Carlitz and Zinga 1994 showed a collaboration between the University of Pittsburgh Super

Computing Centre and the Pittsburgh public schools. They emphasised a constructivist approach to implementation at all levels of learning. Training for the project continued through the years and included educators, librarians, other professional staff and principals. An important element of the project was its utilization of site-based servers, which provided the scaling necessary to reach all students and teachers at each participating school.

In Chile, a third world country, a programme for the modernization of secondary education using ICT, dubbed **Proyeto Enlaces (The Link Project),** provided a link between certain Chilean universities and the Department of Education. The programme had as its goal the development of computer awareness on the part of the different actors in education and the incorporation of new technologies of information and education in learning. The project equipment included multimedia-based, self-training software and videos. Educational computing centres were installed in the participating universities, where implementation strategies were designed. The implementation stage included computer training and computer use to support projects proposed by the schools. The centres also developed and evaluated software and provided technical and pedagogical support to the schools.

2.8.1.2 Lessons from ICT projects in South Africa

2.8.1.2.1 SchoolNetSA projects

SchoolNetSA co-ordinates information and communication technology projects in South Africa. As a non-governmental organization, it promotes, harmonizes and assists in sustaining policy and in the formulation of policy. After evaluating two of its projects[29], in the Eastern Cape and the Northern Province of South Africa, commonalities found by

29 The projects are the Open Society Foundation of South Africa (OSF)/SchoolNet projects in the Eastern Cape and the Northern Province of South Africa.

Tshenye and Perold (2000:15) were:

- insufficient training time;
- insufficient knowledge of needs assessment;
- insufficient training equipment;

The two researchers found that:

- It was necessary to build sufficient technical support in future, as many of the problems experienced in the projects were technical.
- An inclusive and holistic involvement of project teachers, principals and education officials was critical.
- It was crucial to build success stories before carrying out further expansion.
- Community organizations were needed to build local capacity, which would support school ICT projects.
- It was important to place ICT projects within the structures of the provincial Education Department, for the purposes of appropriate conceptualization and motivation in the schools.
- It was essential for SchoolNetSA to work on the professional development of teachers in areas such as content development, information and searching skills and ICT curriculum integration and collaboration.

2.8.1.2.2 Lessons from an environmental education school ICT project in KwaZulu-Natal

A study involving the utilization of ICT in an environmental education project (Addo 1999) found that lack of microcomputers and, where they existed, the non-functioning of computers denied many pupils, the majority of whom were previously disadvantaged, access to electronic information and to electronic sharing of project findings. Lending of computers to schools by project sponsors, while laudable, made little impact on the inequitable distribution and use of computers and failed to achieve the objectives of project sponsors. It also found that low levels of computer and information skills of teachers and pupils point to the need for extensive training that underpins the use of microcomputers in school ICT projects.

2.8.1.3 Lessons from (WorLD) programme evaluation research in Chile, Paraguay, Peru, Senegal and Uganda

The report (Kozma *et al.*, 1999), which comprised a survey and case study, indicated some positive results. More than 90% teachers expressed satisfaction with the way the programme was implemented. Administrators received training as part of the participation of schools in the programme. The research found that the pedagogical approach was a novelty for the African schools that participated in the programme. A number of problems were identified, such as:

- A large number of teachers in both groups mentioned the difficulty of finding time for computer-related activities in their courses
- Reliable telephone access for Internet was a major problem in Uganda and Paraguay
- While teachers in Senegal experienced problems with access to computers, teachers in Peru and Uganda had problems with the lack of training in integrating computers into the curriculum.

As a consequence of the findings, the following recommendations were made:

- Training on the integration of computers into the curriculum as a component of the WorLD programme.
- The programme works with high-level educational officials in each country to develop a set of goals and plans to integrate technology into the curriculum.
- A more thorough monitoring and evaluation be conducted.

2.8.2 What other challenges are likely to hinder the utilizing of ICT in education in African communities?

2.8.2.1 Challenges regarding a lack of national policy

ICT in education in South Africa has been on the policy agenda since 1995. It has been a holistic approach, which culminated in the Technology-Enhanced Learning Investigation (TELI) policy in 1997, which provides a clear picture of ICT in education. It lists six implementation projects which outline broad principles of ICT implementation in South Africa (James 2001 109-111).

A more coherent national ICT in education policy is required around identified objectives, priorities and time-frames for ICT utilization in schools in South Africa. It is also important that the policy be marketed as much as possible, especially among school administrators. This supports recommendations of The WorLD programme report for South Africa (McGhee and Kozma 2001).

2.8.2.2 Challenges regarding ownership of knowledge and technology

While it is agreed that technology enhances knowledge, writers such as Menou 1993; De Horowitz (1993; Hobart 1993; Hall 1994; and *The World Development Report* 1999 have questioned the determination of knowledge and the control of technology. These issues remain the foremost challenges to the short- and long-term successful utilization by developing countries of ICT in their education programmes. This is so because developing countries have little or no control or influence over the products and circumstances that affect IT production (Hobart 1993:1).

Hobart (1993:1) notes that the West determines the ignorance of developing countries by first constituting them as ignorant. The indigenous knowledge of the underdeveloped countries is not only ignored and dismissed, but the nature of the problems of developing countries and solutions is defined by reference to the Western scientific world ordering of knowledge (Hobart 1993:1).

According to Menou (1993:40), all information, even scientific data, may be culturally biased “power games”, which exert a significant influence on both the national and the international arena. He notes that there was a widespread feeling in the South that the North wished to preserve its control of the tree of knowledge and maintain the South as an exporter of raw information. He feels that traditional communication patterns, information needs of the masses, the lack of true national languages and illiteracy are grossly overlooked in the design

of information and communication systems, with an alleged pressure from the North to force its information technology and products on the South, regardless of their appropriateness.

With the WorLD programme emphasising knowledge for development, Hobart (1993:1) sees development from the West as big business, including development aid, loans and the extension of markets for manufactured products and opening of markets for raw materials and labour. He questions why a priority solution from the West to problems in developing countries seems to be centred on the utilization of technology. De Horowitz (1993:171) points out that, due to a lack of sufficient information from developed donor countries on the technology used for specific projects, professed goals of many development projects fail. This further reinforces the need for a thorough study of the WorLD programme and its projects.

Hall (1994:102) points out that political, economic, cultural and social implications of the technological revolution to developing countries have become so immense that technology can no more be regarded as neutral instruments. He notes that they are not neutral because technology shapes the social choice mechanism of communities that use them. Commitment to technology means acceptance of certain social structures and orientations and implies adoption of certain values of the technology *as well as values of its originating source*[30] (de Horowitz 1993:173).

Developing countries tend to benefit only slowly and feebly from technological innovations not designed for their needs. *World Development Report* (1999) notes that such countries are

30 Emphasis by the Author

able to take steps only after the developed ones have taken leaps regarding the use of technology. According to de Horowitz (1993:172), the basic problem in this regard is the gap that separates reality from the ideals of educational theory and methodology.

De Horowitz (1993) points out that educational theory and methodology gap underlie the foreign educational models that are adopted and followed. Turock (1993:3) disagrees with World Bank policies driven by macro-economic considerations of structural adjustment policies (SAP). His criticism is based on the premise that a squeeze on public educational funding has worsened provision of educational inputs at institutions and removing educational subsidies will further deprive capable students from impoverished homes of education, thus creating a polarized and elitist society. He admits, however, that provision of education by the World Bank was better than the transfer of money directly to developing countries.

In the opinion of this researcher, the World Bank's intervention in revamping education in developing countries can, without a doubt, be described as timely. Such interventions should, however, be seen from the perspective of developing countries and their needs, as such nations now seek development that is indigenous and appropriate to their particular culture and ethos (de Horowitz 1993:173).

2.8.2.3 Lack of developed local knowledge systems as a challenge to ICT education in developing countries

Adapting knowledge to local conditions (*World Development Report* 1999:42) reinforces the development of indigenous knowledge. Local knowledge is important in view of the WorLD programme's objective of the sharing of knowledge between students in the developed and the developing countries. There simply will be no knowledge to share on the side of the developing countries if their knowledge is not developed.

Availability of local knowledge for education in African communities seems to be problematic. This has prompted Raseroka (1997:489) to stress that if the promise of the global information infrastructure (GII) in developing countries was to be realized, rural communities, who form the majority, should not only have access to information on the

Internet and be able to use it, but should also be able to contribute their own indigenous information for the benefit of their own and other communities. The *World Development Report* (1999) acknowledges that there was a need to consider the information of developing countries by allowing them to communicate, which they could do only if their indigenous knowledge systems were developed.

2.8.2.4 Arguments against the use of ICT in education

Gordon (1997:39) poses the question "are the problems faced by education in South Africa able to be solved by the incorporation of computers into the classroom?" He argues that computer-based education was still unproven, even in the First World, and should therefore not be the type of technology that should be high on a Third World country's shopping list.

The Internet and the WWW is not without its critics. Authors such as Morgan (1995), Barclay (1995), Gwyneth, Poulter and Hiom (1996), Welch *et al.* (1996), Jackman (1998) and the SAIDE Report (1998) indicate their misgivings about the information tool. Morgan (1995:14) defines the Internet as a "huge mass of poorly organised information and disinformation". He sees locating and retrieving information on the Internet as hard to do as finding the proverbial needle in the haystack. Barclay (1995:87) summarises the cause of the disorganised information resources of the Internet as follows:

> *"Truth is, almost anyone with a connection can publish whatever they want on the Net. The lack of gatekeepers - one function of the print-based publishing community has both advantages and disadvantages. On the good side, people have access to ideas and information that otherwise might be unavailable; on the other hand, no one entity is responsible for verifying facts and evaluating the usefulness of files to ensure any standard of quality, hence a lot of junk out there in addition to the gems."*

Gwyneth, Poulter and Hiom (1996:91) point out that there are no clearly defined search strategies or manuals which document resources on the Internet. They were also concerned that, though the Internet should be seen as an addition to the existing range of information sources, its very nature made it unreliable for quick reference. They caution that knowing a site and having the necessary computer system to access it did not guarantee that the site was

operational or that the Internet connection would be functioning at the time one needed it.

There was also the possibility that computer viruses[31] could interfere with computer programs, thus rendering impossible the use of files. Flagg (1997:215) reported two incidents in the United States of America in which library Internet services had to be closed for some time. In one incident a hacker[32] continuously stored viruses through the Internet on the server of the library thus filling the memory of the server. In another, a patron of the library either intentionally or unwittingly contaminated the entire library computer system with a virus. Both library services had to be restored by building new systems, at considerable cost.

While accepting that the Internet will be a beneficial part of the educational environment, Welch *et al*. (1996:12) warned that it was unorganised, anarchic in nature and made planning for use difficult. The SAIDE Report (1998:21) warned that the WWW could easily be misused to cut and paste reams of information with little thought, particularly where assessment activities encourage regurgitation of information, rather than the context in which it is used. The report warns that the Web could simply be used to disseminate teacher focussed lecture notes, assignments and tasks, a model which suggests a mistaken assumption that education was nothing more than a process of information transmission and rote learning.

It was reported by Jackman (1998:3) that children who are addicted to the Internet spend hours at the computer and could end up with spinal deformities. Karaliotas (1997:6) points to the sense of alienation and isolation as some of the drawbacks of being addicted to the Internet whilst ostensibly using the computer as an educational tool. Other implications of using the Internet, according to Gitnner (1998:1), were: supervision of pupils as they surf the Web, phone bills, accessing pornographic sites, pupils' inability to assess the appropriateness of the information they access and the possibility of Websites being deleted without the knowledge of an information retriever.

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31 Computer viruses are programs that attach themselves to files so that when files are accessed, or programs are run, the viruses duplicate themselves, alter some aspects of the system configuration, or destroy data (Eyitayo 1996:215).

32 A hacker is a person who gains unregistered and therefore unlawful access to a remote networked computer

O'Kennedy (1995:8) recommends that computer-assisted learning must be used across the curriculum in subjects where learning improvements can be measured. It was essential that teachers be trained and, above all, **be enthusiastic** for computer-assisted education to be a success. Welch *et al*. (1996:12) suggests that a solution to some of the problems of the Internet was that the issue of information literacy needed to be dealt in more depth, as this underpinned the use of the Internet as an information retrieval tool. This point is made more poignant by revelations from a survey they conducted on the preparedness of schools to take up the challenges of using the Internet. The greatest problem highlighted in the literature and verified in the results was the need for the training of teachers and pupils in the schools. One therefore agrees with the SAIDE Report (1998:22) that the strengths and weaknesses of a specific technology are not necessarily intrinsic to the technology itself, but are frequently indications of the uses to which they are put.

2.9 Summary

Chapter 2 presented literature on the utilization of information and communication technologies in education, generally, and also specifically in South Africa. The literature focussed on the problem of the thesis and sought answers to the question which underpinned the research. It dwelt on communities that have not had access to the new technology and presented studies from which lessons could be drawn. The relevance of ICT in education, and challenges likely to impede utilization in developing African communities, were discussed.

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system (Prytherch 1995:288). Such people introduce viruses into computer systems through the Internet.

Chapter 3

Research Methodology

3.1 Introduction

This chapter describes the research methodology employed in the study, including the literature search and review, the data collection method, the data collection instrument, the research population and the method of sampling. The research methodology outlines and explains the relationship between the research problem, the literature review, the data collection method and instrument and the analysis of the research.

3.2 Literature search and review

The literature search is an important component of research in the social sciences. According to Aitchison (1998: 58), the literature search shows the researcher what has been done in relation to the problem being investigated. It ensures that no duplication occurs. It also brings about important understandings and insights necessary for the development of a logical framework (Gay 1976: 24).

Due to the largely exploratory nature of the study, an extensive search of international literature was conducted. The uniqueness of the research to South Africa required extensive literature on South Africa. Information acquired from the literature can be divided into the following categories:

- the relevance of ICT in education;
- pedagogy, training and skills required for computer-based education;
- school information and communication resources required for the utilization of ICT;
- capacity in terms of the time and the skills of teachers to implement ICT projects;
- lack of proficiency in the English language as a possible hindrance to the utilization of ICT in education in South Africa;

- the role of multimedia as a possible solution to the use of ICT in education in South Africa;
- short- and long-term challenges to the utilization of ICT in education in developing countries, including South Africa.[33]

3.3 Research methods employed in the study

3.3.1 The survey method

The research purpose and objectives determine the type of research design employed for a

[33]The first evaluative report of the WorLD programme considers many of the issues raised in this study. The report specifically considers skills required by students to reason with information, communicate ideas, collaborate with projects and use a variety of computer hardware and software tools (Kozma *et al.*., 1999: 1).

study (Katundu 1998: 58). Given the nature of the research problem and purpose of the present study, the most appropriate research methodology is the survey. According to Busha and Harter (1980: 62), survey research is capable of collecting background information and hard-to-find data and the researcher would not have the opportunity to motivate or influence respondents' responses. Sproull (1995: 30) recommends the survey technique for research where attitudes, ideas, comments and public opinion on a problem or issue are studied. The descriptive survey approach was chosen for the present study, because it seeks to gain insight into a phenomenon as a means of providing basic information in an area of study (Bless and Higson-Smith 1995: 42).

The strength of the survey method is also evident in its ability to study, describe, explore and analyse relationships among geographically scattered subjects, such as the WorLD schools included in this study. As a result, the researcher can apply the information gathered from a small sample to a large population. Though all WorLD schools in South Africa participated in this study, 20% of learners were sampled. From this sample, it may be possible to generalize the findings to the rest of Africa and other developing countries, which share characteristics with the areas of South Africa in which this study was conducted.

3.3.2 Evaluative study

At a broader level, this study can be described as evaluative research. The study seeks to assess what the current situation is in relation to what was intended – the plans, targets and objectives (Wyley 1996: 10). "In this evaluation the evaluator has become a mediator, a change agent, and the evaluation process is not viewed as judgmental ... but to assist make more informed decisions" (Guba and Lincoln 1989: 205). An evaluation such as this offers in-depth reflection at a point considered significant in the life of the project phase (Wyley 1996: 11) (in the case of the WorLD programme, the pilot phase from 1997-2000). The definition of evaluation, which guides and informs this study, is provided in van Rooyen (1996: 55):

> *"Evaluation is the process of identifying and collecting data about specific services or activities, establishing criteria by which their success can be assessed, and determining both quality of the service or activity and the*

degree to which the service or activity accomplishes stated goals and objectives."

Ruthman (1984: 162) states that evaluations are carried out to gain information for making decisions. This study is not specifically commissioned and can therefore be described as ritualistic; it should nevertheless provide worthwhile information for the WorLD programme and other similar projects in South Africa.

3.3.2.1 Types of evaluation approaches used in this study

Bawden (1990) mentions certain types of evaluation used in research. He distinguishes between macro-evaluation and micro-evaluation. Macro-evaluation evaluates how well, or otherwise, a system was performing, without attempting to say why it was working well or not. Micro-evaluation is diagnostic and examines in detail a system's performance, especially its failures, and makes recommendations for improvements (Bawden 1990: 15). The present study follows the micro-evaluation approach. Evaluation is also either external or internal. External evaluation, as is the case with the present study, is employed at a crucial period of a project, when there are supposed to be difficulties with the project.

A distinction is made between the attributes of quantitative and qualitative evaluation. Bawden (1990: 15) indicates that, whereas quantitative evaluation can be associated with experimentation and a high degree of control over the factors being studied, qualitative evaluation is associated with 'investigation', which is simply gathering data and suggesting ideas. As noted by Hounsel and Winn, in Bawden (1990: 31), a combination of both techniques, each compensating for the weakness of the other, is powerful. Qualitative research, on the other hand, emphasizes a holistic approach, treating the totality of the system under study and its context. A major benefit of the qualitative method is that it can allow the viewpoint of the user of a system to emerge and become a real factor in a realistic evaluation (Bawden 1990: 28).

3.4 Data collection method and technique

A self-administered questionnaire as a secondary data collection procedure was the main method used to collect data in the present study. Other methods used for the study include primary sources (documentation, online data), interviews, focus group discussions and

observations.

3.4.1 Data collection matrix

Table 3.1 Data collection matrix

Research questions	Research tools employed					
	Documentation	Focus group discussion	Online data	Ques-tionnaire	Interviews	Observation
How successful was the training provided to teachers and students in WorLD schools?	✓	✓	✓	✓	✓	✓
What information resources exist in the schools, and do the schools have media teachers?	✓	✓		✓	✓	✓
To what extent are the WorLD teachers able to handle school projects, attend to computer systems and teach their normal school lessons?	✓	✓		✓	✓	✓
What is the literacy level of WorLD	✓	✓		✓	✓	✓

school pupils in terms of reading, accessing and using information in the English language?						
How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?	✓	✓		✓	✓	✓
What other factors contribute to the success or failure of the WorLD programme in South Africa?	✓	✓	✓	✓	✓	✓

Table 3.1 shows that all tools listed featured in the data collection strategy in relation to issues, with the exception of the online tool. Survey data was the main source of most of the data for the research. Interviews featured during the preliminary phase and were used to collect background information to establish the study. A focus group discussion with teachers was held and interviews during follow-ups to collect the research questionnaires. Observations provided on-the-spot information during the initial phase of the study and during the questionnaire data collection stage. Another source of bulk data was printed material. The Internet also served as a useful source of current and unpublished data.

3.4.2 The self-administered questionnaire

A self-administered questionnaire was used, despite the sampled schools being scattered across three provinces in South Africa (Eastern Cape, North-West and KwaZulu-Natal). This was possible because:

- The researcher and WorLD teachers met at the South African National SchoolNet Computer Conference in 2000, dubbed the *Millennium Minds Conference 2000*.
- A pre-conference session, where the WorLD programme was discussed, provided the researcher with the opportunity of a focus group discussion of questions with WorLD teachers and thereafter administered the questionnaires.

A letter,[34] discussed with a consultant statistician, detailed the procedure for sampling of learner respondents by teachers at their various schools. This letter accompanied all questionnaires that were given out to teachers to administer questionnaires to learners.

[34] The letter can be found in Appendix 5.

Two questionnaires were designed for data collection. The questionnaires were reformatted for coding and computer analysis (done by a computer and research consultant at the Department of Computer Studies at the University of Pretoria). Coding was important in the study, because it involved allocating computer columns to each question (De Vaus 1991: 233). A column for office use (for coding) was therefore created in both questionnaires.

One of the questionnaires was used for the teachers involved in the WorLD programme (Appendix 6). The other questionnaire was used for learners from participating WorLD schools (Appendix 7). Two questionnaires were used because the study sought to elicit views from both teachers' and learners' perspectives.

Questionnaires are one of the best impersonal observation techniques used for eliciting data (Leedy 1993: 187). Respondents are more likely to respond honestly because of anonymity. Questionnaires were used because it was not possible for the researcher to interview all 14 teachers and 20 per cent of the learners in each of the schools covered in the research population, which amounted to 91. A further reason for using self-administered questionnaires was that, since the schools are scattered across three provinces of South Africa, financial, logistical and time constraints would not allow for interviews to be used as the main data collection technique for this research.

The questionnaires were supplemented by telephone interviews and face-to-face interviews with teachers and SchoolNet SA officials who were part of the WorLD project team. This procedure gave clarity on issues, reducing the ambiguity that goes with questionnaires. In addition, the researcher's observation of the actual status of ICT in selected schools in KwaZulu-Natal helped with the design of the questionnaire. The researcher agrees with

Katundu (1998: 59), who said that the use of more than one data gathering instrument – the triangulation method – is considered vital in an under-researched problem such as that in the present study.

3.4.2.1 Format of questionnaire

The questionnaires used for this study are semi-structured, consisting of a mixture of closed and open-ended questions. De Vaus (1991) provides a number of advantages of closed or forced-choice questions. This is in spite of the problems associated with closed questions, such as providing an adequate range of alternatives to respondents. Another problem is that when a questionnaire is long (as in this study), motivation to answer could be low. De Vaus (1991: 86-87) states that closed question questionnaires are easier to code and recommends exhaustive alternative responses as a remedy to the problems. Open-ended questions were included in the questionnaires in the present study to determine the general feelings of teachers and students on issues and the reasons for their opinions.

The questions used in the questionnaires are fairly simple. The researcher therefore assumed that teachers and high school students would easily fill in the questionnaires. Considerable attention was given to developing simple, clear and unambiguous questions. The generic name *computer system,* for example, was used in the questionnaire instead of *information and communication technologies*. The researcher felt that not every student or teacher would know the term *information and communication technologies,* or the different types of computers and their names.

Questionnaires are designed to fulfil specific objectives (Leedy 1997: 192). The questionnaire for this study was designed to fulfil the objectives listed in Chapter 1 (section 1.5) of this thesis. The research questions, from which the sub-questions for the questionnaires were deduced, are also provided in Chapter 1 (section 1.6). An overview of the two questionnaires is provided, based on research objectives.

3.4.2.2 Overview of questions in the questionnaires

Questions in each of the questionnaires are categorized in sections. An overview of the sections and questions is presented.

Section A: Background information of school/project co-ordinator

Teachers/project co-ordinators' questions 1-14 and learners' questions 1-8 sought background information on the various teachers, schools and students.

Section B: Training and provision of skills for the WorLD programme

Teachers' questions 15-31 and students' questions 9-17 focused on training and the provision of skills to enable the use of ICT in the WorLD programme.

Section C: Teachers' background training

Teachers' questions 32-45 dealt with project teachers' background training. This covered pedagogical training and skills required for the implementation of ICT education.

Section D: Teachers' capacity issues

Teachers' questions 46-54 dealt with teachers' capacity (time and skills) to deal with computer problems in normal teaching settings and collaborative projects.

Section E: School resource situation for ICT education

Teachers' questions 55-68 dealt with the availability of school resources that support computer-based teaching and learning.

Section F: English language proficiency as a hindrance to the use of ICT in schools

Teachers' questions 69-74 and students' question 18-24 dealt with learners' English language proficiency.

Section G: Utilization of multimedia

Teachers' questions 75-80 and students' questions 25-27 explored the need for utilizing multimedia as an educational tool.

Section H: Benefits and challenges

Teachers' questions 81-86 and students' questions 28-30 explored the benefits and the challenges of the WorLD programme and factors that contribute to the success or failure of the programme in the schools.

3.4.3 Pre-test for validity and reliability

The questionnaires were pre-tested in two schools, which account for 10.5 per cent of the 19 schools sampled in the study. The purpose was to test the instruments for validity and reliability (Nevell 1993: 99) and to determine how realistic the questions were to the ability of learners and teachers. Nevell (1993: 112) stressed the importance of scrutinizing data-gathering instruments to identify ambiguity or misleading questions and for instructions and suggesting improvements. Minor changes were made after the pre-test, in collaboration with the supervisor of the study and other officials involved in the programme.

3.5 Research population

Leedy (1993: 197-198) observed that nothing comes out at the end of a long and involved study that is any better than the care, precision, consideration and the thought that goes into the basic planning of the research and the careful selection of the population. The research population of this study is defined as teachers/school project co-ordinators and students in schools that participated in the WorLD programme in South Africa. The names of 19 schools that participated in the programme are provided in Appendix 3. Table 3.2 lists the number WorLD schools according to province.

Table 3.2 Population of WorLD schools according to province

Province	Number of schools	Percentage of total
Eastern Cape	6	32
KwaZulu-Natal	7	36
North-West Province	6	32
Total	19	100

Table 3.2 shows the population of schools according to provinces that participated in the

present study.

The targets at the various schools were teachers, specifically WorLD programme co-ordinators, and students who participated in the WorLD programme. Nineteen teachers, representing 19 learning facilities, comprised the total population. Of the 19 learning facilities, one – a resource centre (the Zenzeleni Community Centre[35]) – was not a school, but a WorLD computer centre.

According to a list of a number of learners provided by 14 teachers (see Table 3.3), 456 learners participated in the WorLD programme from the 14 schools. The mean number of learners was calculated and this amounted to 33 learners per school. The total number of learners from the 19 schools would therefore be 19 X 33 = 627.

3.5.1 Sampling

Sampling is a procedure of selecting a part of a population on which research can be conducted, which ensures that conclusions from the study can be generalized to the entire population.

Teachers in this study were not sampled because all 19 teachers, representing schools that participated in the WorLD programme participated in the study. Fourteen of the teachers were present at the Millennium Minds 2000 Conference at the Pretoria Boys' High School in September 2000. The remaining five of the total population of WorLD programme teachers were sent the questionnaires given to all teachers at the conference.

3.5.1.1 Stratified random sampling of learners

A stratified random sampling procedure was employed to determine the number of learners sampled for this study. According to Mulder (1993:58-59):

> *"To ensure that a sample will be representative of a population about which there is a fair amount of information available the population can be divided into sub-groups. One or more variables can be employed for this purpose for*

[35] The Zenzeleni Community Centre (located in Mpophomeni) is one of the WorLD programme centres that serves the whole community instead of a single school.

instance… age, academic qualifications, and so on. The population of 5,500 can be divided into subgroups of … One fifth of the number selected from the latter two groups can be selected from the first".

A stratified random sampling was used for sampling learners, because learners were from different schools, with different total populations. They were thus divided into sub-groups, and 20% (which is one fifth) of each school was selected. Mulder (1993:59) indicated that "This selection from each sub-group is accompanied by either random or systematic sampling". The present study adopted the random sampling procedure to choose the learners at the schools.

Teachers carried out the sampling of learners in a more systematic manner. A rigorous procedure was used to avoid a bias and maintain a representation of the diverse groups of learners in each school project. A simple random sampling procedure was adopted to select learners to answer the questionnaire. Steyn (1994: 16) state that, with a simple random sample, each element in the population that has not yet been included in the sample stands an equal chance of being selected in the next draw.

The sample size in each school was 20 per cent of the student population that took part in the WorLD programme. This number was determined by the researcher (with the help of teachers) and rounded off to the nearest whole number. The sample size was determined by the number of learners presented by each school (see Appendix 8). A strict simple random sampling procedure was discussed with teachers. The procedure was to be adhered to in the selection of learner respondents, as follows:

1. Teachers provide each learner in their class with a number from 01 – ON (N represents the number of the last learner) on the sampling day.
2. A row in a table of random numbers is selected at random.
3. Teachers chose the sampled numbers provided to students from the table, beginning with the first number selected at random. For example, if a teacher selects a random number of 91, he would select the first random learner 01.
4. The teacher goes through the list (row by row) and determines numbers that correspond

with any of the numbers of respondents in the class.

5. The process in step 3 is repeated until the number of selected respondents is completed.
6. The selected students fill in the questionnaire.

The simple random sampling procedure adopted in this study corresponds with the five steps of simple random sampling proposed by de Vaus (1991: 60):

7. Obtain a complete sampling frame.
8. Give each case a unique number, starting from 1.
9. Decide on the required sample.
10. Select the sampled numbers from a table of random numbers.
11. Select the cases, which correspond to the randomly chosen numbers.

Table 3.3 provides details of participating schools, study population and number of learners.

Table 3.3 Name of school, number of learners and sample range

	Name of school	Number of learners	Sample range
1	St. Joseph's Secondary	45	01-09
2	Estcourt Secondary	30	10-15
3	Nottingham Road Secondary	30	16-21
4	Asithuthuke Combined Secondary	40	22-29
5	Quakaza Senior Secondary	35	30-36
6	Mphophomeni High School	20	37-40
7	Ngwenyathi High School	40	41-48
8	Micha-Kgasi High School	15	49-51
9	Kgomotso High School	40	52-59
10	Gabonewe Secondary School	42	60-67
11	Leteane High School	33	68-74
12	Ngaka-Maseko High School	31	75-80
13	St Joseph's JSS	20	81-84
14	Nombulelo	35	85-91

Table 3.3 shows 14 schools that submitted initial data for the study. A mean number of 33 learners in each school took part in the WorLD programme, which works out as 627. The

total number of sampled learners therefore is 20% of 627, which is 125.

3.6 Data analysis

3.6.1 Data presentation and analysis

Descriptive statistics were adopted for presenting and analysing the data in this thesis; the researcher can summarize patterns in the responses from the sample by the use of frequency tables, percentages and charts (De Vaus 1991: 135-137). However, inferential statistics was used, where necessary, to determine if the patterns described in the sample can be applied to the population from which the sample is drawn.

A computer program, developed and provided by the University of Pretoria's Department of Computer Sciences, established the frequency distribution. The frequency distribution was examined by looking at the issues that were represented by the respondents and what the most typical responses were.

3.6.2 Coding of data

3.6.2.1 Coding of closed questions

There was a need to allocate a code to the answers of each question or variable.[36] . De Vaus (1991: 233) said that the essence of coding is to give a distinctive number to each answer in a question. The number is fed into the computer. A pre-coding procedure was adopted for computer data analysis. This is because most of the questions (over 85%) were closed questions, with predetermined answers to each question. It was therefore necessary to allocate codes to the answers.

3.6.2.2 Coding of open questions

According to De Vaus (1991: 239), open-ended questions often produce multiple responses that require the creation of several variables to capture the responses. It is therefore best to construct a number of variables into which responses can be sorted and coded. A multiple

[36] A detailed coding process is provided in Appendix 8 of this study.

response approach was used for coding the open-ended questions in this study. A post-coding procedure was used. Categories were created from the responses received to a particular question. A code was allocated to a particular category, for respondents' answers.

3.7 Summary

This chapter described the research methodology employed in the study. The research method employed is reviewed and details of the evaluative research procedure are provided. The data collection method and tool are discussed, and the research questionnaires and how they were administered are described. The study population provided details of the range and location of individuals covered in the study, while the sampling procedure detailed the method adopted in limiting the range to specific individuals. The data analysis involved the use of a coding method.

Chapter 4

Data presentation and analysis

4.1 Introduction

Chapter 4 presents the survey data and analysis based on the objectives set for the study and the research questions which were outlined in Chapter 1. Findings from two questionnaires project coordinators/teachers and learners are outlined. Tables, figures and descriptions of data are used to present the findings.

4.2 Background data

The data that follows in section 4.2 provides a context in which the study was conducted. Questions and source of data is summarised in Table 4.1

Table 4.1 Data analysis of background on WorLD school co-ordinators and students

Question	Source and location of Data
How many schools participated in the project?	1. Interview with National WorLD project co-ordinator 2. Sampled number of schools 3. SchoolNetSA website **Http://www.school.za**

What was the response to administered questionnaires?	Responses of questionnaire received. Figure 4.1
What was the gender representation of co-ordinators?	Teachers' question 1
What was the racial composition of co-ordinators?	Teachers' question 2
What was the motivation of co-ordinators?	Teachers' question 3
What was co-ordinators' background use of computers?	Teachers' question 4
Are you a black/white south African?	Students' question 2
In what grade are you?	Students' question 3; Table 4.2
Have you ever been trained to use a computer?	Students' question 4
Have you used a computer before the project?	Students' question 5
Do you have a computer at home?	Students' question 6
Does the computer you have at home function?	Students' question 8

4.2.1 Background information of project co-ordinator

According to information acquired from National WorLD project co-ordinator and literature 19 schools in three provinces participated in the WorLD programme in South Africa. All 19 schools which formed the research population participated in the study. Eight schools, represented by WorLD teachers, responded to the questionnaire. A 42 % response rate was thus achieved. One hundred and twenty-five learners, sampled from a total of 627, represented 20 % of WorLD learners. A single learner could have been sampled from each school to gauge learners' experiences. This was extended to 20% to expand the experience of learners from the project. A total of 45 learners (36%) responded to the questionnaire. A small response sample size limited generalisability therefore grounding findings in the extensive literature survey of study.

Figure 4. 1 Provincial response rate of WorLD schools in South Africa

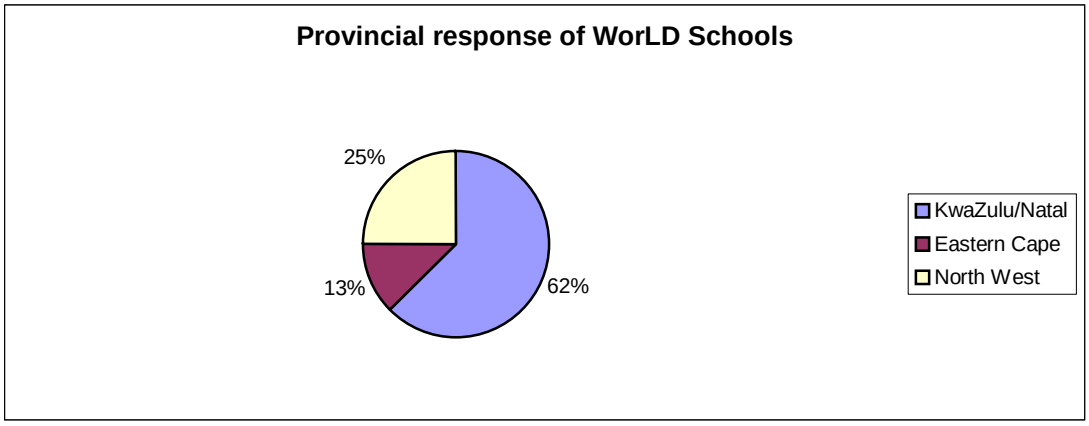


Figure 4.1 shows that the majority (five (62%) of the eight teacher respondents are from the KwaZulu-Natal province. Two (25%) are from the North-West Province.

Four (50%) teacher respondents are female and the rest are male. An equal gender participation in the programme bodes well for teacher ICT education in South Africa.

The majority of teacher respondents (five (64%), are black South Africans. White, Indian South Africans and a black non-South African teacher also participated in the programme. Half of the teacher respondents were self-motivated participants in the project, while others were either nominated or appointed after an interview process. The high number of self-motivated teachers is an indication of teachers' interest in ICT education. Despite the enthusiasm, a large number of them (five (62%), had never used a computer before the introduction of the WorLD programme to their schools.

4.2.2 Students' background data

A total of 45 learners participated in the study as respondents. Fifty-six per cent of learner respondents were male and 45 per cent female. A majority of (43 96%) were South African black students; one was a non-South African black and one a white non-South African. It is noted again that the WorLD programme targeted previously disadvantaged black schools.

Table 4. 2 Grades of respondent learners N=45

Grade	Number of students	Percentage
8	4	9
9	11	24
10	13	29
11	10	22
12	7	16
Total	**45**	**100**

Table 4.2 shows that most of the learner respondents that participated in the WorLD programme were in Grade 10 i.e. (13(29%); the lowest number of learners, (4(9%) were in

Grade 8.

Twenty-eight learners (62%) had never used a computer before the introduction of the WorLD programme to their school. Regarding training, (35 (77%) learners had not been trained to use computers before the programme. Thirty-nine (89%) learners do not have a computer at home. All respondents with computers at home said the computers were functional. Eighty per cent of learners' computers at home are not connected to the Internet.

4.3 Data covering research questions

Sections 4.3.1 to 4.3.9, provides data and analysis of the main research questions covered by this study. A table in each section provides the main research questions and data relating to specific questions relating to the issue under study.

4.3.1 Training for the WorLD project.

Table 4.3 provides the main research question, sub-questions, tables and figures that provide data relating to the questions.

Table 4.3 Training provided during the WorLD project

Question	Data
1. How successful was the training provided to teachers and learners during the WorLD programme in South Africa?	**Sect. 4.3.1**
Which application software have teachers been trained in?	Table 4.4; Figure. 4.2
Which technical skills were provided to WorLD teachers?	Table 4.5; Figure 4.3
Which pedagogical methods are teachers familiar with, trained in and use?	Figure 4.4
What number of days and hours were teachers trained?	Figure. 4.5
What information related training have you and other teachers had?	Figure 4.6
What other teachers on staff had access to technical ICT training?	Table 4.6
How have you been trained for the WorLD programme?	Figure 4.7
If you have been trained, how many hours per day were you	Table 4.7

trained?	
How many days in total were you trained?	Table 4.8
Which of the listed application software have you been trained in?	Figure 4.8
Which of the following training did you find to be unsatisfactory?	Table 4.9
Which of the following systems have you been trained in?	Figure 4.9
Which operating system were you as a learner trained in?	Table 4.10
To what extent have you had a computer to practise after training?	Table 4.11
To what extent have you been trained for collaborative school projects?	Table 4.12

4.3.1.1 Training of teachers for the WorLD programme

This section provides data that determines the extent to which teachers were trained for the WorLD programme. The areas of training explored are:

- Computer literacy
- Technical computer skills
- Pedagogical methods and
- Collaborative training

1. Computer literacy training

This section addresses the extent of computer literacy provided to teachers to enable them to train learners and to use computers for the WorLD project. It outlines the skills required and teachers' responses to the skills provided.

The question was asked whether or not teachers were trained at all and which application systems they were trained in. All respondents indicated that they were trained in one or more computer application programs for the WorLD project. Table 4.4 and Figure 4.2 represent the computer application skills in which teachers were trained. Table 4.4 provides absolute numbers of teachers trained per application program and percentages. Table 4.2 and Figure

4.2 show that many respondents received training in many of the listed applications. All respondents were trained in word processing, spreadsheets and Web design skills. There was, however, no training in databases and programming.

Table 4.4 Applications in which WorLD teachers were trained N=8

Application software	Type/product	Absolute number trained	Percentage trained
Word processing	Microsoft Word	8	100
Spreadsheets	Microsoft Excel	8	100
Presentation graphics	Power Point	6	75
The Internet	Internet Explorer	4	50
The Internet	Netscape	3	38
Electronic mail	GroupWise	6	75
Electronic mail	Pegasus	4	50
Database	Microsoft Access	0	0
Web design		8	100
Information skills		4	50
Programming		0	0

Figure 4.2 Applications in which WorLD teachers were trained

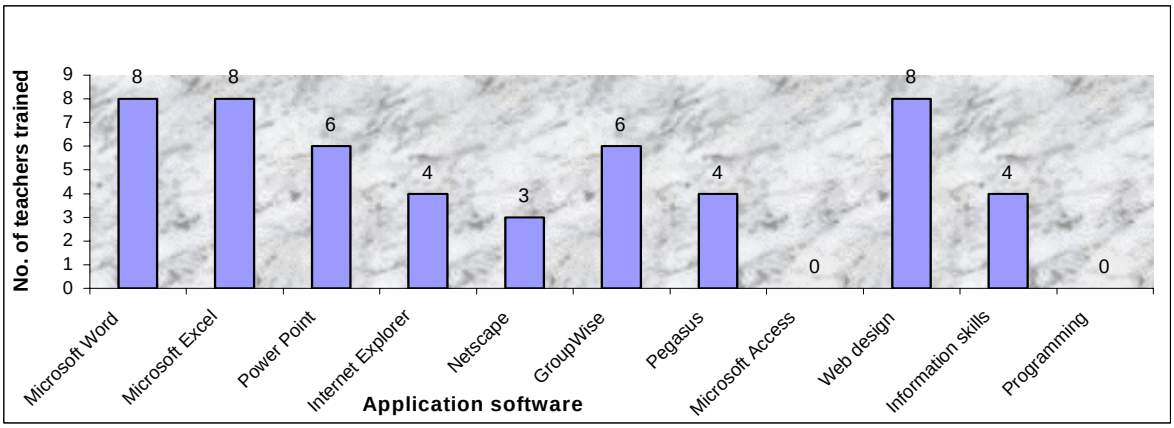


Table 4.4 and figure 4.2 provide data showing the number of WorLD teachers and application software in which they were trained.

2. Technical computer skills

Training in technical computer skills was a critical component of the WorLD programme. The question asked was which technical skills were provided to WorLD teachers to enable them to maintain computer systems during the project. The three main areas of computer systems explored were hardware, software and networking.

Table 4.2 and Figure 4.3 provide an overview of the technical skill which WorLD teachers were trained in during the project. Table 4.2 shows the three main components of the technical training of WorLD teachers. It details the type of training and the particular product that the teachers were trained in, the absolute number of teachers trained and the percentages.

As observed in Figure 4.3, the majority, (seven (88%), of the teachers were trained to physically identify computer components and their functions. Only one teacher was trained in the use of Windows 2000 and none in the UNIX operating system.

Table 4.5 Computer systems in which WorLD teachers were trained N=8

Computer system	Type/product	Absolute number trained	Percentage trained
Hardware	Physical identification of computer components and their function in a computer system	7	88

Operating system software	MS DOS	2	25
	Windows 95	5	63
	Windows 98	5	63
	Windows 2000	1	12
	Windows NT	2	25
	Unix	0	0
Networking	Networking systems and procedures	2	25

Figure 4. 3 Computer systems in which WorLD teachers were trained

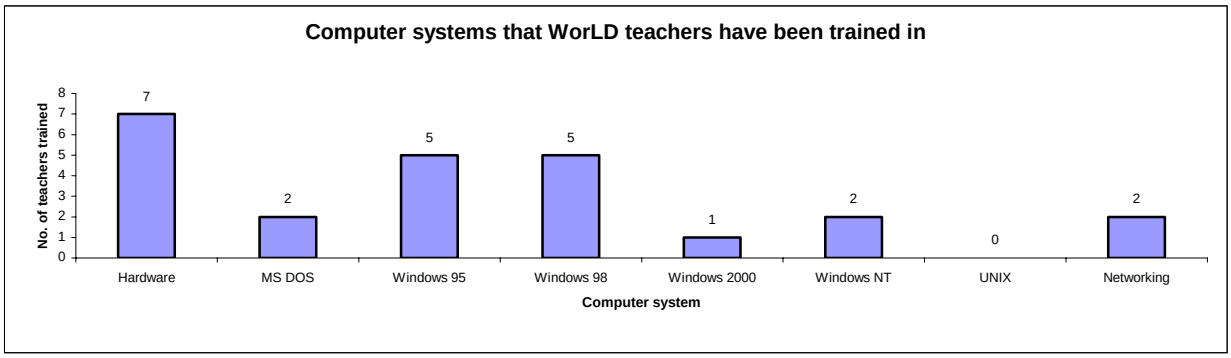


Table 4.5 and Figure 4.3 show number of teachers and the computer systems in which they were trained.

3. Pedagogical skills

As the WorLD programme sought to integrate computers into the teaching and learning process in project schools it was required not only to train teachers in the skills of using computers, but for teachers to integrate the computers into the teaching and learning process and to be able to use the computer to teach subjects such as language, mathematics and science. To this end a number of questions were asked which related to the project teachers' professional knowledge and use of teaching methods. The questions addressed pedagogical areas such as:

- project-based learning
- the constructivist learning method
- resource-based learning method
- authentic learning method
- research-based learning
- student team method and
- the systematized learning method

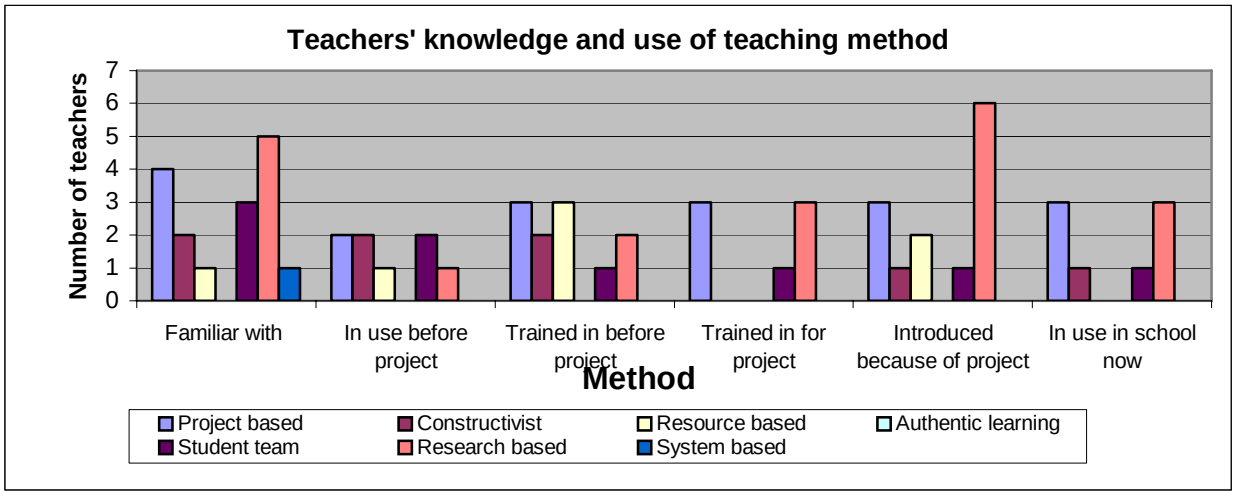
Figure 4.4 shows that (five (62%) respondents are familiar with the research-based teaching method. Fewer than half of the teachers were trained in each of the methods and were trained in only three teaching methods for the WorLD programme. While only one teacher has knowledge of what the system-based method is, no teacher is familiar with, or has been exposed to, any training regarding the authentic learning method. Two teachers use the constructivist and the student team methods in their schools now. One school in each case uses the resource and research-based methods. No school utilizes the authentic and system-based methods of teaching.

Perhaps respondents' professional training accounted for the limited familiarity, exposure, or use of the listed teaching methods. Half of the respondents have only a Higher Diploma in Education. One respondent has a Bachelor's degree in Education; two have Honours degrees and one has a Masters degree. Regarding the introduction of new teaching methods to the school, three of six respondents indicated that the WorLD trainer introduced the new teaching method, while the other three said they, the teachers, had introduced the method into their school. An interesting observation in Figure 4.4 is that the new method (resourced-based) introduced to the schools because of the WorLD project had been abandoned and was no longer in use. Another interesting observation is that the constructivist method which has been in use by two schools before the WorLD project was now being used only in one school.

As to whether teachers were pursuing further studies regarding these methods, (three (37%) were undergoing training to upgrade and equip themselves for technology-based professional

education. Two of those pursuing further training indicated that they were receiving training at a university and the other was receiving training at a college. Three (37%) respondents who were not undergoing further studies indicated that finance was their constraining factor, while the remaining two were pursuing other interests outside teaching.

Figure 4.4 Project teachers' training, knowledge and use of teaching methods



4. Collaborative training

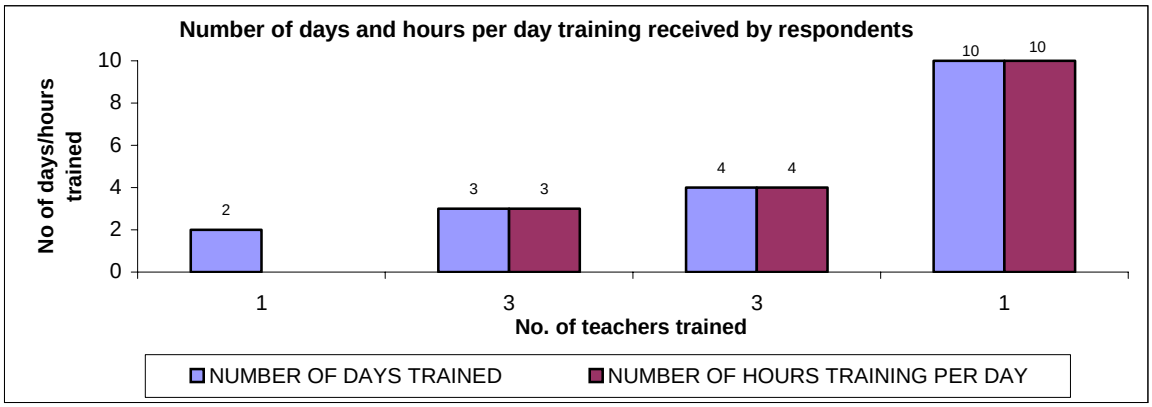
Collaborative training for teachers was crucial to enable them to train WorLD learners to undertake online education projects with their peers all over the world. The question asked was whether or not teachers had been trained in collaborative skills.

Six (75%) teachers received training in online collaborative school projects. Five (62%) of these teachers do not use information from the Internet for teaching purposes, although they have all been involved in at least one collaborative project. To the question why they do not use information from the Internet, three (50%) of the six respondents said the Internet was often not available. As to why not many collaborative projects have been undertaken, half of the six respondents indicated that the Internet was often not available; the other half said there was often no time for collaborative projects.

The number of days and hours for which teachers were trained could have a negative impact

on the skill level acquired. Figure 4.5 shows that training varied in duration from one to ten days and from three to ten hours per day. The majority of teachers, six (75%), were trained for between two and five hours per day, for six days. Only one teacher was trained for up to ten days.

Figure 4.5 Number of days and hours in which respondent teachers were trained



It is gratifying to know that all respondent teachers had computers with which to practise after training sessions.

The majority, (six (75%), were unable to provide technical support for their schools' computer system due to a lack of the required technical skills. This might be due to the limited number of days of training acquired. The aspect of training found to be most satisfactory, according to 83% of the respondents, was word processing. The aspect found to be most unsatisfactory was technical training. Perhaps the inadequacy of technical training led to an 88 % response recommending it as the area that required further training.

Teachers generally had embarked on technology related training themselves, in one form or another, to keep abreast of the skills necessary to be able to use ICT tools to teach.

Figure 4.6 reveals that many teachers – those that were part of the WorLD programme and

those that were not – have received other educational ICT training. Non-WorLD teachers have had no access to one-to-one professional mentoring and the training offered by the Department of Education. Data was also provided regarding efforts made by other teachers to provide themselves with ICT related skills. Table 4.6 shows that, in a particular school, as many as ten teachers were trained in technical ICT-related skills. In seven of the eight respondents' schools, other teachers on the staff had access to technology-related training.

Figure 4.6 Information technology-related training that WorLD and other teachers

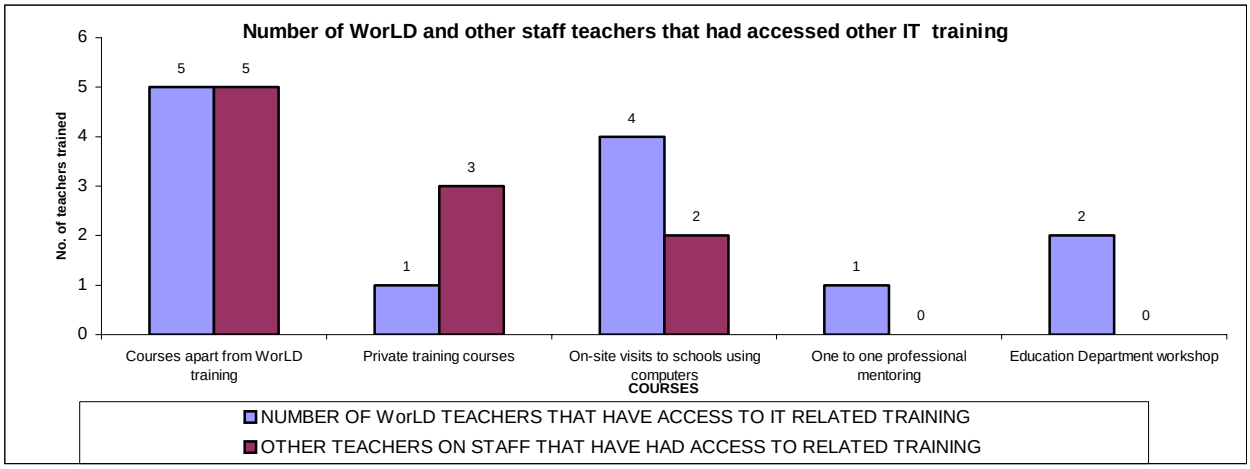


Table 4.6 Other teachers on staff who had access to technical ICT training N=7

Course	Number of school	Number of Teachers accessing training themselves
Technical ICT training	1	2
	1	3
	4	4
	1	10

Table 4.6 shows number of schools and number of teachers excluding WorLD co-ordinators that are making efforts to provide themselves with technical skills.

4.3.1.2 Training of learners for the WorLD programme

Training of WorLD school learners comprised a major component of the programme and hence one of the objectives of the project. The study therefore investigated the manner in which the training was provided to the learners. Learners were asked about the type of training and manner in which the training was conducted.

On the whole, respondent learners did not receive satisfactory training during the project. Regarding the manner of training received, Figure 4.7 shows that 18 (40%) of the respondents indicated that they were not trained well during the project. Sadly, 16 (36%) were not trained at all. It is evident that there was no consistency in the training time provided. For example, Table 4.7 shows that, while seven learners (23%) were trained for less than one hour a day, five other learners (17%) were trained for more than five hours per day. The data have shown that there was no consistency in the number of days for which learners were trained. Table 4.8 shows that although the majority, 18 (60%), of the learners were trained for more than a total five days; four (13%) were trained for only two days.

Learners had been trained in many of the application systems listed (Figure 4.8). There was, however, no training in database, information skills and programming. Figure 4.9 shows that it was only in Windows 95 that some training was provided for more than half of the respondents. There was no training in Windows 2000, Windows NT and the UNIX operating systems.

Regarding satisfaction with training received, Table 4.9 shows that 11 (25%) learners were least satisfied with the training in Microsoft Excel and Pegasus Mail. They were most satisfied with training related to GroupWise and Microsoft PowerPoint. Training in computer systems generally was unsatisfactory. As observed in Table 4.10, all trainees in networking found it to be unsatisfactory. Two-thirds of learners who took part in the hardware training, as well as 80% who took part in the Windows 95 training, found them to be unsatisfactory.

Access to training equipment to practise was no better. From Table 4.11 it can be seen that only two learners (7%) always had access to computers to practise after training. Eleven learners (36%) had no access to computers after training. Finally, some credit has to be given for collaborative training. Table 4.12 shows that 72% were trained well. Seven learners (22%) were not trained in collaborative projects at all.

Figure 4.7 Manner of training WorLD learners

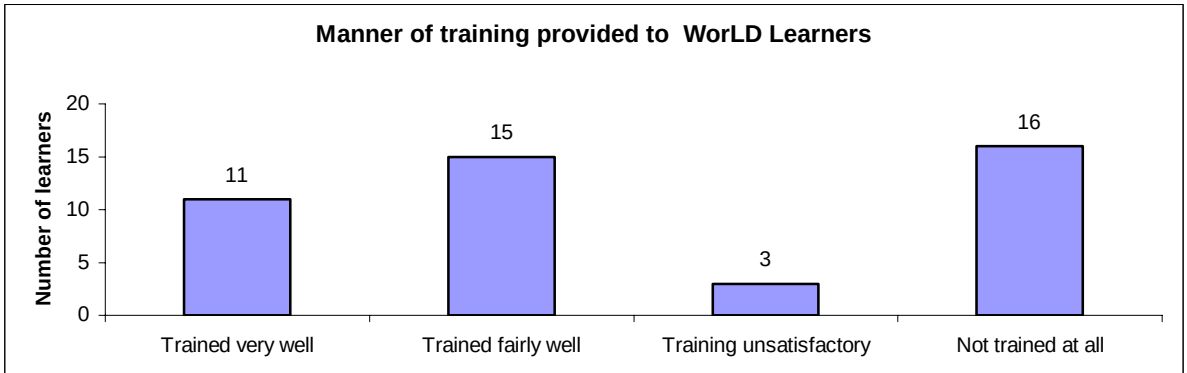


Table 4.7 Hours trained per day N=30

Hours per day	Number response	Percentage response
Less than 1 hour	7	23
2 hours	9	30
3 hours	5	17
4 hours	4	13
More than 5 hours	5	17

Table 4.8 Number of days trained N = 30

Number of days trained	Number response	Percentage response
2	4	13
3	6	20
4	2	7
≥5	18	60

Figure 4.7, Tables 4.7 and 4.8 provide data on manner and duration of training provided to learners during the WorLD project.

Figure 4.8 Applications in which WorLD learners were trained

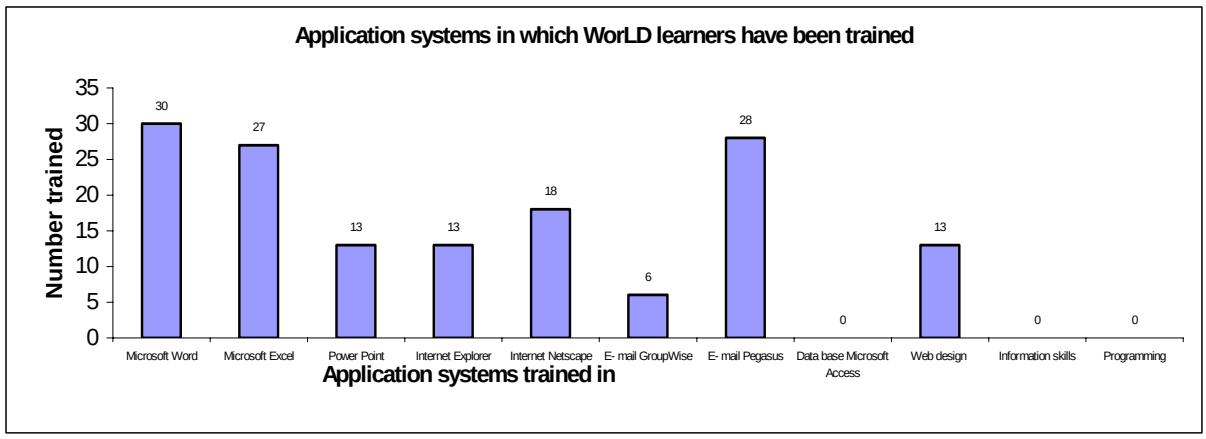


Table 4.9 Satisfaction with training in computer applications N=44

Application software	Absolute response	Percentage response
Microsoft Word	3	7
Microsoft Excel	11	25
Microsoft PowerPoint	1	2
Internet Explorer	8	18
Netscape	3	7
GroupWise	1	2
Pegasus	11	25
Web design	6	14

Figure 4.8 outlines data on the Application systems in which WorLD teachers have been trained in and Table 4.9 provides data on the satisfaction derived from the training.

Figure 4. 9 Computer systems in which WorLD learners were trained

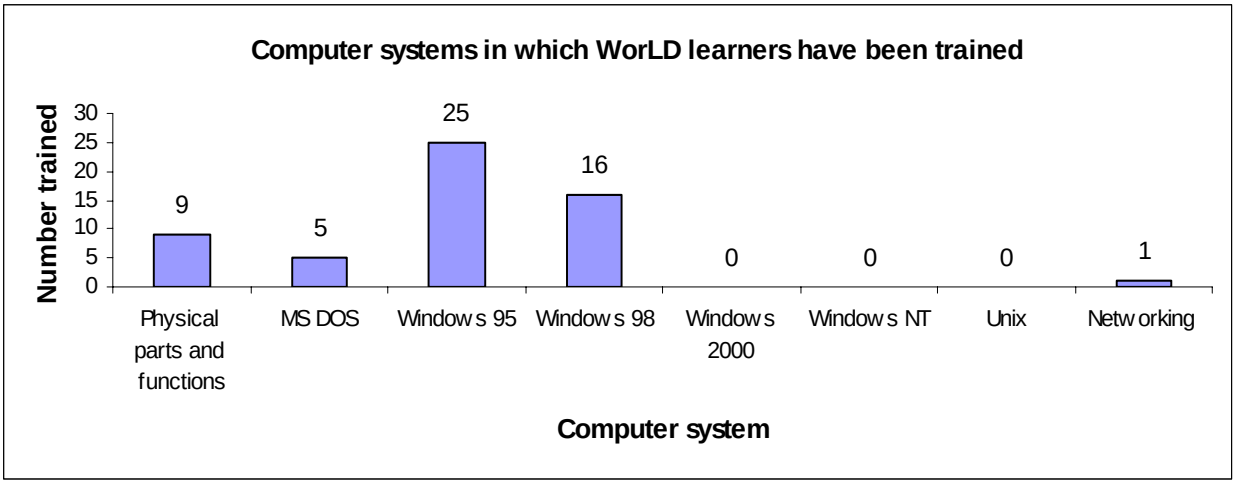


Table 4.10 Operating systems learners were trained in. Percentage not satisfied N=30

System	Response	Percentage not satisfied with training
Hardware	8	89
MS DOS	4	80
Windows 95	14	56
Windows 98	15	94
Windows 2000	0	0
Windows NT	0	0
Networking	1	100

Figure 4.9 and Table 4.10 provide data on operating systems learners have been trained in and the level of satisfaction of each of the systems trained in.

Table 4.11 Access to computer to practise after training N=30

Access to computer for practice	Response	Percentage
Always had access	2	7
Sometimes had access	12	40
Seldom had access	6	20
Never had access	11	36

Table 4.12 Manner of training for collaborative school projects N=31

How learner was trained	Response	Percentage
Trained very well	13	41
Trained fairly well	10	31
Unsatisfactory training	2	6
No training	7	22

Tables 4.11 and 4.12 provide data on access to computers by learners to practice skills learnt and manner in which collaborative training took place.

Table 4.13 provides questions and location of data relating to resources in WorLD schools

Table 4.13 WorLD information resource situation questions and data

Question	Data
2. What information resources (Computer laboratories, Internet, libraries, multimedia centres) exists in the schools and do the schools have media teachers?	**Sect. 4.3.2**
Which of the resources listed existed in your school before the introduction of the project?	Figure 4.10
Which of the listed information resources exists in your school	Figure 4.11

now?	
How many computers are not in working condition in your school?	Table 4.14
How many computers do you have in working condition in your school?	Table 4.15
How many of the school computers have CD-ROM drive?	Table 4.16
Which of the following technology existed in your school for the purposes of teaching?	Figure 4.12
Which of the following technology existed in your school for the purpose of teaching before the WorLD programme?	Figure 4.13
What forms of support did your school receive during the WorLD project?	Table 4.17
What computer operating systems did you have in WorLD schools?	Table 4.18

4.3.2 WorLD school resource situation

All human activities require the provision of appropriate resources to bring about their implementation. This study investigated the provision of the requisite resources that would allow the implementation of the WorLD programme in schools in South Africa. The questions posed among others were: what was the state of resources in WorLD schools before and during the project?

There was very limited provision of the requisite resources that support ICT education in WorLD schools before the implementation of the project in WorLD schools. Figure 4.10 shows that three schools (38%) had a library or media centre, (two (25%) had a computer laboratory and one (13%) had a dedicated library media teacher. There was no multimedia centre, Internet access or Network controller.

The implementation of the WorLD programme saw improvements in the resource situation. Figure 4.11 shows that the majority, seven (88%), of the sampled schools had computer laboratories. Three sampled schools (21%) had libraries and (two (14%) had media teachers and regular Internet access. There was no multimedia centre and no Network controller in any of the sampled WorLD schools.

Figure 4.10 Resources at schools before WorLD programme was introduced

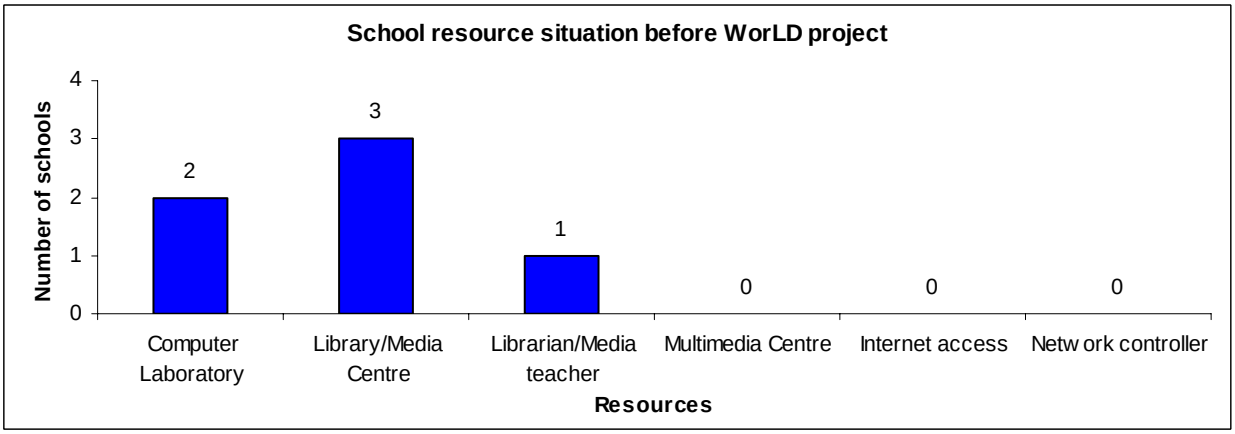
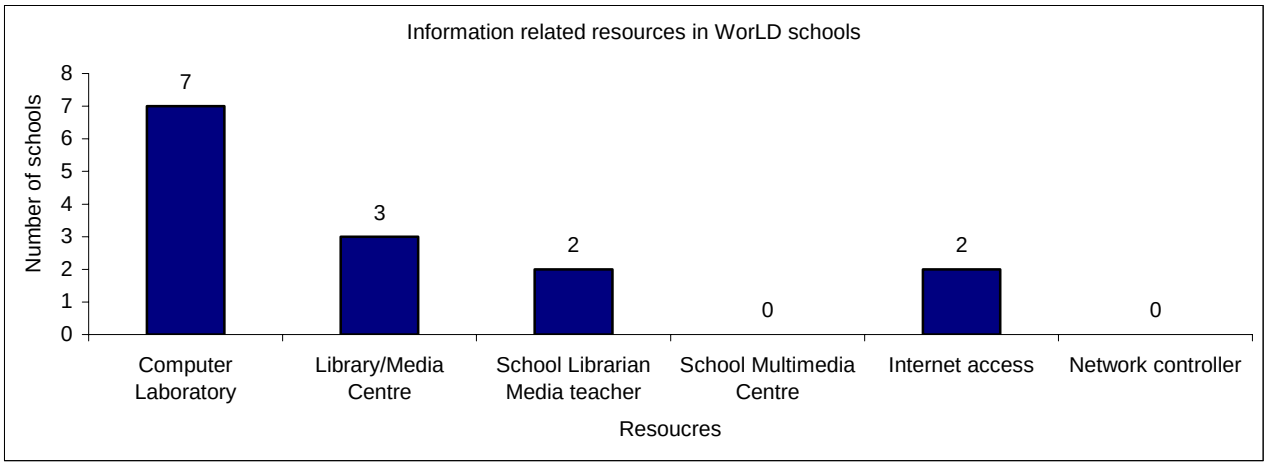


Figure 4.11 Information resources existing in WorLD schools during the programme



Figures 4.10 and 4.11 details WorLD school information resource situation before and during the WorLD programme in schools.

Figure 4.11 shows that three schools with Library/Media centres constituted the highest number of information resources before the WorLD project was introduced. There was no school with working computers, computer systems or peripherals.

Critical resources, without which the WorLD programme could not take place, were

computers. Schools were therefore asked what type of computers they had. In this regard the issue that was investigated was solely the computer hardware resources.
Table 4.15 shows that 108 working computers, in total, were available in WorLD schools, which is an average of 13.5 computers per school. Only three schools had Pentium computers. What was interesting was that one school had as many as 21 Pentium computers.

Not all computers were in working condition. Table 4.16 shows that 16 computers (a mean average of two computers per school) were not functional during the WorLD programme. This means that schools had, on average, only (11.5 (12) working computers.

Concerning computer peripherals, only a limited number had CD ROMs. It is observed, however, in Table 4.16 that all computers with CD-ROMs in the sampled schools were in working condition at the time of taking the sample. The Table also shows that, while an average of five computers per school have CD-ROMs; one particular school has 21 Pentium computers with CD-ROMs. This indicates skewed access to computers with CD-ROM drives.

Table 4. 14 Computers not in working condition at WorLD schools N=8

Type of computer	Number available and not in use	Number of schools
286	3	1
486	2	1
	3	1
	4	1
Pentium	4	1
Total	**16**	**5**

Table 4.15 Computers in working condition at WorLD schools N=8

Type of computer	Number available and in	Number of schools

	use	
286	3	1
486	4	1
	6	1
	8	2
	11	1
	14	1
	22	1
Pentium	5	1
	6	1
	21	1
Total	**108**	**11**

Tables 4.14 and 4.15 provide comparative data between computers in working condition and those not.

Table 4.16 Computers with CD-ROM N=8

Type of computer	Number working with CD-ROM	Number of schools
286	0	8
486	1	1
	2	3
	3	1
Pentium	3	1
	5	1
	21	1
Total	**39**	**16**

4.3.2.1 Other technology present and used in WorLD schools

The study investigated whether or not there was other technology present at WorLD schools during the project. It is supposed that the presence of other technology would influence the general use of technology for education in schools. Teachers were asked which technology existed in their schools during the project.

Available data shows that technological equipment was being used in WorLD schools. Televisions and video machines top the list of school equipment. Data projectors and slide

projectors are not used in any of the sampled schools (Figure 4.11). As seen in Figure 4.12, much of this equipment had existed in the WorLD schools before the project. It is interesting to observe in Figures 4.12 and 4.13 that during the project the amount of equipment had increased, except for radios, which had decreased by one. Available data shows that (six, (75%) of the sampled schools received support from better-resourced schools within their proximity. The forms of support received are presented in Table 4.17.

Figure 4. 12 Other technology used for teaching in WorLD schools

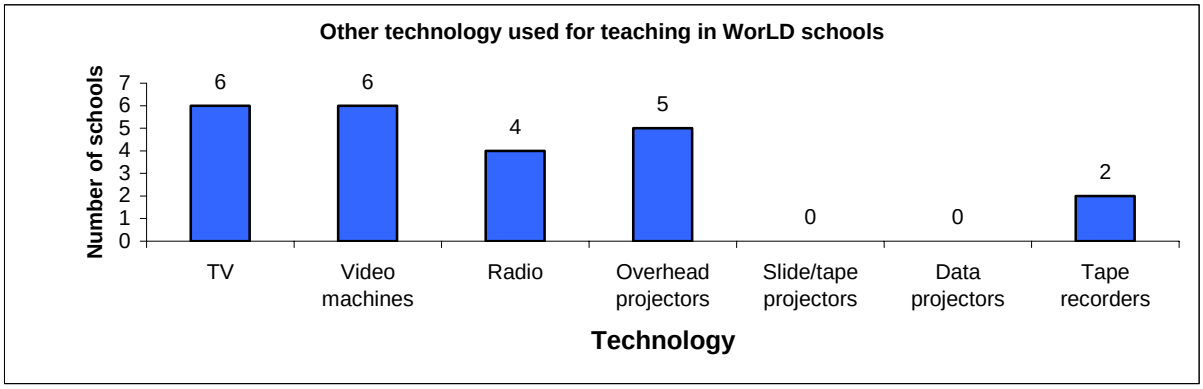
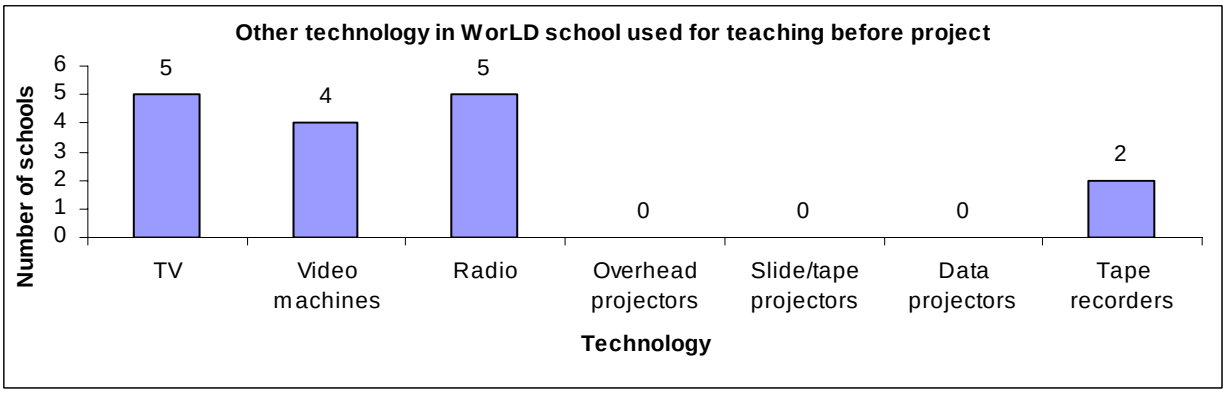


Figure 4.13 Other technology used before WorLD programme



Figures 4.12 and 4.13 compare other technology used for teaching in schools before and during the WorLD project in Schools in South Africa.

Table 4.17 Forms of support received by WorLD schools

Form of support	Number of schools receiving support
Donation of old computers	2
Donation of new computers	2
Technical	3
Mail/network services	1
Other (software)	1

Technical support was the main form of support received from better-resourced schools, as shown in Table 4.17. A respondent school indicated that it did not seek such support. Another said schools that could offer such support were far away.

4.3.2.2 Computer operating systems in WorLD schools

Computers without operating systems that make them functional are empty boxes. The study investigated which of the two categories were present in the WorLD schools. The type of operating system had many implications for the project in the school. Teachers were asked which computer systems were available in the computers in their schools. The responses (Table 4.18) show that many computers use a variety of operating systems, which include DOS, UNIX, Windows 95 and Windows 98. Windows 3.1, Windows 2000 and Windows NT are not in use in any of the schools.

The majority, seven (88%) of the sampled WorLD schools had computer networks. Four had file servers. Six (75%) schools use dial-up modems and three (60%) out of five schools had only one computer connected to the Internet.

Table 4.18 Computer operating systems in WorLD schools N=8

Type of operating system	Number of computers with system	Number of schools with system
DOS	26	3
	27	1
UNIX	26	3
Windows 3.1	0	0
Windows 95	11	3
	20	2

Windows98	12	4
	27	3
Windows 2000	0	0
Windows NT	0	0

Table 4.18 lists computer operating systems in WorLD schools while Table 4.19 provides questions relating to Teachers' capacity and data location.

Table 4.19 Teachers' capacity situation providing questions asked and data

Question	Data
3 To what extent are computer teachers able to handle school computer projects, attend to computer systems and attend to their normal school lessons?	**Sect. 4.3.3**
Which of the following attributes have you acquired to manage your school computer system?	Table 4.20
If you have acquired any of the attributes how do you rate it?	Table 4.21
To what extent does your project duty affect your normal teaching?	Table 4.22
Which of these supports have you received from the project?	Figure 4.14
How supportive has your school and principal been?	Figure 4.15
Reasons for lack of support from school principals	Table 4.23

4.3.3 Capacity issues

The WorLD project was a new project in schools in which it was undertaken and it was a novelty for administrators, educators and learners. Project teachers did not carefully consider the workload they had before the project so as to make adjustments and prepare for their new roles of manning computer networks, training learners and undertaking collaborative projects. This section provides data on the extent to which teachers had acquired skills they were trained in, and on other capacity issues, that affected their new role as WorLD project co-ordinators. The issues considered were ability, time and confidence to deliver on WorLD projects in schools. Teachers were asked which of the listed attributes, namely ability, time

and confidence, they had acquired to manage their school computer system.

Teachers, generally, had acquired the ability to deliver first level support and maintenance of their school computer system. Table 4.20 testifies to the fact that almost two-thirds of the respondents (63%) had acquired the necessary skill to support and maintain computer systems. The Table shows, however, that there was no time to implement the skills in their schools. Table 4.21 shows how they rated themselves regarding the attributes listed.

Table 4.21 reveals that respondents were adequately trained and rated themselves reasonably well in terms of ability and confidence, but very low in terms of the time at their disposal to utilize their newfound skills. As to the effect of the project on normal teaching duties, the majority (88%) in Table 4.22 shows that the WorLD programme has had some effect on their teaching duties. Half of the respondents felt there was a need for an additional staff member to help with the programme. Concerning the nature of training of such a teacher, half of the respondents stated that the additional staff member should be a teacher who will manage the library and provide first level technical support. The other half felt that such a person would be a purely technical person who should provide technical support.

Table 4. 20 Attributes acquired to manage school computer system N=8

Attribute	Number of teachers that acquired attribute	Percentage of teachers that acquired attribute
Ability – Skill to deliver first level support and maintenance	5	63
Time – Enough of it outside teaching duties to engage in collaborative projects	1	12
Confidence – To operate computers without fear of causing damage to the tool	2	25

Table 4.21 WorLD teachers' rating of their ability, time and confidence N=15

Attribute	Rating	Response	Percentage

Ability	Fair – 0% to 50%	1	6.6
	Good – 51% to 74%	3	20
	Excellent – 75% to 100%	1	6.6
Time	Fair – 0% to 50%	1	6.6
	Good – 51% to 74%	1	6.6
	Excellent – 75% to 100%	1	6.6
Confidence	Fair – 0% to 50%	3	20
	Good – 51% to 74%	4	27
	Excellent – 75% to 100%	0	0
Total		**8**	**100**

Table 4.20 Depicts attributes acquired by teachers to manage school computer labs. Table 4.21 rates their ability, time and confidence and Table 4.22 provides the effect of project on teachers' normal classroom duties.

Table 4.22 Effect of project on normal classroom teaching N=8

Effect	Absolute response	Percentage response
Unable to manage computer system and engage in collaborative projects because of teaching load/duties	2	25
To a large extent	2	25
Minimal extent	3	38
Not at all	1	12
Total	**8**	**100**

The question then arose as to what support teachers had received during the period that the project was implemented in view of its novelty, and what the consequences of lack of support had been.

Many teachers had received a wide range of support during the WorLD pilot project during its implementation period. Figure 4.14 shows that half of the respondents received support in learning strategies and collaborative planning. The Table also shows that although there was emotional mentorship and technical support, these were provided to less than half of the

teachers. Two teachers were unfortunately not given any support at all. As to what support was provided by the principal of the school, Figure 4.15 reveals that although all teachers received some support from the principal of the school, the majority, 62%, received lukewarm support from their principal during the WorLD programme. The reasons why support was lukewarm makes interesting reading.

Figure 4.15 shows there had been no support from principals because many of them were ignorant of the role of ICT in education. Lack of resources, which is a combination of lack of funds and technical equipments, also played a significant part in the principals' attitude.

Figure 4.14 Support received by WorLD teachers during programme

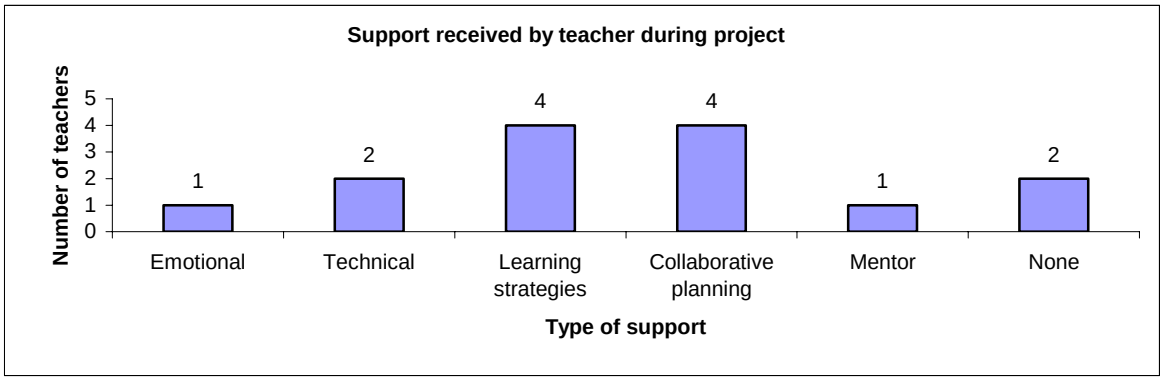


Figure 4. 15 Support received from WorLD school principal

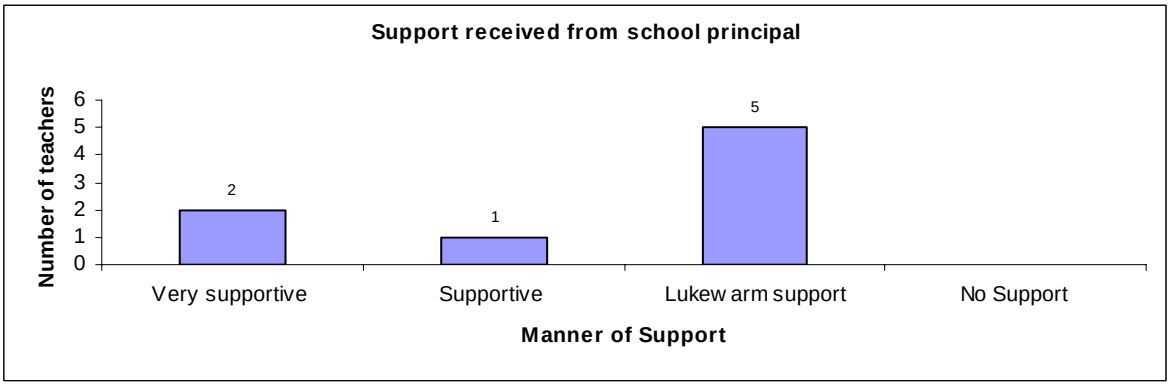


Table 4.23 Reasons for lack of support from school principals N=6

Reasons for lack of support	Absolute number	Percentage response
Ignorance of principal	3	50
Lack of technical resources	2	33
Lack of funds	1	17

Figure 4.14 provides data on support received by WorLD teachers during the project while Figure 4.15 explores the nature of support at the school management level. Table 4.23 provides data explaining the lack of support from school principal.

Table 4.24 outlines relevant questions relating to learners' English Language proficiency and sections in which data is located.

Table 4.24 Learners' English language proficiency level

Question	Data
4 What is the literacy levels of WorLD pupils in terms of reading, accessing and using information in the English language?	**Sect 4.3.4**
How do you rate your ability to read and write without assistance?	Table 4.25
Where students have problems with reading and writing indicate roughly the percentage range that experience such problems.	Figure 4.16
How do you rate your ability to read English texts from books?	Table 4.26
How do you rate your ability to read English texts from computers and the Internet?	Table 4.27
If your reading is not good, what do you think are responsible?	Table 4.28

4.3.4 Lack of proficiency in the English language as a hindrance to the use of ICT in schools

1 Reading and writing generally in WorLD schools

Education in areas in which this research was conducted is mainly provided in the English language, which is not the language spoken in learners' homes. The main source of information on the Internet is also in English. The listed factors, coupled with the fact that many of such schools lacked the resources with which to improve upon the English language,

necessitated an investigation into the possible lack of proficiency in the English language and what its effects were.

Educators were asked among other questions (Table 4.24) about the extent to which their learners were able to read and write without assistance.

Generally, WorLD respondent learners are able to read and write without assistance. Table 4.25 shows that (five, or (62%), of many WorLD learners, are able to read and write without assistance. The majority of educators indicate that, of the learners who are unable to read, serious reading problems prevail among such learners. Refer to Figure 4.16.

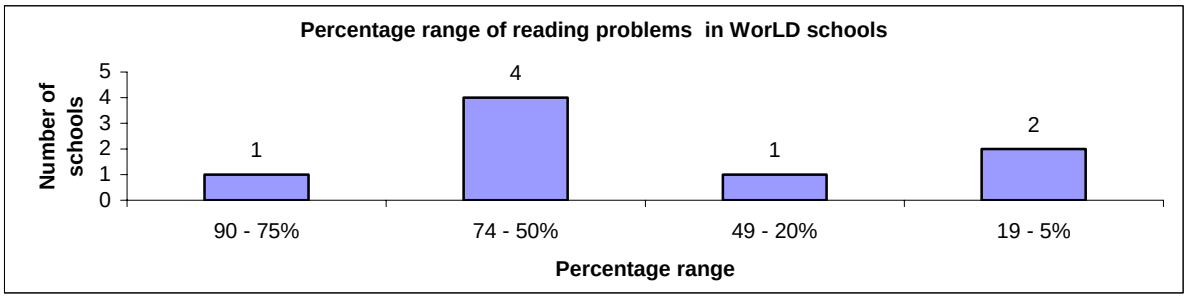
2 Accessing information from the Internet

Educators were asked about the extent to which students were able to read from the Internet. Only 12 % of learners are able to access information from the Internet without assistance. Educators also revealed that half of their learners cannot use the Internet without assistance and only 12 % of them said their learners could use the information on the Internet. Some of the educators (40%) indicated that a lack of resources at learners' homes was responsible for reading problems. Forty percent said that the problem was a lack of resources at the schools.

Table 4.25 Ability to read and write without assistance N=8

Reading and writing	Number of learners	Percentage
Ability to read and write	5	62
Not able to read and write	3	38

Figure 4.16 Range of reading problems in WorLD schools



4.3.4.1 Language proficiency

The ability to read and write in the English Language was more of a learner's problem than an educator's. The study sought to find out from the learners themselves how easy or difficult it was for them to access information in the English language.

The main question put to learners was what was learners' ability to read English texts from books and computers?

The majority (60%) of learners indicated that their ability to read English texts from books was very good (Table 4.26). Most learners 41 (91%) prefer to communicate in English at school. It is, however, a challenge for many (79%) learners to read very well from computers and the Internet (Table 4.27). Many of the respondent learners (56%) according to Table 4.28 attributed lack of excellent reading skills to lack of reading material in their homes.

Table 4.26 Ability to read English texts from books N=45

Rating	Response	Percentage
Excellent	12	27
Very good	15	33
Good	16	36
Fair	2	4

Table 4.27 Learners' ability to read from computers and the Internet N=45

Rating	Response	Percentage
Excellent	2	4
Very good	8	17
Good	15	34
Fair	20	45

Table 4.26 rates learners' ability to read from books, Table 4.27 depicts ability to read from computers and Table 4.28 provides data as to why reading was not as good as expected.

Table 4.28 Why reading was not as good as expected N=18

Reason why reading is fair	Response	Percentage
Lack of reading material at school	2	11
Lack of reading material at home	10	56
Local language as a means of instruction at school	2	11
Local language as a means of communication	4	22

Table 4.29 Utilisation of multimedia by WorLD schools

Question	Data
5 How far can multimedia fill the gap in the utilisation of ICT in South African WorLD schools?	**4.3.5**
How do you think multimedia as a computer product can help WorLD learners to improve upon knowledge and skill?	Table 4.30
Which of the minimum multimedia equipment do you have in your school?	Figure 4.16

Table 4.29 outlines questions relating to the use of multimedia in WorLD schools and the tables figures that provide the data.

4.3.5 Utilization of multimedia

This study investigated the use of multimedia in WorLD schools, as a basis for the future use of a multimedia system to stimulate learners' interest in the use of computers in education. Educators were asked as in Table 4.29 the extent to which multimedia systems were used in WorLD schools.

Only 40% of respondent teachers indicated that they had used multimedia. Concerning the combination used, one respondent (20 %) indicated the use of sound, text and image.
As to how multimedia would assist educators, the majority (75%) stated that multimedia can have a stimulating effect on the learning process at schools.

With regards to access and use of multimedia equipment, Figure 4.16 shows that no school has the entire minimum list of equipment that will support the use of multimedia in WorLD schools. The majority of respondent teachers (66%) indicated that they have the ability to utilize multimedia for teaching purposes with the skills they have acquired through the

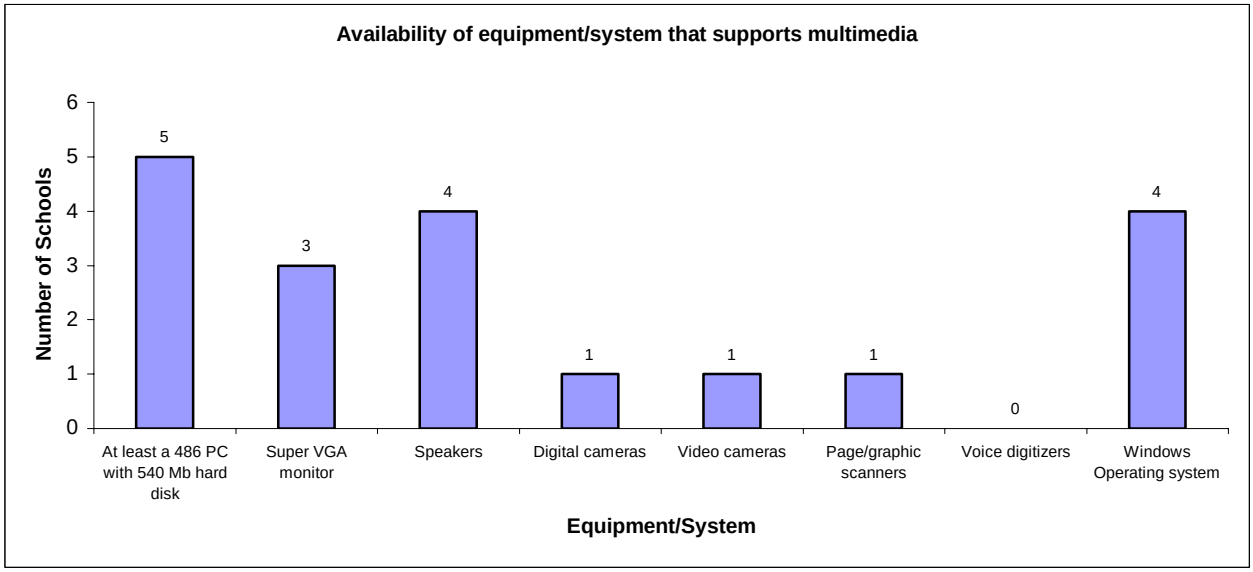
WorLD programme. Teachers who could not use multimedia felt they will need further training in multimedia computer skills.

Table 4.30 How multimedia aids ICT education N=37

Means of multimedia assistance in education	Response	Percentage response
Attract students to practise and acquire skills	5	62
Stimulate learners' learning process	6	75
Make up for learners' inability to read effectively	4	50
Enhance learners' concentration	4	50
Eliminate passive learning	5	62
Equip learners with independent learning habits	4	50
Build in curiosity and the quest for knowledge	5	62
Support learners' oral cultural background	4	50

Table 4.30 provides information on how multimedia aids ICT in education while Figure 4.17 details access to multimedia equipment in WorLD schools.

Figure 4.17 Access to equipment/system that supports multimedia



4.3.5.1 Utilization of multimedia by learners

The study investigated the view of learners regarding the use of multimedia for learning.

Most of them (37, or (82%) have television sets at home and over half of them (52%) watch television very often, while 12% do not watch television at all. A majority of 38 learners (88%) out of 43 prefer sound as an additional medium when using a computer for learning. Learners have a high interest, using multimedia from the equipment that they have at home.

Table 4.31 Benefits and challenges of the WorLD programme

Question	Data
6 What are the benefits and challenges of the WorLD programme?	**Section 4.3.6**
In what way has the programme been of benefit to you?	Table 4.32
In what ways has the programme been of benefit to the school?	Table 4.33
In what ways has the project been a challenge to the project teacher?	Table 4.34
In what ways has the programme been a hindrance to the school?	Table 4.35
What problems do you anticipate in the future with the introduction of computers in your school?	Table 4.36
What suggestions do you have to improve on the WorLD programme?	Table 4.37
How frequently do you use computers for class exercises?	Table 4.38
What collaborative projects were learners involved in?	Table 4.39
In what way do you think a computer as a tool helps you to improve upon your studies?	Table 4.40
What is the most important thing you should do to derive the full benefit from learning with computers?	Table 4.41
What suggestions do you have which will help improve upon the projects in your school?	Table 4.42

Table 4.31 details questions relating to the benefits and challenges of the WorLD programme in South Africa.

4.3.6 Benefits and challenges of the WorLD programme

The study investigated the benefits and challenges that WorLD schools were exposed to.

1 Benefits of the project to WorLD Schools

Educators were asked to select from a list their choices regarding the benefits of the project to them as individuals and to their schools.

Many of the project co-ordinators, (5(62%), in Table 4.32, felt that the WorLD programme enabled them to equip themselves with computer and information skills. Table 4.33, for example, shows that the majority of respondents (75%) were of the opinion that learners had acquired skills which they will be able to utilize in work and further education environments.

Table 4.32 Benefits of WorLD programme to the project co-ordinator N=8

Programme benefit	Response	Percentage
Introduced modern approaches to teaching and learning	3	37
Introduced new insights into education	4	50
Introduced new challenges to my professional development	4	50
Ushered me into the global educational arena	3	37
Enabled me to develop myself as far as the new approach to education is concerned	4	50
Enabled me to equip myself with computer and information skills	5	62

Table 4.33 Benefit of WorLD programme to the school N=8

Benefit to the school	Response	Percentage
School has been put on the information superhighway	2	25
Modern educational equipment has become part of the school's teaching and learning environment	3	37
Learners are able to engage in collaborative learning	4	50
Learners acquire skills which they will be able to utilize in work and further education environments	6	75
Infrastructure and logistics of school has improved	1	12

Table 4.32 shows the benefits WorLD schools have derived from the project coordinators from coordinators perspective while table 4.33 shows benefits to the school.

2 Challenges posed by project to WorLD schools

Educators were asked to select from a list what the challenges regarding the project were to teachers and to their schools.

The majority of respondent educators (75%) felt, as evidenced in Table 4.34, that the programme has given them more work to do and added responsibility, without additional remuneration. Interestingly, only one respondent (12%) cannot perform normal teaching duties. Three (37%) have also experienced conflicts with their principals because of the programme. Half of the respondents (50%) in Table 4.35 saw the WorLD programme as an expensive venture to undertake. Table 4.36 shows that many respondents (75%) see the cost of maintaining the computer system as a major problem in the future.

Table 4.34 Challenges of WorLD programme for teacher/co-ordinator N=8

Challenge	Response	Percentage
More work and added responsibility without additional pay	6	75
Inability to fulfil normal teaching role	1	12
Conflicts with other members of staff	2	25
Un-refunded financial expenditure	1	12
Conflict with school principal	3	37

Table 4.35 Hindrances posed by the WorLD programme N=8

Hindrance	Teacher/co-ordinator
Students spend more time in computer lab, at the expense of examination subjects	3
It is an expensive venture	4
No hindrance	1

Table 4.36 Future problems N=8

Future problems	Teacher/co-ordinator
Cost of maintaining the system may be out of reach of schools/parents	6
Teachers who will not update their knowledge will frustrate the system	3
None	1

Tables 4.34 shows the challenges posed by the WorLD project from the coordinator's

perspective Table 4.35 depicts the challenges and Table 4.36 the future problems.

3 Improving upon the use of computers in schools

Educators were asked to suggest means by which the use of computers in WorLD schools could be improved upon.

Half of the teachers in Table 4.37 were of the view that there was a need to provide more and better computer equipment. The other half felt that more and better technical training was needed. Computer courses as subjects in schools are the least favoured suggestion to improve computer utilization.

Table 4.37 Suggestions to improve upon the use of computers in schools N=8

Suggestion	Response	Percentage
Attract more teachers to the idea	3	37
Provide more and better computer equipment	4	50
Computer courses as subjects in schools	2	25
Schools must be linked to the Internet	3	37
More and better technical training	4	50

4.3.6.1 Use of computers for learning

It is gratifying that the majority of learners (23, or 53%) use computers for class exercises. Table 4.38, however, shows that (21 (47%) of the learners do not use computers at all for class exercises. Table 4.39 shows that the majority (24, or 56%) of learners were involved in at least one collaborative project. In all, a large number, (38 (90%), of respondents indicated that they enjoyed learning at school with computers.

Table 4.38 Frequency of using computers for class exercises N=44

Frequency	Response	Percentage
Very often	15	35
Often	8	18
Not at all	21	47

Table 4.37 provides suggestions to improve upon the use of computers in schools; table 4.38 shows the frequency of use of computers for class exercises and Table 4.39 outlines the number of collaborative projects that learners had undertaken.

Table 4.39 Collaborative projects that learners were involved in N=43

Number of projects	Response	Percentage
One	24	56
Two	3	6
Three	1	3
None	15	35

4.3.6.2 Using computers for education advantages and challenges

The present study elicited from learners, who are the ultimate users of ICTs for education, what, in their view, the advantages and challenges of education with ICTs were.

Learners were asked how the computer could help improve their studies. From a list provided (Table 4.40), the majority (31%) felt that the computer was a tool that helps learning, followed by learners' opinion that computers provide much information. Many learners, 18 (43%), believe that learning computer programming will help them derive the full benefits of learning with computers. Only 10 learners (24%) indicated that more practice of the correct use of applications would help learners to derive full benefits from the computer.

The majority of (31 or 69%) believe that introducing computer studies as a subject will help improve the WorLD programme and the utilization of computers in schools.

Table 4.40 How the computer can help improve learners' studies N=39

How computers help with studies	Response	Percentage response
Help concentrate on learning	3	8
Aid learning	12	31
Communicate and share knowledge	4	10
Provide access to lots of information	8	21
Develop learning skills	5	13
Provide fun while learning	6	15

Not sure	1	2

Table 4.41 Deriving the full benefits from learning with computers N=42

Action	Response	Percentage
Read more about computers	14	33
Learn computer programming	18	43
Practise to learn the correct use of applications	10	24

While Table 4.40 shows how the computer can help improve studies from the learner's perspective, Table 4.41 outlines learners' views of deriving full benefits from learning with computers and Table 4.42 provides suggestions on how to improve upon the WorLD programme.

Table 4.42 Suggestions to help improve the WorLD programme N=45

Suggestion	Response	Percentage
Provide/improve access to computers and the Internet	10	22
Introduce computer studies as a subject	31	69
Sharing ideas with other schools	4	9

Chapter 5

Interpretation of data

5.1 Introduction

Chapter 5 interprets the data presented in Chapter 4. To do this, the researcher generalized the findings of the study sample to the whole population (WorLD participant teachers and learners). It is noted that the small sample size limited the generalisability of the study. Research findings and conclusions drawn are therefore grounded in the extensive literature review undertaken, which emphasises the context in which the study was conducted.

Interpretation entails an analysis of relevant literature and survey data, based upon the research questions that underpin the study. The questions, which are outlined in Chapter 1, are:

- How successful was the training provided to teachers and students in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?
- What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?
- To what extent are the WorLD teachers able to handle school projects, attend to computer systems and teach their normal school lessons?
- What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?
- How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?
- What other factors contribute to the success or failure of the WorLD programme in South Africa?

Lundall and Howell[37] (2000: 2) state that several factors can determine the success or failure of ICT in schools. Some of these factors, which have been the basis of the present study, include networks of connectivity and structured and continuous programmes to train teachers to use the new technology for educational purposes. The two researchers add that ICT should be integrated, from the start, into the teaching and learning process and into the structures of administration and management. In the following section research questions are presented, analysed and compared with related literature.

5.2 How successful was the training provided to teachers and learners in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?

5.2.1 Training of teachers

The training of teachers and learners was a key component of the WorLD programme. Training was important, as it provides not only knowledge, but also the hands-on skills that enable the computer user to meet the programme's objectives. Training was also important because 62 % of participating teachers and learners had never used a computer before the introduction of the programme to their school. Training is therefore a useful benchmark to evaluate the WorLD programme in South Africa.

The findings of this study show that all teachers involved in the WorLD programme were trained (Tables 4.4 and Figure 4.2) and had computers to practise on after training. Most teachers were trained satisfactorily in computer applications and collaborative school projects. The aspect of training found to be most satisfactory was Microsoft Word.

37 Lundall and Howell conducted one of the first most comprehensive studies on ICT in schools in South Africa. The project, entitled *Computers in Schools,* was conducted under the auspices of the Education Policy Unit of the University of the Western Cape and sponsored by the International Development Research Centre (IDRC).

Technical training of teachers, on the other hand, was found to be unsatisfactory. No teacher was trained in the UNIX operating system (Table 4.5 and Figure 4.3). This was a major drawback for the WorLD programme, because the e-mail system used during the programme is based on the UNIX operating system. There was a major need for effective technical training because most of the WorLD computers were refurbished and often non-functional, requiring constant maintenance. The majority of teachers (88%) stated that technical training was critical to be able to maintain the programme. A lack of effective technical training was therefore a serious flaw in the WorLD programme in South Africa. McGhee and Kozma (2001:5) support this finding, namely that, in South Africa, the variety of training support received by teachers was low and the South African national score on the teacher training benchmark was lower than the African and WorLD programme average.

It is noteworthy from this survey (Table 4.6) that many teachers embark on efforts to equip themselves with ICT training. The enthusiasm of the educators for taking private ICT courses bodes well for ICT education in schools in South Africa.

The lack of effective technical training, evidenced by the present study, suggests that teachers and learners will have to familiarise themselves with the technology, as observed by Goldman *et al.* (1999), before settling down to integrate technology with content. This means that the period of integrating ICT into education will take longer than previously expected. Schools may also have to resort to the following suggested solutions (Lundall and Howell 2000: 43), to keep their computer Networks functioning. The solutions include:

- outsourcing some of the work regarding computer networks;
- sharing technical staff with other schools in the area;
- combining certain roles such as technical support staff.

The recommended solutions are critical in situations such as the WorLD programme, where schools use refurbished computers, which often break down. It is also important for school managers using ICT to recognize that the best plans will remain unfulfilled if there is lack of communication between technical and educational functions.

5.2.2 Training of learners

Training of learners has also not been satisfactory. Thirty-six per cent of WorLD learners were not trained at all and 40 per cent of those trained were not trained well enough (Figure 4.7). Learners spent less time being trained than their educators (Figure 4.5, Tables 4.7 and 4.8). Fifty-three per cent of learners were trained for less than three hours a day; all teachers were trained for three hours or more per day. No training was done in database systems or programming skills for learners or teachers (Figure 4.2 and 4.8), even though this had been stressed in the literature (Hawkridge, Jaworski and McMahon 1990:15 and Clyde 1997). No training regarding information skills was provided for learners, even though some teachers had been exposed to such training.

A number of writers (Addo 1999, 2001; Holland 1999; Clyde 1997; Hawkridge, Nahl and Harada 1996 and Kafai and Bates 1997) emphasized that training and skills development for learners are prerequisites for the utilization of computers in education. Clyde (1997: 48) states that to be able to use a computer for educational purposes one requires “the knowledge and skills which are related to the hardware, the system, the software, the information source.”

The findings of the present study show that not enough skill and confidence in using ICT was developed among learners. This is because only seven per cent of learners always had access to a computer to use for practice after training sessions. Thirty-six per cent of learners trained did not have access to computers to practise on after training.

One may argue that WorLD learners would receive continuous training as the programme progressed. The importance of mastering computer skills, stressed by Nahl and Harada (1996) and Kafai and Bates (1997), cannot be over-emphasised. It must also be noted that learners not skilled could be intimidated in their use of computers during the WorLD programme, as was observed by Holland (1999).

Learners would have performed better if they had been trained adequately. Nahl and Harada

(1996), for example, found that students who reported that they were more experienced in the use of computers performed significantly better than those with less experience. Kafai and Bates (1997) conclude that not only do students with more Internet experience dominate the computer interaction process, but those with more computer experience become the teachers of search teams. Nahl and Harada (1996: 203) advise that self-confidence, *which can only be attained through practice with computers*, is an important factor in an information search process.

Findings relating to the implications of lack of adequate learner training are supported by the conclusions of Addo (1999, 2001), in a research project carried out in areas in which some WorLD schools are located. The majority of learners could not use computers effectively for a schools' online environmental education project, because they had not attained the required computer and information retrieval competencies. Sagahyroom (1995), quoted in Addo (2001), states that in Kenya and other developing countries the quality of in-service training was crucial and more important than the nature of the hardware and software used in ICT utilization in education.

The findings of the present study draw a parallel with a similar one conducted by Bot (1999:7), namely that only ten per cent of learners always used computers for learning, and only six per cent of teachers always used the tool for teaching in schools where computers exist. It is hoped that the Educator Development Network online training, embarked upon by SchoolNet South Africa, will be able to provide the clear strategy regarding the training of teachers, and therefore learners, in previously unresourced schools, thereby integrating computers into the teaching and learning process in South Africa.

5.2.3 How far does the existing pedagogy in WorLD schools

support computer-based teaching?

This study has found that, apart from the project team and the research-based teaching methods, WorLD teachers are not familiar with, and do not use, teaching methods that support the use of ICT in education (Figure 4.4). It is also evident that, apart from the research-based teaching method introduced in some of the WorLD schools, teachers have not been trained in most of the methods for the implementation of the programme.

Researchers and writers such as O'Kennedy (1995); Johnson (1995); De Villiers (1998); Karaliotas (1997) & Govender (1999), made it clear that the utilization of ICT in education is possible only with certain teaching models. These models have been analysed in Chapter 2 (Section 2.3.2). The models are:

- the project-based teaching method;
- the student team method;
- the constructivist method;
- the research-based method;
- the system-based method;
- the authentic teaching method.

These models essentially place the learner in the position of initiating and taking charge of the learning process, while the teacher acts as facilitator, mediator or coach.

Bot (1999: 7) found that, in certain provinces of South Africa, only a few learners solve problems on their own, or participate in learning activities. She concludes that teaching methodologies in some provinces still rely on what is termed 'chalk and talk' and "it seems therefore that the methodology required to effect computer-based education, which requires active learner participation, has still a long way to go in its infusion into the education process in South Africa and this needs to be addressed" (Bot 1999: 7).

An evaluation of the WorLD programme in five countries (Chile, Paraguay, Peru, Senegal and Uganda) (Kozma *et al.*, 1999) found that the pedagogical approach was a novelty for

African schools that participated in the programme.

The present study establishes that the existing pedagogy in WorLD schools does not support computer-based teaching. This finding supports an earlier one of Govender (1999), who concludes that South African schoolteachers do not fully understand the concept of utilizing educational technology in schools. Efforts are being made by teachers themselves and the WorLD facilitators to develop the teaching models. Such efforts, though laudable, seem inadequate to address teachers' knowledge and skill gaps in ICT teaching models in South African schools. These findings show that full integration of ICT education into teaching and learning will take some time, not only in the WorLD programme but in other like projects.

According to Lundall and Howell (2000: 46), proponents of quality teacher training believe that it would have been ideal if teachers were trained during professional stages to appreciate the use of computers in their practice and acquire the necessary skills before entering the classroom. Demand on services requiring the use of ICT in schools in its nascent stage makes such training difficult. ICT training therefore seems to favour in-service training, where many teachers acquire only the basic skills, and a little confidence, before going into the class.

Teachers require training that integrates ICT into curricula to design courses that will convey both content and skills. Most importantly, teachers must be able to collaborate and work in teams, across job categories and, increasingly, across borders. Training in the use of ICT, therefore, has to be part of a much richer education for teachers and must address issues of pedagogy in the context of global curriculum change (Lundall and Howell 2000: 46).

The opinion of de Moura Castro (1999) is that developing countries will only reap the benefits of the ideal kind of training many years from now. While developing countries may not be able to afford the ICT priority afforded to teachers in developed countries, the need to include key components into professional in-service training and pre-teacher training is critical.

5.3 What information resources (computer laboratories,

Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?

The present study (Figures 4.11, 4.12 and Table 4.14), shows that most WorLD schools have fewer than the minimum required information resources (computer networked laboratories, Internet access, libraries, multimedia centres) and media teachers necessary to effect computer-based education. It is also evident that the number of functioning computers at WorLD schools, software and, more importantly, the Internet access available during the project, makes it impossible for any effective collaborative projects to take place.

Other technologies, namely television, video, radio and overhead projectors, which support technology-based education, exist in most schools. Seven of the WorLD schools included in this study have computer laboratories. Three schools have media centres, two have media teacher/librarians and two have regular Internet access. None of the sampled schools has a multimedia centre or Network controller (Table 4.11). There is an average of 14 computers per school (Table 4.15). There is an average of five computers with CD-ROM drives (Table 4.16). A number of schools still have computers, with Windows 95 operating systems (Table 18), which Microsoft software vendors no longer support. While many schools have television sets, few schools have slide or data projectors (Figure 4.12). Evidence from this research shows that better-resourced schools often support under-resourced schools in South Africa.

Significantly, only two sampled schools (25%) have regular Internet access. This is

significant, because Internet access is a basic factor of the project, since the objective of the WorLD programme was collaborative online projects with other learners across the world. Also, in 60 per cent of the schools, only one computer was connected to the Internet. This is a serious hindrance for collaborative projects. In one of the schools, the researcher found that the computer connected to the Internet was located in the principal's office, which means that no collaborative project could take place in that school. It is also important to point out that most teachers (62%) do not use information from the Internet for education because the Internet was often unavailable. This finding is no different from the case of Mozambique, where McGhee & Kozma (2001) report that 65 per cent of teachers reported that the lack of Internet access was a major barrier to the implementation of the WorLD programme.

Many authors (Linddell, Masilela, Rapodile & Strydom 1990; Radebe 1997; Gordon 1997, Todd 1997; SAIDE 1998; World Bank 1999 & Addo 1999) state that an adequate school resource environment, with the appropriate logistics, infrastructure and personnel, is a *sine qua non* for good-quality ICT education. A study by the World Bank (Liddell, Masilela, Rapodile & Strydom 1990) suggests that the provision of good educational material is the most cost-effective way of improving educational quality. Addo (1999: 86) found that the adequacy of infrastructure and logistics in schools is conditional to the availability and use of ICT for education. Important elements for utilizing ICT in education are a school computer laboratory, a school library, a school librarian/media teacher, electricity, a telephone and security against theft.

The situation in South Africa (which is gradually improving, as shown by Tables 2.3 and 2.4) is, according to Gordon (1997: 40), schools without walls, teachers without teaching skills

and full knowledge of the subjects they teach, and the need for students to read, write and reason. This has prompted Radebe (1997: 224) to suggest, correctly, that computers did not feature as a factor in education in South Africa. Lundall and Howell (2000: 157) recommend that technologies in education should not be viewed in isolation, but rather seen from the broader societal distribution of resources. Bot (1999:3) observed that, in South Africa, roughly six out of every ten teachers said that a lack of teaching materials considerably limited their teaching. This lack had a serious effect on the morale of teachers nationally.

5.4 To what extent are the WorLD teachers able to handle school projects, attend to computer systems and teach their normal school lessons?

All teachers participating in the WorLD programme were trained to provide ICT education. The present study found that not only were the teachers adequately trained but they rated themselves highly, in terms of ability and confidence. Conversely, however, the study revealed that there was not enough time to utilize the skills acquired in WorLD schools. The teachers rated themselves very low in terms of time to discharge activities relating to WorLD programmes (Tables 4.20 & 4.21).

Unavailability of time to deliver on WorLD programmes is further shown by the fact that 88% of teachers indicated that their involvement in the programme had affected their teaching duties. The feature of unavailability of time to deliver on WorLD programmes is

also reported in other WorLD countries on the African continent by a WorLD country report (McGhee and Kozma 2001). The report submitted that, in Ghana, more than half (54%) of the teachers reported that a lack of time to implement WorLD programmes, given school curriculum requirements and the limited school day, was a major barrier. Similar sentiments relating to lack of time were reported by teachers from almost all the other WorLD countries in Africa, namely Mauritania, South Africa, Senegal and Uganda. A similar finding was made by Tshenye and Perold (2000:15), in reviewing other School ICT projects, in the Eastern Cape and the Northern Province of South Africa, as evidenced in the literature review of this study. Lack of time to deliver on WorLD programmes is further corroborated by a study of the WorLD programme in Chile, Paraguay, Peru, Senegal and Uganda. Kozma *et al*. (1999) found that a large number of teachers mentioned the difficulty of finding time for computer-related activities in their schools.

The effect of the WorLD programme on teachers' normal duties in South Africa is exacerbated by the fact that only minimum support was provided to teachers, not only technically but, worst of all, by the schools' principals, many of whom were ignorant of the programme and the role of ICT in education. Bot (1999:6) confirms teachers' perception of principals as lacking knowledge, and therefore not supporting school ICT projects, in that more than half of the principals lacked the capacity to support their staff.

With the lack of time to deliver on WorLD programmes and their effect on teachers, one would have thought that support from various sources would raise the morale of teachers who were not paid to undertake ICT projects in their schools. More often than not, school ICT projects marginalize the school librarian, who is a critical personnel resource in the integration of any form of information technology into the curriculum. The role of the school library in the WorLD ICT resource model testifies to the crucial role of the school librarian.

According to Lundall and Howell (2000: 44), teachers often do not know what they can do with technology. The tendency was to use ICT simply to automate traditional teaching methods. The need for support to provide a resource base to guide teachers is a critical factor and also for an advisor, who can facilitate group work among teachers so that there is a

sharing of experience and, it is hoped, collaboration around projects. Lundall and Howell (2000) maintain that such practice was prevalent in the developed countries of the United States of America and Britain. They indicate that the process involved the training of **Master Trainers,** who then serve as resources for their colleagues. Lundall and Howell (2000:44) stress that such expertise could be from other staff, such as librarians and computer co-ordinators, or from volunteers from business, the parent body or student groups. In reality it is often these support people, rather than teachers, who supervise the students.
O' Kennedy (1995:7) was correct in his observation that teachers who man computer systems were already overloaded with work and the additional load of being Network manager would be too much to cope with. Maintaining a computer network in a school is an expensive undertaking and it requires a full-time job position.

5.5 What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?

It is evident from the present study that the majority of learners (62%) are able to read (that is, access content in books) and write without assistance (Table 4.28). The study reveals, however, that where reading problems exist, close to two-thirds of learners experience acute reading problems, ranging from 50 to 90% (Figure 4.16). The study also shows that only 12% of learners could access information from the Internet without assistance and only about half of learners could read from the Internet.

Learners' inability to read and access information from the Internet has been attributed to lack of resources at home and at school (Table 4.28). The use of the local language as a means of instruction and communication also plays a significant role in limiting reading and accessing of information which is primarily in the English language (Table 4.28).
Lack of information skills is a major likely reason for the inability to access information from the Internet. This is because no learner has been trained in information skills (Figure 4.8**)**. The non-involvement of the school librarian in the project in schools contributes, in no uncertain terms, to the lack of information skills. It is noted that 89% of learners do not have a computer at home and 80% of those who have, indicate that the computers are not

connected to the Internet. It is therefore not surprising that nearly half, or 47%, of the learners did not use a computer for class exercises during the programme (Table 4.38) and 35% have not been involved in any collaborative project (Table 4.39).

Available literature (Blacquiere 1989; Macdonald 1990; Radebe 1994, 1997; Bouwer 1998) corroborates frustrations experienced by learners in this study about using the English language as a second language for education. The literature not only dwells on the causes, which in many instances are the non-availability of resources at learners' homes and at schools, but it elaborates on the related consequent effects on learners' studies.

Heugh, Siegruhn & Plludelemann (1995:46) and NEPI (1992:72) have made it clear that in a situation where a learner's home language is not the language of learning in a school, the phenomenon of language-cum-cognitive difficulty exacerbates existing learning difficulties. Bouwer (1998:226) notes that research demonstrates that it is virtually crippling to grapple with content in a language inadequately understood, or mastered at the lower competence level of basic interactive communication skills.

The school resource situation, especially library provision (Table 2.3), corroborated in this study by Figures 4.10 and 4.11, justifies the views of Radebe (1997), that where libraries do not exist in schools for pupils to read in the language of instruction, their grasping of content in non-mother-tongue languages is impeded.

This study exposes the lack of resources at learners' homes and the absence of the culture of literacy in many black African families. This creates problems for learners, with parents and guardians unable to assist, as indicated by Bouwer (1998: 226). This situation, according to Blacquiere (1989) and Radebe (1994), manifests itself in many such students' lack of critical thinking skills, even at higher education levels in South Africa.

While Blacquiere (1989:78) concludes that black students at tertiary institutions were unable to read as efficiently as their white peers because they were intellectually malnourished, Radebe (1994:43) found that, in almost all tertiary institutions, the most noticeable concern in students' inadequacies in terms of their preparedness was information illiteracy, which was along racial lines. Both writers attribute the problems to the lack of reading resources in the schools. Many black learners in South Africa no doubt view as incapacitating their poorly developed skills in the language they use for learning (Macdonald 1990:48-49).

This research has shown (Figure 4.16) that the inability of pupils to retrieve information from computers in the WorLD programme is not only a result of scarce reading resource provision but also of lack of information skills. It is logical that if as many as 62% of learners (Table 4.25) can read without assistance, but only 12% can retrieve information from the Internet without assistance (Table 4.27), a possible reason for the low information retrieval situation is lack of information skills.

Accessing content in an information retrieval system is not the only drawback of information seekers who use information retrieval systems which use their second language. Information retrieval performed in the information seeker's second language raises relevant issues such as command of the computer language, command of keywords, the level of education and the level of experience, all of which are lacking among many teachers and learners in schools in South Africa (Radebe 1994).

Nahl and Harada (1996:199) point out that, students often use natural language, which is not compatible with the online catalogue's controlled language. This situation could be a problem for many learners due to lack of information skills. In the present study only 12% of WorLD learners were able to retrieve information from computers without assistance.

A study by Large *et al*., (1994:500) concluded that retrieving information from all databases involves some cognitive activity. These activities are alluded to in section 2.3.4 of the

literature survey of the present study and dovetail with the conclusions of Large *et al*., (1994:500), namely that the process of information retrieval is affected by personal characteristics such as knowledge, experience, information need and the information system being used. These are attributes which are lacking in many schools in South Africa because of the non-provision of information skills in many schools, as has been established by the present study. Radebe (1994:43) raised the concern that, in many tertiary institutions in South Africa, a noticeable concern in students' preparedness was information illiteracy.

Findings of the famous Schools' Network Action Project, dubbed the SNAP-Dragon project of the University of California Los Angeles (UCLA) by Kafai and Bates (1997), are still valid today. Conclusions from the research are that, though the Internet supported free text, students were not able to select good sites for their projects because they used the titles of their project to decide on the sites from which they wanted to retrieve information, instead of keywords. It was also found in the SNAP-Dragon study that using rudiments of Boolean logic enhanced the search skills of students.

The essence of information skills in this study brings into focus the role of the media teacher, presented in section 2.4.3 of the literature survey of this study. According to Kafai and Bates (1997), the success of the SNAP-Dragon project was due to the role played by skilled Library and Information Science (LIS) Interns, who acted as *de facto* librarians during the project. Silva (1995:243) noted that librarians have been key resources in the introduction and success of Internet classroom activities and have been resource persons offering advice, instruction and even technical support to teachers. The number of WorLD schools with media teachers/librarians (Figure 4.9) does not favour the expected role of media teachers in the

project in South Africa. It was not surprising that teachers, many of whom had not used school libraries in the past and were unaware of their functions, were undecided about the qualifications of the additional staff member - whether he or she should be a librarian or a purely technical person each received a 50% response.

This researcher agrees with concerned teachers that, as previously disadvantaged schools and pupils cannot immediately escape the legacy of past educational policies, scars still exist in terms of infrastructure, logistics and the know-how of teachers, which reflect the abilities of students in schools. Such students lack the foundation and resources to undertake rigorous computer-based education. Where the Internet content is not yet available in the local language for easy access, an alternative computer system is required to provide further motivation and to address the problems of illiteracy, inadequate teacher training and low learner motivation found in the WorLD and many other schools in South Africa. Such a system, as suggested by concerned WorLD teachers in KwaZulu-Natal, should be one of computer-based multimedia.

5.6 How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?

This study shows that 40% of WorLD teachers have used a multimedia computer system before. Of the 40%, half have used a combination of text, sound and image. Many of the teachers responded positively to the means by which multimedia can assist in ICT education. The largest response (75%) believes that multimedia will stimulate the learning process of students (Table 4.30)

A number of authors (Gates 1994; Sprainger 1997; Malapile 1996; and de Horowitz 1993) share the response of the majority of WorLD teachers, namely that multimedia has a positive role in ICT education. While Malapile writes from a black African setting that utilization of multimedia will help rekindle in learners the curiosity and the quest for knowledge, Gates (1994:170) observes that multimedia stimulates all learning paths by offering information through pictures, written text, sound animation and video. Many of the teachers (62%) indicated that multimedia will attract students to practise and acquire skills. This, the researcher believes, should be a tonic for the WorLD programme. As the majority of learners (82%) have television sets at home and over half (52%) view television very often, it is certain that a multimedia system will attract learners to ICT-facilitated learning. This is reinforced by the fact that 38% of the learners indicated that they prefer sound as an additional medium in using a computer for learning.

Edelstein (1995:44) emphasises the fact that multimedia products are expensive. Download time, which is the time taken to convert the data in computer format to information accessible to the user, can be frustratingly long, depending upon the quality of the equipment being used (DiNucci, Giuidice and Stiles 1998:24). Edelstein (1995:44) categorised a set of the minimum equipment requirements to determine the applicability of a multimedia system.

The present study has found that no WorLD school has all the minimum requirements to utilise multimedia (Figure 4.16.). The majority of teachers (66%) have, however, indicated that with the skills they have acquired they will be able to utilise multimedia for teaching purposes. Teachers who feel they cannot utilise multimedia for educational purposes indicated that they will require further training in technical skills that relate to multimedia.

5.7 What other factors contribute to the success or failure of the WorLD programme in South Africa?

5.7.1 Success of the WorLD programme

The World Links for Development (WorLD) Programme is one of the flagship projects of SchoolNet South Africa. The organization is engaged in bridging the gap between policy and the implementation of ICT education in South Africa. It is also addressing the equitable utilization of ICT for teaching and learning as one of its objectives. The WorLD programme therefore focused solely on the previously non-resourced schools, which had never used computers for education.

Sixty-two percent of the teachers (Table 4.32) felt that the programme had equipped them with computer and information skills, which, according to Clyde (1997:48), are the skills required for living beyond mere survival in an information economy. Half of the teachers felt that the programme had not only introduced new insights into education for them but enabled them to develop themselves as far as new approaches to education were concerned. Teachers reported similar comments across the African continent, according to McGhee and Kozma (2001).

Almost two-thirds of teachers (62%) felt that the school had provided learners with skills which they will utilize in work situations and further education. Lundall and Howell (2000: 92) found similar sentiments with the majority of teachers. In effect, enthusiasm of the teachers in applying ICT to education related only to the social and direct benefits to teachers and learners in the previously non-resourced areas in South Africa. The issue of integrating ICT into education has yet to catch up with learners and teachers.

Thirty-one percent of learners indicated that the computer was a tool that aids the learning process. Twenty-one percent felt that it provided access to much information and 15% indicated that it was a tool that provided fun during the learning process (Table 4.40) Sixty-eight percent felt that there was a need to introduce the study of computer programming in order to derive the full benefits of learning with computers

5.7.2 Challenges facing the WorLD programme in South Africa

The WorLD programme presented a number of challenges, which in certain cases could have contributed to a near failure to achieve the programme's objectives in South Africa.

5.7.2.1 Training

Training of teachers and learners was a key component of the WorLD programme. Although teachers were adequately trained, transfer of knowledge and skills to learners who required such knowledge and skills to make effective project objectives could not take place, because of lack of capacity in terms of time. It was not surprising that the majority of teachers indicated that the programme had provided them with more work and added responsibility. Many said that the programme had caused conflict between them and their school principals.

5.7.2.2 Access to computers and Internet Connectivity

The present study found that access to working computers was a major problem. An average of only 14 working computers to a WorLD school is considered a limited number. The study shows that as many as 33 learners on average per school (Table 3.3) took part in the project, which means that there were more than two learners to a computer. Lack of adequate hardware was reported as a major barrier to the WorLD programme in the South African Country Report (McGhee and Kozma: 2001). In addition to the number of persons per computer and inadequacy of hardware was the question of Internet availability, which was only 25%.

Half of the teachers suggested that the provision of more and better computer equipment and more and better technical training would improve the use of computers for education in the WorLD programme (Table 4.37). This reinforces the point made earlier concerning refurbished computers.

Sixty-nine percent of learners (Table 4.42) believe that the introduction of computer studies as a subject in schools will help improve the rate of utilization of the computer as a learning tool and hence improve the WorLD programme. It is supposed that the introduction of computer studies will make provision for a dedicated teacher and capacity in terms of time and personnel for computer-related subjects and issues, not only in WorLD schools but also in the future integration of ICT in education in South Africa.

5.7.2.3 Cost

Cost was not investigated in this study. It was, however, an issue that impinged on the immediate utilization and sustainability of the programme. Half (50%) of the teachers indicated that the programme was an expensive venture to be undertaken. Sixty-two percent of them concluded that the cost of maintaining the computer system may be out of the reach of the school in the future. Telephone costs were reported as a major barrier to the implementation of the WorLD programme in Senegal.

Lundall and Howell (2000) point out that cost, and particularly the cost of Internet access, has been cited as the most important factor for limiting Internet use in schools in South Africa. Table 4.36 draws attention to cost as an important phenomenon. As pointed out in James (2001:105), the non-availability of financial sustainability models in “soft” funding projects from grants provided by funding agencies render the medium- to long-term future of projects very fragile and with limited social impact. In this case evidence suggests that financial problems were visible in the short-term period of the project.

5.8 Summary

Chapter 5 provided a detailed analysis of the research data and literature available to determine the findings of the study. The study established that, whereas WorLD teachers were adequately trained to deliver ICT education, technical and learner training was not adequate. It was also established that the existing pedagogy, as well as existing information resources in WorLD schools, do not support ICT education. The study found that, in spite of adequate teacher training, there was not enough time to implement the skills gained by teachers in the WorLD programme.

Learners did not experience problems with reading or accessing content in WorLD schools. Nevertheless, they were unable to access information from computers for collaborative projects because they lacked the skills to do so. While multimedia can be used effectively to

enhance ICT education, most schools do not have the required equipment to use multimedia.

Finally, although the cost of computer systems was not a feature of this study, it was observed as a major factor in utilizing ICT in the WorLD programme. The project may not be sustained if the cost factor is not given attention and resolved.

Chapter 6

Summary of the findings of the study, conclusions and recommendations

6.1 Introduction

This chapter presents a summary of findings and conclusions drawn from the study. It proposes recommendations for action and areas for further study, to improve upon utilization of ICT in education in the WorLD schools and other ICT in education projects in South Africa, in particular, and Africa, in general. The findings and conclusions are generalized to the WorLD study population of learners and educators.

The purpose of this study was to investigate the utilization of ICT in WorLD programme schools in South Africa and to provide strategies aimed at achieving or improving utilization to achieve school ICT educational outcomes and impact (Figure 6.1). The following research questions guided the study:

- How successful was the training provided to teachers and students in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?
- What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?
- To what extent are South African computer teachers able to handle school computer projects, attend to computer systems and attend to their normal school lessons?
- How far does the existing pedagogy in WorLD schools support computer-based teaching?
- What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?
- How far can multimedia fill the gap in utilizing ICT in South African WorLD schools?
- What other factors contribute to the success or failure of the WorLD programme in South Africa?

6.2 Summary of findings

This section presents a summary of findings established by this study from the previous five chapters, with respect to the purpose, objectives and the main research questions that guided the study. Insight from the literature is also presented.

6.2.1 From the literature it has been established that:

1. Information and communication technology (ICT) was not only an educational tool but also a driving mechanism for socioeconomic development in a globalizing knowledge economy.
2. ICTs can contribute to improving the quality and delivery of education
3. ICT utilization in education and school networking is not new to schools in South Africa. Nevertheless, a large majority of schools previously excluded have no access to these modern educational tools.
4. ICT in education is new to education administrators, educators and learners in previously excluded schools, especially in the rural areas of South Africa.
5. An organization called SchoolNet South Africa is in place to integrate national ICTs policy in the education system of South Africa.
6. The World Links for development (WorLD) programme is an attempt by the World Bank to provide ICT education for the future generation of developing countries, including South Africa, to enable them to sustain their economies.
7. It is imperative that evaluation studies such as this are conducted to provide information that will guide stakeholders to move to extend access to more schools and improve upon utilization.

After a detailed and an elaborate investigation of the World Links for development programme in South Africa, this study established the following:

6.2.2 Training of educators and learners

1. Educators in the WorLD schools in South Africa have been adequately trained in

computer application programmes and collaborative school projects, but not in database systems and programming.

2. Educators were satisfied with the time allocated to the training and each teacher had a computer to practise skills acquired during training.
3. The study found that technical training of educators was unsatisfactory and no teacher was trained in programming and the UNIX operating system.
4. Lack of training in the UNIX operating system is considered a handicap for the project, because the E-mail system was based on the UNIX operating system.
5. Lack of technical training for educators cast a shadow on the success of the programme, because WorLD computers were predominantly refurbished and required constant maintenance.
6. Lack of technical training prevented the programme from proceeding to the levels of integrating ICTs into the teaching and learning process and schools would have to outsource the technical functions of ICT to private service providers, which have high cost implications for schools in impoverished environments.
7. Many teachers in WorLD schools in South Africa are doing their best to equip themselves, on their own, with IT knowledge and skills. Teachers' enthusiasm and zeal in embarking on private IT tuition bodes well for the WorLD project, in particular, and for ICT utilization in education in South Africa as a whole.
8. Training of learners was found to be unsatisfactory. More than a third of WorLD learners had not been trained at all and close to half of those trained were not trained well enough. Learners spent less time during training than teachers did.
9. No training had been provided to learners in database systems, programming and information skills.
10. Training of learners was unsatisfactory because teachers did not have enough time outside their normal duties to deliver the training, as they had to attend to their normal teaching duties.
11. WorLD learners in South Africa had not acquired sufficient skill and confidence in using ICT during the project pilot phase, as only a limited number had access to a computer to practise after training sessions.

6.2.3 ICT pedagogy in WorLD schools

1. Apart from the project team and research-based teaching methods, WorLD educators in South Africa are not familiar with or trained in, nor do they use, teaching methods that support the utilization of ICT in education.
2. Educators have not been trained in the majority of the required pedagogical methods for the implementation of the WorLD project itself.
3. The existing pedagogy in WorLD schools during the pilot phase (1997-2000) did not support computer-based teaching, for the following reasons:
   - The previous professional training of teachers which did not recognize modern pedagogies.
   - Prevailing in-service training does not integrate ICT into curricula design and training.
   - The lack of cognitive resource-based learning environments, including the non-involvement of media teachers in the integration of ICT into the curriculum.
   - The preponderance of a *chalk and talk* pedagogy found to be prevalent in rural South African schools where this study was conducted and where cognitive education resources, such as libraries and computer laboratories, are lacking.

6.2.4 School Information resources

1. Though a strong correlation exists between the technology and other resources for teaching and learning, recommended as pre-requisites by the resource model (Appendix 1), the majority of WorLD schools in South Africa during the project phase had less than the minimum requirements of the pre-requisite information resources (computer networked laboratories, Internet access, libraries/media centres, media teachers and multimedia centres).

2. The marginalization of the role of the school librarian creates difficulties in the integration of ICTs into the curriculum in schools.
3. The number of functioning computers at WorLD schools and Internet access during

the project made it impossible for effective collaborative projects to take place.

4. Other technology - television, video machines, radio and overhead projectors - which support technology-based education, exists in the majority of the schools.
5. The information resource situation in previously un-resourced rural South African schools, in general, though gradually improving, were not adequate to support ICT education and therefore needed massive improvement.

6.2.5 Teachers' capacity to deliver on WorLD projects

1. There was hardly time for educators to deliver on WorLD projects, even though teachers had acquired the skills and confidence.
2. Project activities affect educators' normal teaching duties negatively, because they were not full-time and dedicated and were engaged in the projects on a voluntary basis.

6.2.6 Literacy effect of the WorLD project on learners

1. The majority of WorLD learners could read, that is access the content from books, and write without assistance.
2. Reading problems were, however, acute where they existed.
3. Only a few learners could access information from the Internet without assistance and just about half of them were able to read from the Internet.
4. Learners' inability to read and access information from the Internet is attributed to the lack of resources at the learners' homes and schools.
5. The use of the local language as a means of instruction and communication also played a significant role in limiting reading and accessing of information from the Internet, which uses the English language.
6. Lack of information skills were identified as the major barrier to the ability of learners to access and use information from the Internet.

6.2.7 Multimedia filling the gaps

Even though many WorLD educators and learners have used a multimedia computer system and are very positive that the tool can assist in ICT education, none of the schools had the minimum ICT requirements to utilise such a system.

6.2.8 Success factors

1. Educators and learners in WorLD schools have been equipped with new skills and modern insights into education.
2. Learners have been equipped with skills which they will utilize in work situations and further education.

6.2.9 Challenge factors

1. The number of functioning computers in a WorLD school is considered a serious limitation to the project.
2. Lack of Internet access, resulting in inability to engage in collaborative projects and inability to integrate ICT into the educational system, meant that the project did not achieve a major outcome.
3. Cost is an issue that seriously impinged on the success and sustainability of the project.
4. The project was found to be an expensive venture and maintaining the computer system may be out of the reach of the schools in the future.

6.3 Conclusions

The conclusions of this study are based on the findings of the study and project outcomes from expectations of the WorLD evaluation research model (Figure 6.1). Achievements and failures, with respect to the expected outcomes and impact of the project, are:

6.3.1 Achievements

The study concludes that the World Links for development programme in South Africa achieved limited outcomes and impact on ICT education in schools during the project pilot phase between 1997 and 2000. This was because educators who were project co-ordinators in the schools did not have time outside their normal working schedules, they did not have the required technical skills to repair frequently non-functional computers, the Internet was not available in the majority of the schools and support from both school administration and the project was minimal. Nevertheless, modern insights into education have been gained and new approaches to education developed in the schools, as well as new challenges. Educators have been provided with additional skills, including the ability to utilise many computer application programs.

Marginal outcomes were recorded in certain areas of the project. International collaboration with peer learners, for example, were developed in the few schools that had Internet access and engaged in collaborative projects. Access to the World's maze of information was available at schools with Internet access. Teachers utilized a few new methods for teaching, at least during the WorLD projects.

6.3.2 Failures

On the whole, however, the project failed to achieve a great proportion of its outcomes and impact (Figure 6.1), which include the following:

6.3.2.1 Learners skilled in computer application systems

This study concludes that South African WorLD learners, the ultimate beneficiaries of the project, had not benefited from the skills acquired by the teachers. This was against the backdrop that 77% of them have never been trained to use a computer and 89% did not have a computer at home. It would be fair to say that less time and effort than required was

devoted to the training of learners by educators for the WorLD project. Learners were not skilled in the computer application systems because educators did not have the time beyond their normal teaching schedules to teach them the systems.

6.3.2.2 Teachers' use of technical skills

It is conclusive from this study that WorLD teachers could not use technical skills effectively because they had not been trained sufficiently and there was no time for them to utilize whatever skills they had acquired through their own training efforts.

6.3.2.3 Teachers' use of Internet resources for education

Though teachers had acquired skills for the use of the Internet they could not utilize the Internet for education purposes because the Internet was often not available. This study therefore concludes that the Internet facility provided during the WorLD project in South Africa was unreliable and did not support the programme during the pilot phase of 1997-2000.

6.3.2.4 Teachers utilize new methods for teaching

The study showed that teachers were not able to effectively utilize new methods for teaching in WorLD schools, because many were not trained in and familiar with the majority of the new methods and there was hardly enough time and Internet access to utilize any new methods that they had acquired.

6.3.2.5 Learners use of Internet resources

South African WorLD learners' use of Internet resources during the project pilot phase was very limited and non-effective. This is because of the lack of training in information skills, the Internet often not being available and educators having little time to teach, guide and supervise learners. This study concurs with the SAIDE Report (1998), that, unless resource

backlogs in schools were addressed, programmes seeking to exploit and implement ICT projects would be marginal or have no effect. Again, it would have been ideal for the project to utilize Internet-based compact discs (CDs) during the project pilot phase, as was done in Uganda, or as is the case with SchoolNet South Africa Educators' Development Network (EDN) CD. The present study argues that the non-involvement of the school media teacher where they existed in the project frustrated the use of the Internet because the use of the Internet is the domain of the school library media teacher.

6.3.2.6 Learners' interactive, collaborative and communication skills developed

This study concludes that South African WorLD learners interacted only to a very minimal degree with other learners across the globe, as was required by the project, and therefore did not benefit fully from collaborative and communication skills, because the Internet was often not available in schools and teachers did not have the time to supervise and assist the learners.

6.3.2.7 Integration of ICT into curriculum

Throughout this study, it has become apparent that one of the most important objectives of the WorLD project, which is to integrate ICT into the curriculum, was not achieved during the project pilot phase. Though the literature has made it abundantly clear that it was the aspect of ICT utilization in education that would take a long time to be achieved, South African WorLD educators and learners believe that the introduction of computer studies as a subject in the schools will help improve ICT integration into the curriculum. It is supposed that the introduction of computer studies will make provision for a full-time (dedicated) teacher and provide capacity in terms of time and personnel for ICT education in start-up schools such as the WorLD schools.

6.3.2.8 Learners engage in collaborative projects

This study showed that learners in the WorLD project were not able to fully utilize ICT for collaborative projects. Data provided by this study indicated that, although the majority of them were involved in at least one collaborative project, only 6% were involved in two projects and as few as 3% in three projects, during the pilot phase. The Internet was often not

available; in any case, to support collaborative projects and teachers did not have the time to help learners in the process.

6.3.2.9 Learners think through school projects and develop knowledge

The literature and available research data has shown that the general school resource and pedagogical situation in WorLD schools did not provide the requisite environment for learners to effectively think through school projects. The study also concludes that the impact of the project on schools has been minimal, given the dire resource situation, as well as the educator capacity situation in which the projects have been carried out, especially the lack of time and technical skills of the teachers. Learners' ability to think through school projects and develop their own knowledge was not introduced by computers. The non-involvement of school librarians, where they existed in the project, is again seen as a setback to the project.

6.3.2.10 Learners' critical thinking skills developed

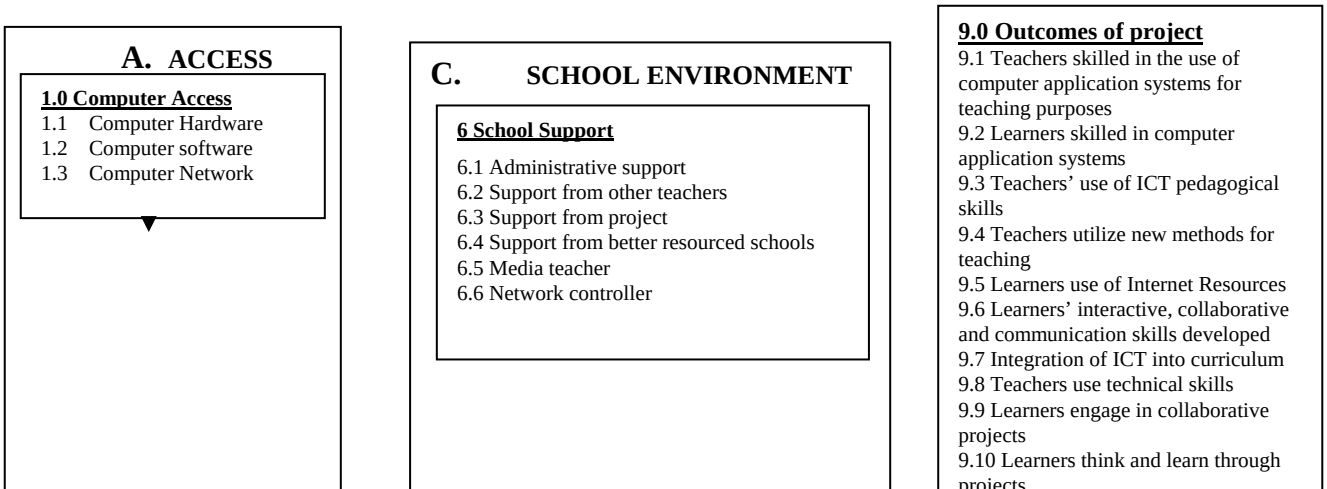
As learners think through their own research projects and use their own acquired information they develop their own knowledge and a critical thinking skills process. This has not been fully developed in this project, in view of the information resource situation in schools and the lack of regular Internet access.

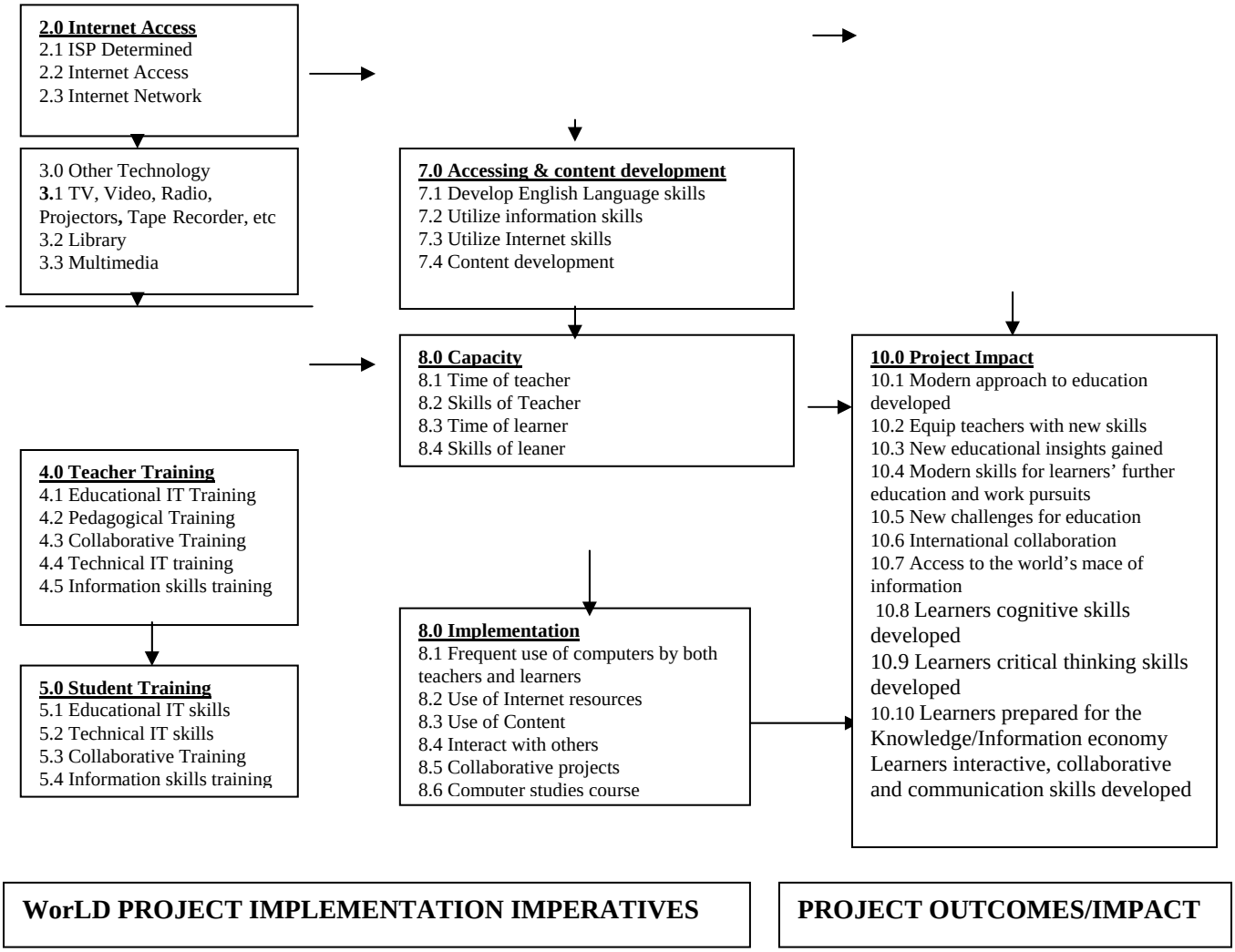
6.3.2.11 Learners prepare for knowledge/information age economy

Ultimately, the aim of the WorLD project was to prepare learners in developing countries to conveniently integrate into the knowledge and information age economy, where prompt access to information or knowledge enables individuals to play worthwhile roles in life. This study concludes that such an aim though very laudable was not achieved because the project did not make adequate provision for the educator and the resource environment. An evaluation model upon which this study was based is presented in Figure 6.1.

Figure 6.1

An Evaluation Model of The WorLD Project in South Africa





This model details an implementation process of the WorLD project hence this study. It begins with the two principal issues that form the core of the study, namely, access to computers and training of educators and learners to utilize ICTs for education. The school environment is an important factor, without which implementation and use of ICTs could not be attained. The model, adapted from the World Bank (McGhee 2000) can be adopted for the evaluation of other ICTs projects not only in South Africa but other African countries.

6.4 Recommendations

The WorLD projects were located in rural South African schools, where the bulk of its population resides, to address the rural-urban ICT education divide and provide useful lessons for a future national roll-out. It has become apparent throughout this study that lessons have been learnt and useful insights gained to guide present and future start-up ICT education projects and processes. The recommendations presented relate to the specific

findings of the study and to a broader policy perspective.

This study recommends that, for an ICT education project to be effective in rural areas in South Africa and the rest of Africa, and to meet its outcomes and make the required impact, the following are crucial:

6.4.1 Training

A national technical ICT strategy for educators must be developed, similar to the SchoolNet South Africa Educators' Development Network (EDN) pedagogical course, being run at the time of writing. Teachers will proceed to an online technical training from the limited face-to-face training they had acquired. It is argued that the limited technical training provided during the WorLD project and what is currently being pursued by SchoolNet South Africa does not provide educators with the knowledge to be able to engage the helpdesk with the right information and confidence to solve hardware and network problems. This situation leads to many school computer laboratories not being able to function to their optimum level, more especially as many schools currently do not have network administrators.

It is recommended that the WorLD project, or the start-up process of any school ICT project in Africa, should make provision for a highly motivated and dedicated ICT teacher, who should be adequately trained in pedagogical, as well as technical skills, to train learners and other teachers on the staff and be able to attain project outcomes in a particular school.

This study recommends that teachers are supported with face to face-to face training in the use of a particular ICT until they are familiar with it, master its use, develop the required confidence and can use it on their own. Taking into account how teachers were trained in the past, it will be difficult to embark on an online training course to master application or technical skills where the rudiments have not been achieved. Nevertheless, this study endorses the new online pedagogy course being provided by SchoolNet South Africa.

Teachers viewed school ICT projects in this study as additional, unremunerated duties. It is therefore important to involve district education officials, school principals, heads of departments, participating teachers and the community in project design and implementation. With such an holistic and inclusive approach schools will be more receptive to ICT use and development, because the education managers in the districts with the communities endorsed the projects. Ntutule & Perold (2001) found that principals who were originally cautious of ICT projects became more co-operative once they knew regional and district managers were involved. With the involvement of school managers and administrators in the planning and implementation of school ICT projects teachers will be able to see the urgency and adjust their time to accommodate the project. They will then not be in danger of losing their jobs. Closely related to this is the recommendation that ICTs in schools must be integrated with the school administration, which requires that the principal and administrative clerk of the school must be trained. Perhaps the model of the WorLD project in Zimbabwe, where project teachers were relieved of all teaching responsibilities and made to manage school tele-centres to serve as school and community information and education centres, could be explored and implemented in South Africa, as well as the rest of Africa.

It is recommended that all persons intending to become teachers should be provided with a pre-service ICT education training in universities and colleges, before they are certified as professional educators. Teachers will be more skilled and confident in a pre-service training environment and it will be less expensive to train them than when they are in service.

6.4.2 The provision of information resources to schools

This study has demonstrated that for a successful ICT education to take place in schools a strong correlation should exist between ICT and other information resources. It is recommended that information resources should not be seen in isolation, but from a holistic perspective. The WorLD information resource model in Appendix 1 must be strictly adhered to. School librarians should be involved in ICT projects at their schools and trained in Internet information retrieval skills, so that they can guide learners with information retrieval and can use library resources to augment their knowledge.

To avoid “dumping”, a national policy on refurbished computers is recommended, to standardise computers donated to schools. Again, the school library and media teacher is a prerequisite, not only to the utilization of ICT in education but, most importantly, for the integration of ICT into the teaching and learning process. As ICT projects cannot take place in schools without the Internet, it is recommended that the cost of Internet access, which is predominantly the cost of a telephone line, be fully explored and discussed with role-players during the project planning phase before the start-up process, to avoid accumulated phone bills and the cessation of Internet access. It is also ideal for school ICT projects to utilize Internet-based compact discs (CDs) during the training phase of projects. Such an approach would not incur Internet costs, but assist in providing the required skills. The current Internet access rate of 50% for schools in South Africa bodes well for school ICT projects and must be examined for other African countries. What is, however, required is that the cost of the telephone helpdesk service be halved, if not eliminated altogether.

6.4.3 Government school ICT policy

Teachers, schools and the entire country of South Africa stand to benefit from a national mission statement on the introduction of ICT to schools. This statement should come from government, along with financial policy support for the use of new technologies and strategic partnerships with industry, the private sector and non-governmental organizations (NGOs). Policy direction is required to strategically incorporate ICT into education and to encourage teachers to use new technologies in their classrooms, nationally and especially in the rural areas of South Africa. A national ICT policy framework for education should aim at:

- Mobilising human and material resources nationally, with incentives for rural schools
- Addressing a holistic school information resource situation, to include school libraries, media teachers and multimedia centres
- Developing human resources among educators in ICT and management skills
- Exploring and deploying appropriate, affordable, but non-specific, ICT for schools in rural South Africa and Africa, including satellite technology in wired, wireless or a combination of wireless and wired network environments.
- Rural infrastructure development, with regards to telecommunication and electricity
- Addressing issues relating to universal access and service in Africa

- Providing pre-service ICT technical and pedagogical training to all teachers
- Determining a model that will integrate the school as a learning centre with a community information resource.

The present study recommends that the South African Department of Education utilises a model which will involve the school community to augment the provision of computers by the WorLD and other projects and be thoroughly discussed during the project-planning phase. Provincial efforts such as "Gauteng online", of the Gauteng Provincial Department of Education and the Khanya project of the Western Cape Department of Education[38], are commended and must be emulated by other provinces.

6.4.4 Integration of ICT into school curriculum

The integration of ICT into the curriculum is a complex and long-term process. It involves the availability of a full-time, well-trained, experienced and motivated educator and the involvement of the school library media teacher. The present work recommends the need to introduce computer studies at all stages of the curriculum and computer science and programming at senior level. They should be examinable subjects so that learners can derive the full benefits of being educated with computers in schools.

The integration programme must create mechanisms and structures to support teacher and learner collaboration after both have mastered sufficient skills. This should be an effort which should create more time for teachers to plan together and train and collaborate in the integration of ICT across disciplines (Ntutule & Perold 2001). Integration of ICTs into the curriculum can only begin if there is less emphasis on the passing of examinations and the pressure of teachers' work is decreased.

It is recommended that content usage and the integration of ICT into the curriculum should begin with the mastering of applications programmes and the application of information literacy, which should then be followed by questioning skills. The spirit of enquiry, devoid of

38 Information on these initiatives can be found at: http://www.schoolnet.school.za

a *chalk and talk* approach to education in African communities, must be inculcated in learners and the learning process. Skills gained from this inquiring approach can be used in specific projects such as collaboratory projects with learners in subjects such as mathematics, English, science and social science.

The idea of integrating ICT into teaching and learning must be conducted in such a manner that educators and learners see mastering of application programmes and learning of specific subjects as one complementing the other. As seen during the WorLD project, learners and educators had regarded themselves as benefiting from computer skills for use in other aspects of life and not for education purposes. ICT in the curriculum must be combined with educators' administration duties in mind. For example, using Excel for designing school and class timetables or mark sheets, which are used by teachers in their day-to-day education activities. It also fosters the holistic approach mentioned earlier.

Care must be taken when recruiting teacher trainers for in-service training, as non-educationists would not be conversant with teachers' roles and would relate training to other uses of ICT, thus missing the holistic approach. A mechanism must be put in place for monitoring the uses to which educators put the skills they had acquired. The tendency to use ICT for other purposes provided grounds and temptation for teachers to leave the classrooms for other services, where their demand is high. In the present study, at least one teacher mentioned pursuing other goals outside teaching, after gaining ICT skills.
The present study recommends that the programme managers educate WorLD school principals on the role of ICT in education, as motivated teachers who see their roles being appreciated by principals will, in turn, encourage their learners. This is critical in school ICT projects, which are considered as added-on jobs, with no extra remuneration. Of course, if these issues are addressed during the project planning stages, such problems will not arise.

6.4.5 Imperatives for the success of the project

It is recommended that a thorough base scan should precede school ICT projects. This should be discussed with schools and followed by a thorough needs analysis of the educators. Learners should show some signs of cognitive learning skills in a library/media centre before

computers are introduced into the schools. In many instances this was not the case in selected WorLD schools. Media teachers did not, therefore, form part of the project.

Establishing a sense of community, by using electronic mail (e-mail) (asynchronous communication) and “chat rooms” (synchronous communication systems), are essential and considered an important social outcome of ICT implementation programmes in schools. ICT will encourage both educators and learners unconsciously to learn skills fast. Care should, however, be taken to provide guidance on issues of interest concerning communication, to foster focus-group discussions.

It is recommended that steps be taken to consolidate project outcomes and successes prior to expansion in subjects or to the community. Issues such as the following are crucial:

- The adequacy of ICT infrastructure at the school
- Technical support from the school and from outside sources
- School management support
- Consolidated and continuous training
- Practising of new skills
- Motivation of participants

6.5 Recommendations for further studies

The focus of this study has been the monitoring and evaluation components of the WorLD programme. Determining the success or failure of a project and hence value for money is crucial to that project. It is therefore recommended that the evaluation model proposed by this study be tested to prove its efficacy, with regards to evaluating ICT education projects being sponsored by schools, communities, funders and governments.

It is also recommended that, with the advancement of technology and the emergence of nascent ICT products that could foster more affordable and sustainable computer access and connectivity, research be conducted into the use of new technologies such as wireless,

satellite and open-source software in schools in South Africa and in the rural areas in general.

It was indicated in the literature review for this study that one of the most formidable challenges to the use of ICTs in developing countries, especially in Africa, was the challenge of ownership of knowledge and knowledge products. This study recommends that research be conducted to establish the extent to which Africans are being alienated from their way of life or otherwise because of their lack of control of the knowledge systems and products that are being used in the name of globalisation and a knowledge economy. Perhaps the question to investigate is, to what extent are African communities, and particularly those in South Africa, thinking global and acting local?

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Chapter 5

Interpretation of data

5.1 Introduction

Chapter 5 interprets the data presented in Chapter 4. To do this, the researcher generalized the findings of the study sample to the whole population (WorLD participant teachers and learners). It is noted that the small sample size limited the generalisability of the study. Research findings and conclusions drawn are therefore grounded in the extensive literature review undertaken, which emphasises the context in which the study was conducted.

Interpretation entails an analysis of relevant literature and survey data, based upon the research questions that underpin the study. The questions, which are outlined in Chapter 1, are:

- How successful was the training provided to teachers and students in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?
- What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?
- To what extent are the WorLD teachers able to handle school projects, attend to computer systems and teach their normal school lessons?
- What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?
- How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?
- What other factors contribute to the success or failure of the WorLD programme in South Africa?

Lundall and Howell[37] (2000: 2) state that several factors can determine the success or failure of ICT in schools. Some of these factors, which have been the basis of the present study, include networks of connectivity and structured and continuous programmes to train teachers to use the new technology for educational purposes. The two researchers add that ICT should be integrated, from the start, into the teaching and learning process and into the structures of administration and management. In the following section research questions are presented, analysed and compared with related literature.

5.2 How successful was the training provided to teachers and learners in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?

5.2.1 Training of teachers

The training of teachers and learners was a key component of the WorLD programme. Training was important, as it provides not only knowledge, but also the hands-on skills that enable the computer user to meet the programme's objectives. Training was also important because 62 % of participating teachers and learners had never used a computer before the introduction of the programme to their school. Training is therefore a useful benchmark to evaluate the WorLD programme in South Africa.

The findings of this study show that all teachers involved in the WorLD programme were trained (Tables 4.4 and Figure 4.2) and had computers to practise on after training. Most teachers were trained satisfactorily in computer applications and collaborative school projects. The aspect of training found to be most satisfactory was Microsoft Word.

37 Lundall and Howell conducted one of the first most comprehensive studies on ICT in schools in South Africa. The project, entitled *Computers in Schools,* was conducted under the auspices of the Education Policy Unit of the University of the Western Cape and sponsored by the International Development Research Centre (IDRC).

Technical training of teachers, on the other hand, was found to be unsatisfactory. No teacher was trained in the UNIX operating system (Table 4.5 and Figure 4.3). This was a major drawback for the WorLD programme, because the e-mail system used during the programme is based on the UNIX operating system. There was a major need for effective technical training because most of the WorLD computers were refurbished and often non-functional, requiring constant maintenance. The majority of teachers (88%) stated that technical training was critical to be able to maintain the programme. A lack of effective technical training was therefore a serious flaw in the WorLD programme in South Africa. McGhee and Kozma (2001:5) support this finding, namely that, in South Africa, the variety of training support received by teachers was low and the South African national score on the teacher training benchmark was lower than the African and WorLD programme average.

It is noteworthy from this survey (Table 4.6) that many teachers embark on efforts to equip themselves with ICT training. The enthusiasm of the educators for taking private ICT courses bodes well for ICT education in schools in South Africa.

The lack of effective technical training, evidenced by the present study, suggests that teachers and learners will have to familiarise themselves with the technology, as observed by Goldman *et al.* (1999), before settling down to integrate technology with content. This means that the period of integrating ICT into education will take longer than previously expected. Schools may also have to resort to the following suggested solutions (Lundall and Howell 2000: 43), to keep their computer Networks functioning. The solutions include:

- outsourcing some of the work regarding computer networks;
- sharing technical staff with other schools in the area;
- combining certain roles such as technical support staff.

The recommended solutions are critical in situations such as the WorLD programme, where schools use refurbished computers, which often break down. It is also important for school managers using ICT to recognize that the best plans will remain unfulfilled if there is lack of communication between technical and educational functions.

5.2.2 Training of learners

Training of learners has also not been satisfactory. Thirty-six per cent of WorLD learners were not trained at all and 40 per cent of those trained were not trained well enough (Figure 4.7). Learners spent less time being trained than their educators (Figure 4.5, Tables 4.7 and 4.8). Fifty-three per cent of learners were trained for less than three hours a day; all teachers were trained for three hours or more per day. No training was done in database systems or programming skills for learners or teachers (Figure 4.2 and 4.8), even though this had been stressed in the literature (Hawkridge, Jaworski and McMahon 1990:15 and Clyde 1997). No training regarding information skills was provided for learners, even though some teachers had been exposed to such training.

A number of writers (Addo 1999, 2001; Holland 1999; Clyde 1997; Hawkridge, Nahl and Harada 1996 and Kafai and Bates 1997) emphasized that training and skills development for learners are prerequisites for the utilization of computers in education. Clyde (1997: 48) states that to be able to use a computer for educational purposes one requires “the knowledge and skills which are related to the hardware, the system, the software, the information source.”

The findings of the present study show that not enough skill and confidence in using ICT was developed among learners. This is because only seven per cent of learners always had access to a computer to use for practice after training sessions. Thirty-six per cent of learners trained did not have access to computers to practise on after training.

One may argue that WorLD learners would receive continuous training as the programme progressed. The importance of mastering computer skills, stressed by Nahl and Harada (1996) and Kafai and Bates (1997), cannot be over-emphasised. It must also be noted that learners not skilled could be intimidated in their use of computers during the WorLD programme, as was observed by Holland (1999).

Learners would have performed better if they had been trained adequately. Nahl and Harada

(1996), for example, found that students who reported that they were more experienced in the use of computers performed significantly better than those with less experience. Kafai and Bates (1997) conclude that not only do students with more Internet experience dominate the computer interaction process, but those with more computer experience become the teachers of search teams. Nahl and Harada (1996: 203) advise that self-confidence, *which can only be attained through practice with computers*, is an important factor in an information search process.

Findings relating to the implications of lack of adequate learner training are supported by the conclusions of Addo (1999, 2001), in a research project carried out in areas in which some WorLD schools are located. The majority of learners could not use computers effectively for a schools' online environmental education project, because they had not attained the required computer and information retrieval competencies. Sagahyroom (1995), quoted in Addo (2001), states that in Kenya and other developing countries the quality of in-service training was crucial and more important than the nature of the hardware and software used in ICT utilization in education.

The findings of the present study draw a parallel with a similar one conducted by Bot (1999:7), namely that only ten per cent of learners always used computers for learning, and only six per cent of teachers always used the tool for teaching in schools where computers exist. It is hoped that the Educator Development Network online training, embarked upon by SchoolNet South Africa, will be able to provide the clear strategy regarding the training of teachers, and therefore learners, in previously unresourced schools, thereby integrating computers into the teaching and learning process in South Africa.

5.2.3 How far does the existing pedagogy in WorLD schools

support computer-based teaching?

This study has found that, apart from the project team and the research-based teaching methods, WorLD teachers are not familiar with, and do not use, teaching methods that support the use of ICT in education (Figure 4.4). It is also evident that, apart from the research-based teaching method introduced in some of the WorLD schools, teachers have not been trained in most of the methods for the implementation of the programme.

Researchers and writers such as O'Kennedy (1995); Johnson (1995); De Villiers (1998); Karaliotas (1997) & Govender (1999), made it clear that the utilization of ICT in education is possible only with certain teaching models. These models have been analysed in Chapter 2 (Section 2.3.2). The models are:

- the project-based teaching method;
- the student team method;
- the constructivist method;
- the research-based method;
- the system-based method;
- the authentic teaching method.

These models essentially place the learner in the position of initiating and taking charge of the learning process, while the teacher acts as facilitator, mediator or coach.

Bot (1999: 7) found that, in certain provinces of South Africa, only a few learners solve problems on their own, or participate in learning activities. She concludes that teaching methodologies in some provinces still rely on what is termed 'chalk and talk' and "it seems therefore that the methodology required to effect computer-based education, which requires active learner participation, has still a long way to go in its infusion into the education process in South Africa and this needs to be addressed" (Bot 1999: 7).

An evaluation of the WorLD programme in five countries (Chile, Paraguay, Peru, Senegal and Uganda) (Kozma *et al.*, 1999) found that the pedagogical approach was a novelty for

African schools that participated in the programme.

The present study establishes that the existing pedagogy in WorLD schools does not support computer-based teaching. This finding supports an earlier one of Govender (1999), who concludes that South African schoolteachers do not fully understand the concept of utilizing educational technology in schools. Efforts are being made by teachers themselves and the WorLD facilitators to develop the teaching models. Such efforts, though laudable, seem inadequate to address teachers' knowledge and skill gaps in ICT teaching models in South African schools. These findings show that full integration of ICT education into teaching and learning will take some time, not only in the WorLD programme but in other like projects.

According to Lundall and Howell (2000: 46), proponents of quality teacher training believe that it would have been ideal if teachers were trained during professional stages to appreciate the use of computers in their practice and acquire the necessary skills before entering the classroom. Demand on services requiring the use of ICT in schools in its nascent stage makes such training difficult. ICT training therefore seems to favour in-service training, where many teachers acquire only the basic skills, and a little confidence, before going into the class.

Teachers require training that integrates ICT into curricula to design courses that will convey both content and skills. Most importantly, teachers must be able to collaborate and work in teams, across job categories and, increasingly, across borders. Training in the use of ICT, therefore, has to be part of a much richer education for teachers and must address issues of pedagogy in the context of global curriculum change (Lundall and Howell 2000: 46).

The opinion of de Moura Castro (1999) is that developing countries will only reap the benefits of the ideal kind of training many years from now. While developing countries may not be able to afford the ICT priority afforded to teachers in developed countries, the need to include key components into professional in-service training and pre-teacher training is critical.

5.3 What information resources (computer laboratories,

Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?

The present study (Figures 4.11, 4.12 and Table 4.14), shows that most WorLD schools have fewer than the minimum required information resources (computer networked laboratories, Internet access, libraries, multimedia centres) and media teachers necessary to effect computer-based education. It is also evident that the number of functioning computers at WorLD schools, software and, more importantly, the Internet access available during the project, makes it impossible for any effective collaborative projects to take place.

Other technologies, namely television, video, radio and overhead projectors, which support technology-based education, exist in most schools. Seven of the WorLD schools included in this study have computer laboratories. Three schools have media centres, two have media teacher/librarians and two have regular Internet access. None of the sampled schools has a multimedia centre or Network controller (Table 4.11). There is an average of 14 computers per school (Table 4.15). There is an average of five computers with CD-ROM drives (Table 4.16). A number of schools still have computers, with Windows 95 operating systems (Table 18), which Microsoft software vendors no longer support. While many schools have television sets, few schools have slide or data projectors (Figure 4.12). Evidence from this research shows that better-resourced schools often support under-resourced schools in South Africa.

Significantly, only two sampled schools (25%) have regular Internet access. This is

significant, because Internet access is a basic factor of the project, since the objective of the WorLD programme was collaborative online projects with other learners across the world. Also, in 60 per cent of the schools, only one computer was connected to the Internet. This is a serious hindrance for collaborative projects. In one of the schools, the researcher found that the computer connected to the Internet was located in the principal's office, which means that no collaborative project could take place in that school. It is also important to point out that most teachers (62%) do not use information from the Internet for education because the Internet was often unavailable. This finding is no different from the case of Mozambique, where McGhee & Kozma (2001) report that 65 per cent of teachers reported that the lack of Internet access was a major barrier to the implementation of the WorLD programme.

Many authors (Linddell, Masilela, Rapodile & Strydom 1990; Radebe 1997; Gordon 1997, Todd 1997; SAIDE 1998; World Bank 1999 & Addo 1999) state that an adequate school resource environment, with the appropriate logistics, infrastructure and personnel, is a *sine qua non* for good-quality ICT education. A study by the World Bank (Liddell, Masilela, Rapodile & Strydom 1990) suggests that the provision of good educational material is the most cost-effective way of improving educational quality. Addo (1999: 86) found that the adequacy of infrastructure and logistics in schools is conditional to the availability and use of ICT for education. Important elements for utilizing ICT in education are a school computer laboratory, a school library, a school librarian/media teacher, electricity, a telephone and security against theft.

The situation in South Africa (which is gradually improving, as shown by Tables 2.3 and 2.4) is, according to Gordon (1997: 40), schools without walls, teachers without teaching skills

and full knowledge of the subjects they teach, and the need for students to read, write and reason. This has prompted Radebe (1997: 224) to suggest, correctly, that computers did not feature as a factor in education in South Africa. Lundall and Howell (2000: 157) recommend that technologies in education should not be viewed in isolation, but rather seen from the broader societal distribution of resources. Bot (1999:3) observed that, in South Africa, roughly six out of every ten teachers said that a lack of teaching materials considerably limited their teaching. This lack had a serious effect on the morale of teachers nationally.

5.4 To what extent are the WorLD teachers able to handle school projects, attend to computer systems and teach their normal school lessons?

All teachers participating in the WorLD programme were trained to provide ICT education. The present study found that not only were the teachers adequately trained but they rated themselves highly, in terms of ability and confidence. Conversely, however, the study revealed that there was not enough time to utilize the skills acquired in WorLD schools. The teachers rated themselves very low in terms of time to discharge activities relating to WorLD programmes (Tables 4.20 & 4.21).

Unavailability of time to deliver on WorLD programmes is further shown by the fact that 88% of teachers indicated that their involvement in the programme had affected their teaching duties. The feature of unavailability of time to deliver on WorLD programmes is

also reported in other WorLD countries on the African continent by a WorLD country report (McGhee and Kozma 2001). The report submitted that, in Ghana, more than half (54%) of the teachers reported that a lack of time to implement WorLD programmes, given school curriculum requirements and the limited school day, was a major barrier. Similar sentiments relating to lack of time were reported by teachers from almost all the other WorLD countries in Africa, namely Mauritania, South Africa, Senegal and Uganda. A similar finding was made by Tshenye and Perold (2000:15), in reviewing other School ICT projects, in the Eastern Cape and the Northern Province of South Africa, as evidenced in the literature review of this study. Lack of time to deliver on WorLD programmes is further corroborated by a study of the WorLD programme in Chile, Paraguay, Peru, Senegal and Uganda. Kozma *et al*. (1999) found that a large number of teachers mentioned the difficulty of finding time for computer-related activities in their schools.

The effect of the WorLD programme on teachers' normal duties in South Africa is exacerbated by the fact that only minimum support was provided to teachers, not only technically but, worst of all, by the schools' principals, many of whom were ignorant of the programme and the role of ICT in education. Bot (1999:6) confirms teachers' perception of principals as lacking knowledge, and therefore not supporting school ICT projects, in that more than half of the principals lacked the capacity to support their staff.

With the lack of time to deliver on WorLD programmes and their effect on teachers, one would have thought that support from various sources would raise the morale of teachers who were not paid to undertake ICT projects in their schools. More often than not, school ICT projects marginalize the school librarian, who is a critical personnel resource in the integration of any form of information technology into the curriculum. The role of the school library in the WorLD ICT resource model testifies to the crucial role of the school librarian.

According to Lundall and Howell (2000: 44), teachers often do not know what they can do with technology. The tendency was to use ICT simply to automate traditional teaching methods. The need for support to provide a resource base to guide teachers is a critical factor and also for an advisor, who can facilitate group work among teachers so that there is a

sharing of experience and, it is hoped, collaboration around projects. Lundall and Howell (2000) maintain that such practice was prevalent in the developed countries of the United States of America and Britain. They indicate that the process involved the training of **Master Trainers,** who then serve as resources for their colleagues. Lundall and Howell (2000:44) stress that such expertise could be from other staff, such as librarians and computer co-ordinators, or from volunteers from business, the parent body or student groups. In reality it is often these support people, rather than teachers, who supervise the students.
O' Kennedy (1995:7) was correct in his observation that teachers who man computer systems were already overloaded with work and the additional load of being Network manager would be too much to cope with. Maintaining a computer network in a school is an expensive undertaking and it requires a full-time job position.

5.5 What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?

It is evident from the present study that the majority of learners (62%) are able to read (that is, access content in books) and write without assistance (Table 4.28). The study reveals, however, that where reading problems exist, close to two-thirds of learners experience acute reading problems, ranging from 50 to 90% (Figure 4.16). The study also shows that only 12% of learners could access information from the Internet without assistance and only about half of learners could read from the Internet.

Learners' inability to read and access information from the Internet has been attributed to lack of resources at home and at school (Table 4.28). The use of the local language as a means of instruction and communication also plays a significant role in limiting reading and accessing of information which is primarily in the English language (Table 4.28).
Lack of information skills is a major likely reason for the inability to access information from the Internet. This is because no learner has been trained in information skills (Figure 4.8**)**. The non-involvement of the school librarian in the project in schools contributes, in no uncertain terms, to the lack of information skills. It is noted that 89% of learners do not have a computer at home and 80% of those who have, indicate that the computers are not

connected to the Internet. It is therefore not surprising that nearly half, or 47%, of the learners did not use a computer for class exercises during the programme (Table 4.38) and 35% have not been involved in any collaborative project (Table 4.39).

Available literature (Blacquiere 1989; Macdonald 1990; Radebe 1994, 1997; Bouwer 1998) corroborates frustrations experienced by learners in this study about using the English language as a second language for education. The literature not only dwells on the causes, which in many instances are the non-availability of resources at learners' homes and at schools, but it elaborates on the related consequent effects on learners' studies.

Heugh, Siegruhn & Plludelemann (1995:46) and NEPI (1992:72) have made it clear that in a situation where a learner's home language is not the language of learning in a school, the phenomenon of language-cum-cognitive difficulty exacerbates existing learning difficulties. Bouwer (1998:226) notes that research demonstrates that it is virtually crippling to grapple with content in a language inadequately understood, or mastered at the lower competence level of basic interactive communication skills.

The school resource situation, especially library provision (Table 2.3), corroborated in this study by Figures 4.10 and 4.11, justifies the views of Radebe (1997), that where libraries do not exist in schools for pupils to read in the language of instruction, their grasping of content in non-mother-tongue languages is impeded.

This study exposes the lack of resources at learners' homes and the absence of the culture of literacy in many black African families. This creates problems for learners, with parents and guardians unable to assist, as indicated by Bouwer (1998: 226). This situation, according to Blacquiere (1989) and Radebe (1994), manifests itself in many such students' lack of critical thinking skills, even at higher education levels in South Africa.

While Blacquiere (1989:78) concludes that black students at tertiary institutions were unable to read as efficiently as their white peers because they were intellectually malnourished, Radebe (1994:43) found that, in almost all tertiary institutions, the most noticeable concern in students' inadequacies in terms of their preparedness was information illiteracy, which was along racial lines. Both writers attribute the problems to the lack of reading resources in the schools. Many black learners in South Africa no doubt view as incapacitating their poorly developed skills in the language they use for learning (Macdonald 1990:48-49).

This research has shown (Figure 4.16) that the inability of pupils to retrieve information from computers in the WorLD programme is not only a result of scarce reading resource provision but also of lack of information skills. It is logical that if as many as 62% of learners (Table 4.25) can read without assistance, but only 12% can retrieve information from the Internet without assistance (Table 4.27), a possible reason for the low information retrieval situation is lack of information skills.

Accessing content in an information retrieval system is not the only drawback of information seekers who use information retrieval systems which use their second language. Information retrieval performed in the information seeker's second language raises relevant issues such as command of the computer language, command of keywords, the level of education and the level of experience, all of which are lacking among many teachers and learners in schools in South Africa (Radebe 1994).

Nahl and Harada (1996:199) point out that, students often use natural language, which is not compatible with the online catalogue's controlled language. This situation could be a problem for many learners due to lack of information skills. In the present study only 12% of WorLD learners were able to retrieve information from computers without assistance.

A study by Large *et al*., (1994:500) concluded that retrieving information from all databases involves some cognitive activity. These activities are alluded to in section 2.3.4 of the

literature survey of the present study and dovetail with the conclusions of Large *et al*., (1994:500), namely that the process of information retrieval is affected by personal characteristics such as knowledge, experience, information need and the information system being used. These are attributes which are lacking in many schools in South Africa because of the non-provision of information skills in many schools, as has been established by the present study. Radebe (1994:43) raised the concern that, in many tertiary institutions in South Africa, a noticeable concern in students' preparedness was information illiteracy.

Findings of the famous Schools' Network Action Project, dubbed the SNAP-Dragon project of the University of California Los Angeles (UCLA) by Kafai and Bates (1997), are still valid today. Conclusions from the research are that, though the Internet supported free text, students were not able to select good sites for their projects because they used the titles of their project to decide on the sites from which they wanted to retrieve information, instead of keywords. It was also found in the SNAP-Dragon study that using rudiments of Boolean logic enhanced the search skills of students.

The essence of information skills in this study brings into focus the role of the media teacher, presented in section 2.4.3 of the literature survey of this study. According to Kafai and Bates (1997), the success of the SNAP-Dragon project was due to the role played by skilled Library and Information Science (LIS) Interns, who acted as *de facto* librarians during the project. Silva (1995:243) noted that librarians have been key resources in the introduction and success of Internet classroom activities and have been resource persons offering advice, instruction and even technical support to teachers. The number of WorLD schools with media teachers/librarians (Figure 4.9) does not favour the expected role of media teachers in the

project in South Africa. It was not surprising that teachers, many of whom had not used school libraries in the past and were unaware of their functions, were undecided about the qualifications of the additional staff member - whether he or she should be a librarian or a purely technical person each received a 50% response.

This researcher agrees with concerned teachers that, as previously disadvantaged schools and pupils cannot immediately escape the legacy of past educational policies, scars still exist in terms of infrastructure, logistics and the know-how of teachers, which reflect the abilities of students in schools. Such students lack the foundation and resources to undertake rigorous computer-based education. Where the Internet content is not yet available in the local language for easy access, an alternative computer system is required to provide further motivation and to address the problems of illiteracy, inadequate teacher training and low learner motivation found in the WorLD and many other schools in South Africa. Such a system, as suggested by concerned WorLD teachers in KwaZulu-Natal, should be one of computer-based multimedia.

5.6 How far can multimedia fill the gap in the utilization of ICT in South African WorLD schools?

This study shows that 40% of WorLD teachers have used a multimedia computer system before. Of the 40%, half have used a combination of text, sound and image. Many of the teachers responded positively to the means by which multimedia can assist in ICT education. The largest response (75%) believes that multimedia will stimulate the learning process of students (Table 4.30)

A number of authors (Gates 1994; Sprainger 1997; Malapile 1996; and de Horowitz 1993) share the response of the majority of WorLD teachers, namely that multimedia has a positive role in ICT education. While Malapile writes from a black African setting that utilization of multimedia will help rekindle in learners the curiosity and the quest for knowledge, Gates (1994:170) observes that multimedia stimulates all learning paths by offering information through pictures, written text, sound animation and video. Many of the teachers (62%) indicated that multimedia will attract students to practise and acquire skills. This, the researcher believes, should be a tonic for the WorLD programme. As the majority of learners (82%) have television sets at home and over half (52%) view television very often, it is certain that a multimedia system will attract learners to ICT-facilitated learning. This is reinforced by the fact that 38% of the learners indicated that they prefer sound as an additional medium in using a computer for learning.

Edelstein (1995:44) emphasises the fact that multimedia products are expensive. Download time, which is the time taken to convert the data in computer format to information accessible to the user, can be frustratingly long, depending upon the quality of the equipment being used (DiNucci, Giuidice and Stiles 1998:24). Edelstein (1995:44) categorised a set of the minimum equipment requirements to determine the applicability of a multimedia system.

The present study has found that no WorLD school has all the minimum requirements to utilise multimedia (Figure 4.16.). The majority of teachers (66%) have, however, indicated that with the skills they have acquired they will be able to utilise multimedia for teaching purposes. Teachers who feel they cannot utilise multimedia for educational purposes indicated that they will require further training in technical skills that relate to multimedia.

5.7 What other factors contribute to the success or failure of the WorLD programme in South Africa?

5.7.1 Success of the WorLD programme

The World Links for Development (WorLD) Programme is one of the flagship projects of SchoolNet South Africa. The organization is engaged in bridging the gap between policy and the implementation of ICT education in South Africa. It is also addressing the equitable utilization of ICT for teaching and learning as one of its objectives. The WorLD programme therefore focused solely on the previously non-resourced schools, which had never used computers for education.

Sixty-two percent of the teachers (Table 4.32) felt that the programme had equipped them with computer and information skills, which, according to Clyde (1997:48), are the skills required for living beyond mere survival in an information economy. Half of the teachers felt that the programme had not only introduced new insights into education for them but enabled them to develop themselves as far as new approaches to education were concerned. Teachers reported similar comments across the African continent, according to McGhee and Kozma (2001).

Almost two-thirds of teachers (62%) felt that the school had provided learners with skills which they will utilize in work situations and further education. Lundall and Howell (2000: 92) found similar sentiments with the majority of teachers. In effect, enthusiasm of the teachers in applying ICT to education related only to the social and direct benefits to teachers and learners in the previously non-resourced areas in South Africa. The issue of integrating ICT into education has yet to catch up with learners and teachers.

Thirty-one percent of learners indicated that the computer was a tool that aids the learning process. Twenty-one percent felt that it provided access to much information and 15% indicated that it was a tool that provided fun during the learning process (Table 4.40) Sixty-eight percent felt that there was a need to introduce the study of computer programming in order to derive the full benefits of learning with computers

5.7.2 Challenges facing the WorLD programme in South Africa

The WorLD programme presented a number of challenges, which in certain cases could have contributed to a near failure to achieve the programme's objectives in South Africa.

5.7.2.1 Training

Training of teachers and learners was a key component of the WorLD programme. Although teachers were adequately trained, transfer of knowledge and skills to learners who required such knowledge and skills to make effective project objectives could not take place, because of lack of capacity in terms of time. It was not surprising that the majority of teachers indicated that the programme had provided them with more work and added responsibility. Many said that the programme had caused conflict between them and their school principals.

5.7.2.2 Access to computers and Internet Connectivity

The present study found that access to working computers was a major problem. An average of only 14 working computers to a WorLD school is considered a limited number. The study shows that as many as 33 learners on average per school (Table 3.3) took part in the project, which means that there were more than two learners to a computer. Lack of adequate hardware was reported as a major barrier to the WorLD programme in the South African Country Report (McGhee and Kozma: 2001). In addition to the number of persons per computer and inadequacy of hardware was the question of Internet availability, which was only 25%.

Half of the teachers suggested that the provision of more and better computer equipment and more and better technical training would improve the use of computers for education in the WorLD programme (Table 4.37). This reinforces the point made earlier concerning refurbished computers.

Sixty-nine percent of learners (Table 4.42) believe that the introduction of computer studies as a subject in schools will help improve the rate of utilization of the computer as a learning tool and hence improve the WorLD programme. It is supposed that the introduction of computer studies will make provision for a dedicated teacher and capacity in terms of time and personnel for computer-related subjects and issues, not only in WorLD schools but also in the future integration of ICT in education in South Africa.

5.7.2.3 Cost

Cost was not investigated in this study. It was, however, an issue that impinged on the immediate utilization and sustainability of the programme. Half (50%) of the teachers indicated that the programme was an expensive venture to be undertaken. Sixty-two percent of them concluded that the cost of maintaining the computer system may be out of the reach of the school in the future. Telephone costs were reported as a major barrier to the implementation of the WorLD programme in Senegal.

Lundall and Howell (2000) point out that cost, and particularly the cost of Internet access, has been cited as the most important factor for limiting Internet use in schools in South Africa. Table 4.36 draws attention to cost as an important phenomenon. As pointed out in James (2001:105), the non-availability of financial sustainability models in “soft” funding projects from grants provided by funding agencies render the medium- to long-term future of projects very fragile and with limited social impact. In this case evidence suggests that financial problems were visible in the short-term period of the project.

5.8 Summary

Chapter 5 provided a detailed analysis of the research data and literature available to determine the findings of the study. The study established that, whereas WorLD teachers were adequately trained to deliver ICT education, technical and learner training was not adequate. It was also established that the existing pedagogy, as well as existing information resources in WorLD schools, do not support ICT education. The study found that, in spite of adequate teacher training, there was not enough time to implement the skills gained by teachers in the WorLD programme.

Learners did not experience problems with reading or accessing content in WorLD schools. Nevertheless, they were unable to access information from computers for collaborative projects because they lacked the skills to do so. While multimedia can be used effectively to

enhance ICT education, most schools do not have the required equipment to use multimedia.

Finally, although the cost of computer systems was not a feature of this study, it was observed as a major factor in utilizing ICT in the WorLD programme. The project may not be sustained if the cost factor is not given attention and resolved.

Chapter 6

Summary of the findings of the study, conclusions and recommendations

6.1 Introduction

This chapter presents a summary of findings and conclusions drawn from the study. It proposes recommendations for action and areas for further study, to improve upon utilization of ICT in education in the WorLD schools and other ICT in education projects in South Africa, in particular, and Africa, in general. The findings and conclusions are generalized to the WorLD study population of learners and educators.

The purpose of this study was to investigate the utilization of ICT in WorLD programme schools in South Africa and to provide strategies aimed at achieving or improving utilization to achieve school ICT educational outcomes and impact (Figure 6.1). The following research questions guided the study:

- How successful was the training provided to teachers and students in WorLD schools (in terms of enabling them to utilize computers for collaborative school projects)?
- What is the literacy level of WorLD school pupils in terms of reading, accessing and using information in the English language?
- To what extent are South African computer teachers able to handle school computer projects, attend to computer systems and attend to their normal school lessons?
- How far does the existing pedagogy in WorLD schools support computer-based teaching?
- What information resources (computer laboratories, Internet, libraries, multimedia centres) exist in the schools and do the schools have media teachers?
- How far can multimedia fill the gap in utilizing ICT in South African WorLD schools?
- What other factors contribute to the success or failure of the WorLD programme in South Africa?

6.2 Summary of findings

This section presents a summary of findings established by this study from the previous five chapters, with respect to the purpose, objectives and the main research questions that guided the study. Insight from the literature is also presented.

6.2.1 From the literature it has been established that:

1. Information and communication technology (ICT) was not only an educational tool but also a driving mechanism for socioeconomic development in a globalizing knowledge economy.
2. ICTs can contribute to improving the quality and delivery of education
3. ICT utilization in education and school networking is not new to schools in South Africa. Nevertheless, a large majority of schools previously excluded have no access to these modern educational tools.
4. ICT in education is new to education administrators, educators and learners in previously excluded schools, especially in the rural areas of South Africa.
5. An organization called SchoolNet South Africa is in place to integrate national ICTs policy in the education system of South Africa.
6. The World Links for development (WorLD) programme is an attempt by the World Bank to provide ICT education for the future generation of developing countries, including South Africa, to enable them to sustain their economies.
7. It is imperative that evaluation studies such as this are conducted to provide information that will guide stakeholders to move to extend access to more schools and improve upon utilization.

After a detailed and an elaborate investigation of the World Links for development programme in South Africa, this study established the following:

6.2.2 Training of educators and learners

1. Educators in the WorLD schools in South Africa have been adequately trained in

computer application programmes and collaborative school projects, but not in database systems and programming.

2. Educators were satisfied with the time allocated to the training and each teacher had a computer to practise skills acquired during training.
3. The study found that technical training of educators was unsatisfactory and no teacher was trained in programming and the UNIX operating system.
4. Lack of training in the UNIX operating system is considered a handicap for the project, because the E-mail system was based on the UNIX operating system.
5. Lack of technical training for educators cast a shadow on the success of the programme, because WorLD computers were predominantly refurbished and required constant maintenance.
6. Lack of technical training prevented the programme from proceeding to the levels of integrating ICTs into the teaching and learning process and schools would have to outsource the technical functions of ICT to private service providers, which have high cost implications for schools in impoverished environments.
7. Many teachers in WorLD schools in South Africa are doing their best to equip themselves, on their own, with IT knowledge and skills. Teachers' enthusiasm and zeal in embarking on private IT tuition bodes well for the WorLD project, in particular, and for ICT utilization in education in South Africa as a whole.
8. Training of learners was found to be unsatisfactory. More than a third of WorLD learners had not been trained at all and close to half of those trained were not trained well enough. Learners spent less time during training than teachers did.
9. No training had been provided to learners in database systems, programming and information skills.
10. Training of learners was unsatisfactory because teachers did not have enough time outside their normal duties to deliver the training, as they had to attend to their normal teaching duties.
11. WorLD learners in South Africa had not acquired sufficient skill and confidence in using ICT during the project pilot phase, as only a limited number had access to a computer to practise after training sessions.

6.2.3 ICT pedagogy in WorLD schools

1. Apart from the project team and research-based teaching methods, WorLD educators in South Africa are not familiar with or trained in, nor do they use, teaching methods that support the utilization of ICT in education.
2. Educators have not been trained in the majority of the required pedagogical methods for the implementation of the WorLD project itself.
3. The existing pedagogy in WorLD schools during the pilot phase (1997-2000) did not support computer-based teaching, for the following reasons:
   - The previous professional training of teachers which did not recognize modern pedagogies.
   - Prevailing in-service training does not integrate ICT into curricula design and training.
   - The lack of cognitive resource-based learning environments, including the non-involvement of media teachers in the integration of ICT into the curriculum.
   - The preponderance of a *chalk and talk* pedagogy found to be prevalent in rural South African schools where this study was conducted and where cognitive education resources, such as libraries and computer laboratories, are lacking.

6.2.4 School Information resources

1. Though a strong correlation exists between the technology and other resources for teaching and learning, recommended as pre-requisites by the resource model (Appendix 1), the majority of WorLD schools in South Africa during the project phase had less than the minimum requirements of the pre-requisite information resources (computer networked laboratories, Internet access, libraries/media centres, media teachers and multimedia centres).

2. The marginalization of the role of the school librarian creates difficulties in the integration of ICTs into the curriculum in schools.
3. The number of functioning computers at WorLD schools and Internet access during

the project made it impossible for effective collaborative projects to take place.

4. Other technology - television, video machines, radio and overhead projectors - which support technology-based education, exists in the majority of the schools.
5. The information resource situation in previously un-resourced rural South African schools, in general, though gradually improving, were not adequate to support ICT education and therefore needed massive improvement.

6.2.5 Teachers' capacity to deliver on WorLD projects

1. There was hardly time for educators to deliver on WorLD projects, even though teachers had acquired the skills and confidence.
2. Project activities affect educators' normal teaching duties negatively, because they were not full-time and dedicated and were engaged in the projects on a voluntary basis.

6.2.6 Literacy effect of the WorLD project on learners

1. The majority of WorLD learners could read, that is access the content from books, and write without assistance.
2. Reading problems were, however, acute where they existed.
3. Only a few learners could access information from the Internet without assistance and just about half of them were able to read from the Internet.
4. Learners' inability to read and access information from the Internet is attributed to the lack of resources at the learners' homes and schools.
5. The use of the local language as a means of instruction and communication also played a significant role in limiting reading and accessing of information from the Internet, which uses the English language.
6. Lack of information skills were identified as the major barrier to the ability of learners to access and use information from the Internet.

6.2.7 Multimedia filling the gaps

Even though many WorLD educators and learners have used a multimedia computer system and are very positive that the tool can assist in ICT education, none of the schools had the minimum ICT requirements to utilise such a system.

6.2.8 Success factors

1. Educators and learners in WorLD schools have been equipped with new skills and modern insights into education.
2. Learners have been equipped with skills which they will utilize in work situations and further education.

6.2.9 Challenge factors

1. The number of functioning computers in a WorLD school is considered a serious limitation to the project.
2. Lack of Internet access, resulting in inability to engage in collaborative projects and inability to integrate ICT into the educational system, meant that the project did not achieve a major outcome.
3. Cost is an issue that seriously impinged on the success and sustainability of the project.
4. The project was found to be an expensive venture and maintaining the computer system may be out of the reach of the schools in the future.

6.3 Conclusions

The conclusions of this study are based on the findings of the study and project outcomes from expectations of the WorLD evaluation research model (Figure 6.1). Achievements and failures, with respect to the expected outcomes and impact of the project, are:

6.3.1 Achievements

The study concludes that the World Links for development programme in South Africa achieved limited outcomes and impact on ICT education in schools during the project pilot phase between 1997 and 2000. This was because educators who were project co-ordinators in the schools did not have time outside their normal working schedules, they did not have the required technical skills to repair frequently non-functional computers, the Internet was not available in the majority of the schools and support from both school administration and the project was minimal. Nevertheless, modern insights into education have been gained and new approaches to education developed in the schools, as well as new challenges. Educators have been provided with additional skills, including the ability to utilise many computer application programs.

Marginal outcomes were recorded in certain areas of the project. International collaboration with peer learners, for example, were developed in the few schools that had Internet access and engaged in collaborative projects. Access to the World's maze of information was available at schools with Internet access. Teachers utilized a few new methods for teaching, at least during the WorLD projects.

6.3.2 Failures

On the whole, however, the project failed to achieve a great proportion of its outcomes and impact (Figure 6.1), which include the following:

6.3.2.1 Learners skilled in computer application systems

This study concludes that South African WorLD learners, the ultimate beneficiaries of the project, had not benefited from the skills acquired by the teachers. This was against the backdrop that 77% of them have never been trained to use a computer and 89% did not have a computer at home. It would be fair to say that less time and effort than required was

devoted to the training of learners by educators for the WorLD project. Learners were not skilled in the computer application systems because educators did not have the time beyond their normal teaching schedules to teach them the systems.

6.3.2.2 Teachers' use of technical skills

It is conclusive from this study that WorLD teachers could not use technical skills effectively because they had not been trained sufficiently and there was no time for them to utilize whatever skills they had acquired through their own training efforts.

6.3.2.3 Teachers' use of Internet resources for education

Though teachers had acquired skills for the use of the Internet they could not utilize the Internet for education purposes because the Internet was often not available. This study therefore concludes that the Internet facility provided during the WorLD project in South Africa was unreliable and did not support the programme during the pilot phase of 1997-2000.

6.3.2.4 Teachers utilize new methods for teaching

The study showed that teachers were not able to effectively utilize new methods for teaching in WorLD schools, because many were not trained in and familiar with the majority of the new methods and there was hardly enough time and Internet access to utilize any new methods that they had acquired.

6.3.2.5 Learners use of Internet resources

South African WorLD learners' use of Internet resources during the project pilot phase was very limited and non-effective. This is because of the lack of training in information skills, the Internet often not being available and educators having little time to teach, guide and supervise learners. This study concurs with the SAIDE Report (1998), that, unless resource

backlogs in schools were addressed, programmes seeking to exploit and implement ICT projects would be marginal or have no effect. Again, it would have been ideal for the project to utilize Internet-based compact discs (CDs) during the project pilot phase, as was done in Uganda, or as is the case with SchoolNet South Africa Educators' Development Network (EDN) CD. The present study argues that the non-involvement of the school media teacher where they existed in the project frustrated the use of the Internet because the use of the Internet is the domain of the school library media teacher.

6.3.2.6 Learners' interactive, collaborative and communication skills developed

This study concludes that South African WorLD learners interacted only to a very minimal degree with other learners across the globe, as was required by the project, and therefore did not benefit fully from collaborative and communication skills, because the Internet was often not available in schools and teachers did not have the time to supervise and assist the learners.

6.3.2.7 Integration of ICT into curriculum

Throughout this study, it has become apparent that one of the most important objectives of the WorLD project, which is to integrate ICT into the curriculum, was not achieved during the project pilot phase. Though the literature has made it abundantly clear that it was the aspect of ICT utilization in education that would take a long time to be achieved, South African WorLD educators and learners believe that the introduction of computer studies as a subject in the schools will help improve ICT integration into the curriculum. It is supposed that the introduction of computer studies will make provision for a full-time (dedicated) teacher and provide capacity in terms of time and personnel for ICT education in start-up schools such as the WorLD schools.

6.3.2.8 Learners engage in collaborative projects

This study showed that learners in the WorLD project were not able to fully utilize ICT for collaborative projects. Data provided by this study indicated that, although the majority of them were involved in at least one collaborative project, only 6% were involved in two projects and as few as 3% in three projects, during the pilot phase. The Internet was often not

available; in any case, to support collaborative projects and teachers did not have the time to help learners in the process.

6.3.2.9 Learners think through school projects and develop knowledge

The literature and available research data has shown that the general school resource and pedagogical situation in WorLD schools did not provide the requisite environment for learners to effectively think through school projects. The study also concludes that the impact of the project on schools has been minimal, given the dire resource situation, as well as the educator capacity situation in which the projects have been carried out, especially the lack of time and technical skills of the teachers. Learners' ability to think through school projects and develop their own knowledge was not introduced by computers. The non-involvement of school librarians, where they existed in the project, is again seen as a setback to the project.

6.3.2.10 Learners' critical thinking skills developed

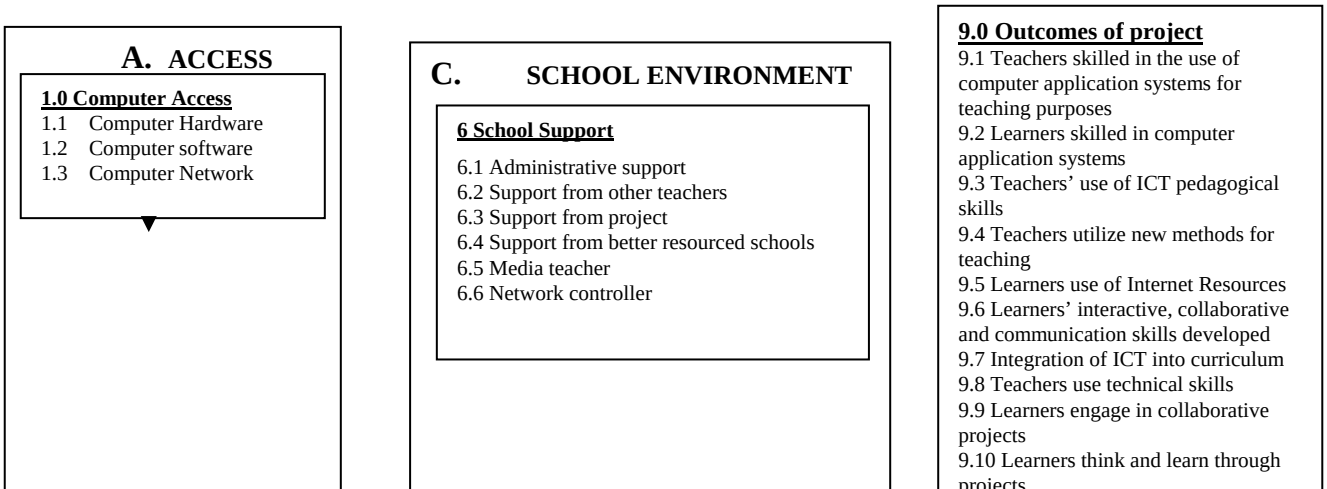
As learners think through their own research projects and use their own acquired information they develop their own knowledge and a critical thinking skills process. This has not been fully developed in this project, in view of the information resource situation in schools and the lack of regular Internet access.

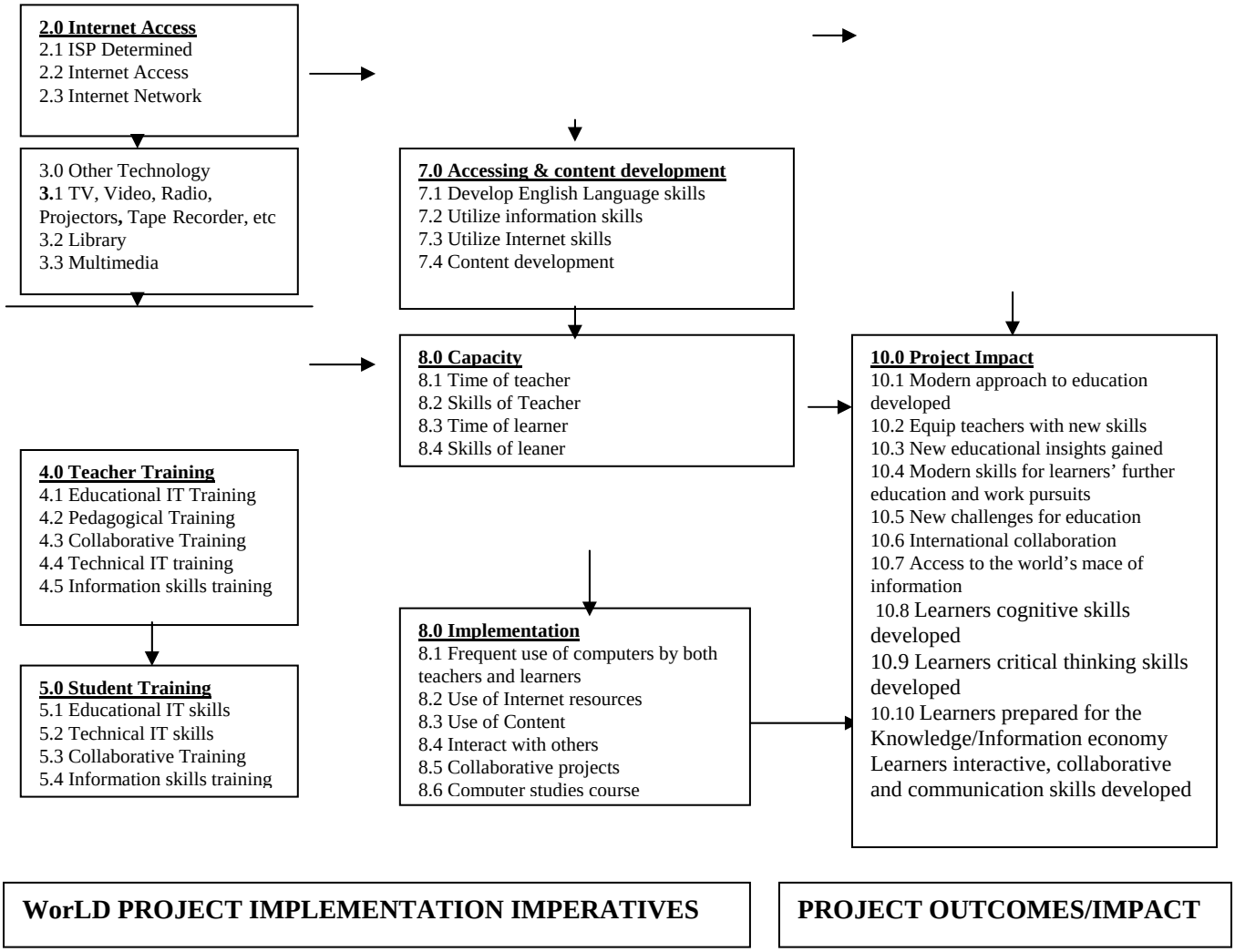
6.3.2.11 Learners prepare for knowledge/information age economy

Ultimately, the aim of the WorLD project was to prepare learners in developing countries to conveniently integrate into the knowledge and information age economy, where prompt access to information or knowledge enables individuals to play worthwhile roles in life. This study concludes that such an aim though very laudable was not achieved because the project did not make adequate provision for the educator and the resource environment. An evaluation model upon which this study was based is presented in Figure 6.1.

Figure 6.1

An Evaluation Model of The WorLD Project in South Africa





This model details an implementation process of the WorLD project hence this study. It begins with the two principal issues that form the core of the study, namely, access to computers and training of educators and learners to utilize ICTs for education. The school environment is an important factor, without which implementation and use of ICTs could not be attained. The model, adapted from the World Bank (McGhee 2000) can be adopted for the evaluation of other ICTs projects not only in South Africa but other African countries.

6.4 Recommendations

The WorLD projects were located in rural South African schools, where the bulk of its population resides, to address the rural-urban ICT education divide and provide useful lessons for a future national roll-out. It has become apparent throughout this study that lessons have been learnt and useful insights gained to guide present and future start-up ICT education projects and processes. The recommendations presented relate to the specific

findings of the study and to a broader policy perspective.

This study recommends that, for an ICT education project to be effective in rural areas in South Africa and the rest of Africa, and to meet its outcomes and make the required impact, the following are crucial:

6.4.1 Training

A national technical ICT strategy for educators must be developed, similar to the SchoolNet South Africa Educators' Development Network (EDN) pedagogical course, being run at the time of writing. Teachers will proceed to an online technical training from the limited face-to-face training they had acquired. It is argued that the limited technical training provided during the WorLD project and what is currently being pursued by SchoolNet South Africa does not provide educators with the knowledge to be able to engage the helpdesk with the right information and confidence to solve hardware and network problems. This situation leads to many school computer laboratories not being able to function to their optimum level, more especially as many schools currently do not have network administrators.

It is recommended that the WorLD project, or the start-up process of any school ICT project in Africa, should make provision for a highly motivated and dedicated ICT teacher, who should be adequately trained in pedagogical, as well as technical skills, to train learners and other teachers on the staff and be able to attain project outcomes in a particular school.

This study recommends that teachers are supported with face to face-to face training in the use of a particular ICT until they are familiar with it, master its use, develop the required confidence and can use it on their own. Taking into account how teachers were trained in the past, it will be difficult to embark on an online training course to master application or technical skills where the rudiments have not been achieved. Nevertheless, this study endorses the new online pedagogy course being provided by SchoolNet South Africa.

Teachers viewed school ICT projects in this study as additional, unremunerated duties. It is therefore important to involve district education officials, school principals, heads of departments, participating teachers and the community in project design and implementation. With such an holistic and inclusive approach schools will be more receptive to ICT use and development, because the education managers in the districts with the communities endorsed the projects. Ntutule & Perold (2001) found that principals who were originally cautious of ICT projects became more co-operative once they knew regional and district managers were involved. With the involvement of school managers and administrators in the planning and implementation of school ICT projects teachers will be able to see the urgency and adjust their time to accommodate the project. They will then not be in danger of losing their jobs. Closely related to this is the recommendation that ICTs in schools must be integrated with the school administration, which requires that the principal and administrative clerk of the school must be trained. Perhaps the model of the WorLD project in Zimbabwe, where project teachers were relieved of all teaching responsibilities and made to manage school tele-centres to serve as school and community information and education centres, could be explored and implemented in South Africa, as well as the rest of Africa.

It is recommended that all persons intending to become teachers should be provided with a pre-service ICT education training in universities and colleges, before they are certified as professional educators. Teachers will be more skilled and confident in a pre-service training environment and it will be less expensive to train them than when they are in service.

6.4.2 The provision of information resources to schools

This study has demonstrated that for a successful ICT education to take place in schools a strong correlation should exist between ICT and other information resources. It is recommended that information resources should not be seen in isolation, but from a holistic perspective. The WorLD information resource model in Appendix 1 must be strictly adhered to. School librarians should be involved in ICT projects at their schools and trained in Internet information retrieval skills, so that they can guide learners with information retrieval and can use library resources to augment their knowledge.

To avoid “dumping”, a national policy on refurbished computers is recommended, to standardise computers donated to schools. Again, the school library and media teacher is a prerequisite, not only to the utilization of ICT in education but, most importantly, for the integration of ICT into the teaching and learning process. As ICT projects cannot take place in schools without the Internet, it is recommended that the cost of Internet access, which is predominantly the cost of a telephone line, be fully explored and discussed with role-players during the project planning phase before the start-up process, to avoid accumulated phone bills and the cessation of Internet access. It is also ideal for school ICT projects to utilize Internet-based compact discs (CDs) during the training phase of projects. Such an approach would not incur Internet costs, but assist in providing the required skills. The current Internet access rate of 50% for schools in South Africa bodes well for school ICT projects and must be examined for other African countries. What is, however, required is that the cost of the telephone helpdesk service be halved, if not eliminated altogether.

6.4.3 Government school ICT policy

Teachers, schools and the entire country of South Africa stand to benefit from a national mission statement on the introduction of ICT to schools. This statement should come from government, along with financial policy support for the use of new technologies and strategic partnerships with industry, the private sector and non-governmental organizations (NGOs). Policy direction is required to strategically incorporate ICT into education and to encourage teachers to use new technologies in their classrooms, nationally and especially in the rural areas of South Africa. A national ICT policy framework for education should aim at:

- Mobilising human and material resources nationally, with incentives for rural schools
- Addressing a holistic school information resource situation, to include school libraries, media teachers and multimedia centres
- Developing human resources among educators in ICT and management skills
- Exploring and deploying appropriate, affordable, but non-specific, ICT for schools in rural South Africa and Africa, including satellite technology in wired, wireless or a combination of wireless and wired network environments.
- Rural infrastructure development, with regards to telecommunication and electricity
- Addressing issues relating to universal access and service in Africa

- Providing pre-service ICT technical and pedagogical training to all teachers
- Determining a model that will integrate the school as a learning centre with a community information resource.

The present study recommends that the South African Department of Education utilises a model which will involve the school community to augment the provision of computers by the WorLD and other projects and be thoroughly discussed during the project-planning phase. Provincial efforts such as "Gauteng online", of the Gauteng Provincial Department of Education and the Khanya project of the Western Cape Department of Education[38], are commended and must be emulated by other provinces.

6.4.4 Integration of ICT into school curriculum

The integration of ICT into the curriculum is a complex and long-term process. It involves the availability of a full-time, well-trained, experienced and motivated educator and the involvement of the school library media teacher. The present work recommends the need to introduce computer studies at all stages of the curriculum and computer science and programming at senior level. They should be examinable subjects so that learners can derive the full benefits of being educated with computers in schools.

The integration programme must create mechanisms and structures to support teacher and learner collaboration after both have mastered sufficient skills. This should be an effort which should create more time for teachers to plan together and train and collaborate in the integration of ICT across disciplines (Ntutule & Perold 2001). Integration of ICTs into the curriculum can only begin if there is less emphasis on the passing of examinations and the pressure of teachers' work is decreased.

It is recommended that content usage and the integration of ICT into the curriculum should begin with the mastering of applications programmes and the application of information literacy, which should then be followed by questioning skills. The spirit of enquiry, devoid of

38 Information on these initiatives can be found at: http://www.schoolnet.school.za

a *chalk and talk* approach to education in African communities, must be inculcated in learners and the learning process. Skills gained from this inquiring approach can be used in specific projects such as collaboratory projects with learners in subjects such as mathematics, English, science and social science.

The idea of integrating ICT into teaching and learning must be conducted in such a manner that educators and learners see mastering of application programmes and learning of specific subjects as one complementing the other. As seen during the WorLD project, learners and educators had regarded themselves as benefiting from computer skills for use in other aspects of life and not for education purposes. ICT in the curriculum must be combined with educators' administration duties in mind. For example, using Excel for designing school and class timetables or mark sheets, which are used by teachers in their day-to-day education activities. It also fosters the holistic approach mentioned earlier.

Care must be taken when recruiting teacher trainers for in-service training, as non-educationists would not be conversant with teachers' roles and would relate training to other uses of ICT, thus missing the holistic approach. A mechanism must be put in place for monitoring the uses to which educators put the skills they had acquired. The tendency to use ICT for other purposes provided grounds and temptation for teachers to leave the classrooms for other services, where their demand is high. In the present study, at least one teacher mentioned pursuing other goals outside teaching, after gaining ICT skills.
The present study recommends that the programme managers educate WorLD school principals on the role of ICT in education, as motivated teachers who see their roles being appreciated by principals will, in turn, encourage their learners. This is critical in school ICT projects, which are considered as added-on jobs, with no extra remuneration. Of course, if these issues are addressed during the project planning stages, such problems will not arise.

6.4.5 Imperatives for the success of the project

It is recommended that a thorough base scan should precede school ICT projects. This should be discussed with schools and followed by a thorough needs analysis of the educators. Learners should show some signs of cognitive learning skills in a library/media centre before

computers are introduced into the schools. In many instances this was not the case in selected WorLD schools. Media teachers did not, therefore, form part of the project.

Establishing a sense of community, by using electronic mail (e-mail) (asynchronous communication) and “chat rooms” (synchronous communication systems), are essential and considered an important social outcome of ICT implementation programmes in schools. ICT will encourage both educators and learners unconsciously to learn skills fast. Care should, however, be taken to provide guidance on issues of interest concerning communication, to foster focus-group discussions.

It is recommended that steps be taken to consolidate project outcomes and successes prior to expansion in subjects or to the community. Issues such as the following are crucial:

- The adequacy of ICT infrastructure at the school
- Technical support from the school and from outside sources
- School management support
- Consolidated and continuous training
- Practising of new skills
- Motivation of participants

6.5 Recommendations for further studies

The focus of this study has been the monitoring and evaluation components of the WorLD programme. Determining the success or failure of a project and hence value for money is crucial to that project. It is therefore recommended that the evaluation model proposed by this study be tested to prove its efficacy, with regards to evaluating ICT education projects being sponsored by schools, communities, funders and governments.

It is also recommended that, with the advancement of technology and the emergence of nascent ICT products that could foster more affordable and sustainable computer access and connectivity, research be conducted into the use of new technologies such as wireless,

satellite and open-source software in schools in South Africa and in the rural areas in general.

It was indicated in the literature review for this study that one of the most formidable challenges to the use of ICTs in developing countries, especially in Africa, was the challenge of ownership of knowledge and knowledge products. This study recommends that research be conducted to establish the extent to which Africans are being alienated from their way of life or otherwise because of their lack of control of the knowledge systems and products that are being used in the name of globalisation and a knowledge economy. Perhaps the question to investigate is, to what extent are African communities, and particularly those in South Africa, thinking global and acting local?

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satellite and open-source software in schools in South Africa and in the rural areas in general.

It was indicated in the literature review for this study that one of the most formidable challenges to the use of ICTs in developing countries, especially in Africa, was the challenge of ownership of knowledge and knowledge products. This study recommends that research be conducted to establish the extent to which Africans are being alienated from their way of life or otherwise because of their lack of control of the knowledge systems and products that are being used in the name of globalisation and a knowledge economy. Perhaps the question to investigate is, to what extent are African communities, and particularly those in South Africa, thinking global and acting local?

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APPENDICES

Appendix 1

Delivering WorLD Objectives -vision, school selection, IT and classroom setup models .

A brief conceptual vision of the WorLD programme is presented in this appendix with technology and classroom set up models as assessment models that can be tailored to the needs of each project country and local community.

1. Vision of the WorLD programme

The World Bank believes that with the help of ICT there can be:

- An open world of learning of on-line communities for students and teachers;
- An improvement in educational outcomes for students;
- A narrowing of the information gap between students in the industrialized and the developing world, and
- The building of bridges among the leaders of tomorrow[39].

It intimates that:

Internet connectivity enables teachers and students in developing countries to contribute to the world body of knowledge about their own societies, while gaining critical access to information from industrialized nations. The programme has thus helped connect many secondary schools in developing countries to the Internet.

2. How schools are selected to participate in the WorLD programme

The selection of pilot schools in developing countries to participate in the WorLD programme takes place in co-ordination with the appropriate government agency in charge of education in the country, as well as with local communities. Pilot schools are chosen in accordance with various criteria, which include the following:

- Existing school and telecommunications infrastructure
- Opportunities for long-term self sustainability, social and economic equity
- The interest of the local communities and
- The capacity to innovate.

[39] This information is taken from http://www.worldbank.org/worldlinks/english/html/about.htm (2000)

3. Technology set-up design for schools

The technology component of the WorLD programme features four classroom set-up models. These models, which can be tailored to match the existing needs and conditions of individual countries and schools, were developed after an initial examination of a range of technical and contextual considerations. These include:

- Average level of pilot countries' telecommunications infrastructure (telephone lines, fiber optics capacity, existing ISP, optimal types of servers, Internet backbone);
- Recurring and fixed costs (on-line access, cost per minute);
- Software choices for various operating systems;
- Existing telecommunications regulatory environment and anticipated reforms; location and level of Internet access of secondary schools;

As part of its work, the WorLD Programme conducts a comprehensive technical needs analysis of each of its participating countries, to create tailored connectivity packages that are adaptable to local circumstances and sustainable into the future.

a). Classroom set-up models

A number of classroom set-up options have been provided for countries and schools to be able to adapt to their needs and circumstances.

Option 1 comprises:

A **Computer Laboratory**: in which 10 (486) computers are networked in a Local Area Network (LAN), with a dialup connection using a 33.6 modem, proxy server and

Option 2

A Computer Laboratory Plus Library Access, 10 (486) computers networked in LAN, with a dialup connection using a 33.6 modem proxy server with a separate computer for teacher use in a common library.

Option 3

Classroom Access 12 (486) computers networked in LAN, with a dialup connection using a 33.6 modem, proxy server with a separate computer for teacher use library common access and 3 classrooms with 4 computers.

Option 4

Full Internet Connection 12 (486) computers networked in LAN with a leased line connection with router proxy server, a separate computer for teacher use library common access 3 classrooms with 4 computers.

The list of participating schools in the WorLD South African program is found in Appendix 3

Appendix 2:

List of Schools that participated in the World Links for Development (WorLD) projects in South Africa

The WorLD project was implemented in only 3 of the 9 provinces in South Africa. The Provinces are: the Eastern Cape, KwaZulu-Natal and the North-West Province.

Eastern Cape – 6 Schools

1. Nathaniel Nyaluza High School
2. Numbulelo High School
3. Maria Louw High School
4. St. Josephs Junior Secondary School
5. Vuli Valley High School
6. Zingiza High School

KwaZulu-Natal –7 Schools

1. Asithuthuke Secondary School
2. Estcourt Secondary School
3. Ngwenyathi Hgh School
4. Nottingham Road Combined School
5. St. Joseph's Secondary School
6. Quakaza Senior Secondary School
7. Zenzeleni Community Centre

North-West Province - 7 Schools

1. Gabonewe Secondary School
2. Kgomotso High School
3. Leteane High School
4. Mmabatho High School
5. Micha-Kgasi High School
6. Ngaka Maseko High School

Appendix 3:

Letter to educators explaining WorLD learner sampling process

Department of Information Science
University of Pretoria
Pretoria
28-09-2000

Dear WorLD Teacher

SAMPLING OF WorLD PROJECT LEARNERS IN SAMPLED SCHOOLS

I wish to thank you once again for participating in this WorLD research. In order to ensure that the views expressed by the learners in this research are both unbiased and as representative as possible, it is important that a scientific process be used for selecting learner respondents in your school.

I will therefore be grateful if you will strictly adhere to the following procedure as discussed in selecting your learners to answer the questionnaire.

1. Provide for each learner in your WorLD class on the sampling day a number from 01 - 0N (Where N is the last number in the class). For example, if there are 20 learners in your class the numbering will be 01 – 20.

2. Determine the sampled size, i.e. 20% of the number of learners by dividing the number in the class by 5. For example, if there are 29 learners the sampled size will be 20/5 = 4. The number of sampled learners should approximate the number you have already submitted and worked out, as in the Table below.

3. Select the sampled learners at random (without any planned procedure) as discussed

4. The selected students should fill in the questionnaire.

Table A1: WorLD Sampled Schools, teachers and Learners

	School	WorLD Teacher	No. of Learners	No. Sampled
1	St. Joseph' Secondary	S.T Ngcobo	45	9
2	Estcourt Secondary	V.Hlatswayo	30	6
3	Nottingham Road Combined	G.K.Doe	30	6
4	Asithuthuke Secondary	J. Mukathi	40	8
5	Quakaza Senior Secondary	K. Mbatha	35	7
6	Zenzeleni (Mpophomeni) High	P. Robertson	20	4
7	Ngwenyathi High School	V.Mtsewu	40	8
8	Micha-Kgasi High School	M. Gaasenwe	15	3
9	Kgomotso High School	K. Gaebe	40	8
10	Gabonewe Secondary School	V. Mohambi	42	8
11	Leteane High School	M. Mashingo	33	6
12	Ngaka – Maseko High	J. Mahuma	31	6
13	St Joseph's High	M. Abraham	20	4
14	Nombulelo	I Kofie	35	7

Table 1 above will guide you regarding the sampled learners in your school.

Please return the completed questionnaires to the address provided to you during the discussion as soon as possible.

Wishing you the best in your service to learners

Hillar Addo

Appendix 4

Teachers'/co-ordinators' letter of introduction of questionnaire.

SCHOOL OF INFORMATION TECHNOLOGY UNIVERSITY OF PRETORIA

QUESTIONNAIRE ON THE UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN EDUCATION FOCUSING ON THE WORLD LINKS FOR DEVELOPMENT (WorLD) PROGRAMME IN SOUTH AFRICA

I am a Doctoral student in the school of Information Technology, University of Pretoria. I am pursuing a study on the utilization of information and communication technologies (ICTs) in education focusing on the World Links for Development (**WorLD**) programme in South Africa.

Your school has been selected as one that is participating keenly in the programme and its projects. I would be most grateful if you as the school project co-ordinator (project teacher) would assist me by responding to the following questions in this questionnaire and returning it to me as soon as possible.

Your answers will be treated confidentially.

INSTRUCTIONS

1. Please answer the questions only if your school is a beneficiary of the World Links for Development (**WorLD**) programme and you are the co-ordinator or teacher responsible for the project in your school.

2. ***Please answer each question by drawing a neat circle around the appropriate number in a shaded box, or where asked for write your answer in the shaded space provided.***

3. Please answer the questions as honestly as possible

Thank you for your assistance

Hillar Addo

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Respondent	VR			1-2
School	VS			3-4

SECTION A: BACKGROUND INFORMATION ON PROJECT CO-ORDINATOR AND SCHOOL

1 Are you a

Male teacher?	**1**	V1	5
Female teacher	**2**		

2 Are you a

Black South African?	**1**	V2	6
White South African?	**2**		
Other: (specify)			

3 How did you become the project co-ordinator in your school? (choose one answer)

I alone showed interest and was accepted by the school	**1**	V3	7
The principal nominated me	**2**		
We applied and I got the job after an interview process	**3**		
Other. (specify)			

4 Have you ever used a computer before the introduction of the **WorLD** programme in your school?

Yes	**1**	V4	8
No	**2**		

5 Do you have a computer at home?

Yes	**1**	V5	9
No	**2**		

6 If yes is it functional?

Yes	**1**	V6	10
No	**2**		

7 If you have a computer at home it is a

286	**1**	V7	11
486	**2**		
Pentium	**3**		
Other: (specify)			

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8 If you have a computer at home is it connected to the Internet?

Yes	**1**
No	**2**

V8 [ ] 12

9 What is the name of your school?

V9 [ ][ ] 13-14

10 What is the name of your province?

V10 [ ][ ] 15-16

11 What is your school's e-Mail address?

V11 [ ] 17

12 How many students participated in the **WorLD** project in your school?

V12 [ ][ ] 18-19

13 How long if any was the delay between registration of school for the **WorLD** project and supply and use of equipment?

V13 [ ][ ] 20-21

14 If there was a delay did it affect the project in your school?

Yes	**1**
No	**2**

V14 [ ] 22

SECTION B: TRAINING FOR THE WorLD PROJECT

15 Have you been trained for the **WorLD** programme?

Yes	**1**
No	**2**

V15 [ ] 23

16 Which of the listed application software have you been trained in?

Application software	Type/Product		
Word Processing	Microsoft Word	**1**	V16 [ ] 24
	Other: (specify)		V17 [ ] 25
Spreadsheets	Microsoft Excel	**2**	V18 [ ] 26
	Other: (specify)		V19 [ ] 27
Presentation graphics	Power Point	**3**	V20 [ ] 28
Using the Internet World Wide Web (WWW)	Internet Explorer	**4**	V21 [ ] 29
	Netscape	**5**	V22 [ ] 30
Using the Internet e-Mail	Group Wise	**6**	V23 [ ] 31
	Pegasus	**7**	V24 [ ] 32

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Database	Microsoft Access	**8**	V25		33	
	Other: (specify)		V26		34	
Desktop publishing		**9**	V27		35	
Web design		**10**	V28			36-37
Information skills (Research)		**11**	V29			38-39
		12	V30			40-41
Programming skills		**13**	V31			42-43
Other: (specify)			V32			44-45

17 Which of the following systems have you been trained in?

System	Type/Product/Explanation				
Hardware	Physical identification of computer components and how these function in the computer system	**1**	V33		46
Operating System Software	MS DOS	**2**	V34		47
	Windows 95	**3**	V35		48
	Windows 98	**4**	V36		49
	Windows 2000	**5**	V37		50
	Windows NT	**6**	V38		51
	UNIX	**7**	V39		52
Networking	Networking systems & procedures	**8**	V40		53
None		**9**	V41		54
Other: (specify)			V42		55-56

18 How many days in total were you trained for the programme? (choose one answer)

2 days	**1**	V43	57
3 days	**2**		
4 days	**3**		
More than 10 days	**4**		
Other. (specify)			

19 How many hours per day did you spend training for the **WorLD** project? (choose only one answer)

2 hours	**1**	V44	58
3 hours	**2**		
4 hours	**3**		
More than 10 hours	**4**		
Other. (specify)			

20 To what extent did you have a computer to practice after training sessions? (choose one answer)

I **always** had a computer to practice on	**1**	V45	59
I **sometimes** had a computer to practice on	**2**		
I **seldom** had a computer to practice on	**3**		
I **never** had a computer to practice on	**4**		
Other. (specify)			

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21 Are you able to provide first level technical support for your school computer system?

Yes	**1**
No	**2**

V46 [ ] 60

22 If "**no**" to Question 21, what is the main reason?

V47 [ ][ ] 61-62

23 Have you been trained for online-collaborative school projects?

Yes	**1**
No	**2**

V48 [ ] 63

24 Do you use information from the Internet for teaching purposes?

Yes	**1**
No	**2**

V49 [ ] 64

25 If no why not? (choose one answer)

The Internet is often not available	**1**
There is often no time to surf the Web for information for teaching purposes	**2**
There is not enough skill to find information from the Web	**3**
Other. (specify)	

V50 [ ] 65

26 How many collaborative projects have you been involved in? (choose one answer)

One	**1**
Two	**2**
More than 2	**3**
None	**4**
Other. (specify)	

V51 [ ] 66

27 If you have not undertaken any collaborative project why not? (choose one answer)

The Internet is often not available	**1**
There is often no time for collaborative school projects	**2**
There is not enough skill to undertake such project	**3**
There was no school partner to collaborate with	**4**
Other. (specify)	

V52 [ ] 67

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28 If you have undertaken successful collaborative projects which one (type) have you found most interesting and had the best participation of students?

V53 68-69

29 Which aspect of the **WorLD** training undertaken did you find most satisfactory?

V54 70-71

30 Which aspect of the **WorLD** training undertaken did you find most unsatisfactory?

V55 72-73

31 Which further training will you recommend for the programme?

V56 74-75
V57 76-77
V58 78-79
V59 80-81

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SECTION C: PROJECT TEACHERS' BACKGROUND TRAINING

32 What is the highest qualification of project teacher? (choose one answer)

Higher Diploma in Education HDE	**1**	V60	82-83
Bachelor of Education BEd	**2**		
Bachelor's degree	**3**		
Honours degree	**4**		
B/Hons	**5**		
Masters MEd/MA	**6**		
Other. (specify)			

33 Which of the teaching methods listed below are you familiar with?

Project based	**1**	V61	84
Constructivist	**2**	V62	85
Resource Based	**3**	V63	86
Authentic learning	**4**	V64	87
Student Team	**5**	V65	88
Research based	**6**	V66	89
System based	**7**	V67	90
None	**8**	V68	91

34 Which of the methods listed below have been in use before the introduction of the **WorLD** project in your school?

Project based	**1**	V69	92
Constructivist	**2**	V70	93
Resource Based	**3**	V71	94
Authentic learning	**4**	V72	95
Student Team	**5**	V73	96
Research based	**6**	V74	97
System based	**7**	V75	98
None	**8**	V76	99

35 Which of the methods below have you been trained in before?

Project based	**1**	V77	100
Constructivist	**2**	V78	101
Resource Based	**3**	V79	102
Authentic learning	**4**	V80	103
Student Team	**5**	V81	104
Research based	**6**	V82	105
System based	**7**	V83	106
None	**8**	V84	107

36 In which of the methods named below have you been **specifically** trained for the **WorLD** project?

Project based	**1**	V85	108
Constructivist	**2**	V86	109
Resource Based	**3**	V87	110
Authentic learning	**4**	V88	111

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Student Team	**5**	V89		112
Research based	**6**	V90		113
System based	**7**	V91		114
None	**8**	V92		115

37 Which of the methods named below have been introduced in your school because of the project?

Project based	**1**	V93		116
Constructivist	**2**	V94		117
Resource Based	**3**	V95		118
Authentic learning	**4**	V96		119
Student Team	**5**	V97		120
Research based	**6**	V98		121
System based	**7**	V99		122
None	**8**	V100		123

38 If **any** of the methods have been introduced who introduced it?

		V101		124-125

39 Which of the methods listed below are in use in the school **now**?

Project based	**1**	V102		126
Constructivist	**2**	V103		127
Resource Based	**3**	V104		128
Authentic learning	**4**	V105		129
Student Team	**5**	V106		130
Research based	**6**	V107		131
System based	**7**	V108		132
None	**8**	V109		133

40 Which technology-related skill development have you had access to?

Courses (apart from **WorLD** training) or workshops on basic introduction to hardware/word processing	**1**	V110		134
Courses offered by a private training organization	**2**	V111		135
On-site training visits to schools where computers are being used	**3**	V112		136
One to one professional mentoring	**4**	V113		137
Courses and workshops offered by an education department (eg a teachers' centre)	**5**	V114		138
None	**6**	V115		139
Other. (specify)		V116		140-141

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41 Which of the training listed above have other teachers on staff had access to?

Courses (apart from **WorLD** training) or workshops on basic introduction to hardware/word processing	**1**	V117	142
Courses offered by a private training organization	**2**	V118	143
On-site training visits to schools where computers are being used	**3**	V119	144
One to one professional mentoring	**4**	V120	145
Courses and workshops offered by an education department (eg a teachers' centre)	**5**	V121	146

42 How many other teachers have had access to technology related training in your school?

	V122	147-148

43 Are you undergoing any further training to upgrade and equip yourself for technology based education?

Yes	**1**	V123	149
No	**2**		

44 If you answered "**yes**" to Question 43, the course is offered by a (choose one answer)

University	**1**	V124	150
Technikon	**2**	V125	151
College	**3**	V126	152
Other: (specify)		V127	153

45 If you are not undergoing further training why not? (choose one answer)

Financial constraints	**1**	V128	154
No government funding	**2**		
No clear government policy on ITCs in education	**3**		
I don't know which institution to go to	**4**		
Other: (specify)			

SECTION D: CAPACITY ISSUES

46 Which of the following attributes have you acquired to manage your school computer system? (choose one answer)

Ability - Skill to deliver first level support as well as maintenance	**1**	V129	155
Time - enough outside teaching to engage in Collaborative projects	**2**		
Confidence - to operate computers without fear of causing damage to the tool	**3**		
None	**4**		

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Other: (specify)

47 If you have acquired any of the attributes how do you rate it?

Ability	**Fair** - 0% to 50%	**1**	V130	156
	Good - -51% to 74%	**2**		
	Excellent – 75% to 100%	**3**		
Time	**Fair** - 0% to 50%	**1**	V131	157
	Good - -51% to 74%	**2**		
	Excellent – 75% to 100%	**3**		
Confidence	**Fair** - 0% to 50%	**1**	V132	158
	Good - -51% to 74%	**2**		
	Excellent – 75% to 100%	**3**		

48 To what extent does your project duties affect your normal teaching? (choose one answer)

Unable to manage computer system and engage in collaborative projects because of teaching load/duties	**1**	V133	159
To a large extent	**2**		
Minimal extent	**3**		
No effect	**4**		
Other. (specify)			

49 Do you think the school requires the services of an additional staff member to help you with your duties?

Yes	**1**	V134	160
No	**2**		

50 Do you think the **WorLD** programme can fund the services of this person?

Yes	**1**	V135	161
No	**2**		

51 What qualification and skills should such a person have? (choose one answer)

A teacher who will manage the school library and provide first level technical support	**1**	V136	162
A purely technical person (Network controller)	**2**		
Other. (specify)			

52 Which of these support have you received from the project?

Emotional	**1**	V137	163
Technical	**2**	V138	164
Learning strategies	**3**	V139	165
Collaborative planning	**4**	V140	166
Mentor	**5**	V141	167
None	**6**	V142	168
Other. (specify)		V143	169-170

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53 How supportive has your school and principal been? (choose one answer)

Very supportive – 75% to 100%	**1**	V144	171
Supportive – 50% to 75%	**2**		
Luke warm support – 25% to 50%	**3**		
Not Supportive – 0% to 25%	**4**		
Other. (specify)			

54 If support has been unsatisfactory what do you think is the **main reason** responsible for that?

	V145	172-173

SECTION E: SCHOOL RESOURCE SITUATION

55 Which of the listed information resources below exist in your school **now**?

Computer Laboratory	**1**	V146	174
Library/Media Centre	**2**	V147	175
School Librarian / Media teacher	**3**	V148	176
School Multimedia Centre	**4**	V149	177
Internet access	**5**	V150	178
Network controller	**6**	V151	179
None	**7**	V152	180
Other. (specify)		V153	181-182

56 Which of the resources listed below existed in your school **before** the introduction of the project?

Computer Laboratory	**1**	V154	183
Library/Media Centre	**2**	V155	184
School Librarian / Media teacher	**3**	V156	185
School Multimedia Centre	**4**	V157	186
Internet access	**5**	V158	187
Network controller	**6**	V159	188
There were no resources present	**7**	V160	189
Other. (specify)		V161	190-191

57 How many computers do you have in your school?

Computers **in use**	286		V162		192-193
	486		V163		194-195
	Pentium		V164		196-197
	Other: (specify)		V165		198

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				V166	199-200
Computers **not** in use	286			V167	201-202
	486			V168	203-204
	Pentium			V169	205-206
	Other: (specify)			V170	207
				V171	208-209

58 How many of the school computers have **CD-ROM** drives?

Computers **in use**	286			V172	210-211
	486			V173	212-213
	Pentium			V174	214-215
	Other: (specify)			V175	216
				V176	217-218
Computers **not** in use	286			V177	219-220
	486			V178	221-222
	Pentium			V179	223-224
	Other: (specify)			V180	225
				V181	226-227

59 What **number** of your school computers have any of the following operating system **in use**?

DOS			V182	228-229
UNIX			V183	230-231
Windows 3.1			V184	232-233
Windows 95			V185	234-235
Windows 98			V186	236-237
Windows 2000			V187	238-239
Windows NT			V188	240-241
Other: (specify)			V189	242
			V190	243-244

60 Does your school have a computer Network?

Yes	**1**	V191	245
No	**2**		

61 If "**yes**" in Question 60, how is it connected to the Internet? (choose one answer)

Dial up modem (14.4 to 56k)	**1**	V192	246
Integrated services digital network (ISDN)	**2**		
Lease line	**3**		
Other. (specify)			

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62 If the school is connected to the Internet, how many computers are connected? (choose one answer)

One	**1**
Two	**2**
Three	**3**
All	**4**
Other. (specify)	

V193 [ ] 247

63 Which of the following technology exist in your school for the purpose of teaching?

TV(s)	**1**
Video Machines	**2**
Radio	**3**
Over head Projectors	**4**
Slide/Tape Projectors	**5**
Data Projectors	**6**
Tape recorder(s)	**7**
None	**8**
Other. (specify)	

V194 [ ] 248
V195 [ ] 249
V196 [ ] 250
V197 [ ] 251
V198 [ ] 252
V199 [ ] 253
V200 [ ] 254
V201 [ ] 255
V202 [ ][ ] 256-257

64 Which of the technology listed below existed **before** the **WorLD** project?

TV(s)	**1**
Video Machines	**2**
Radio	**3**
Over head Projectors	**4**
Slide/Tape Projectors	**5**
Data Projectors	**6**
Tape recorder(s)	**7**
None	**8**
Other. (specify)	

V203 [ ] 258
V204 [ ] 259
V205 [ ] 260
V206 [ ] 261
V207 [ ] 262
V208 [ ] 263
V209 [ ] 264
V210 [ ] 265
V211 [ ][ ] 266-267

65 Does the school have a file server?

Yes	**1**
No	**2**

V212 [ ] 268

66 Have you received any support from any of the established and better-resourced schools?

Yes	**1**
No	**2**

V213 [ ] 269

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67 If "**yes**" to Question 66, which of the following support have you received?

Donation of old Computers	**1**	V214		270
Donation of new Computers	**2**	V215		271
Technical	**3**	V216		272
Mail/Network services	**4**	V217		273
Other. (specify)		V218		274

68 If no why not? (choose one answer)

We have not asked them for support	**1**	V219		275
They are not willing to help despite our plea	**2**	V220		276
Such schools are very far away from us	**3**	V221		277
Other. (specify)		V222		278

SECTION F: ILLITERACY AS HINDRANCE TO THE USE OF ICTs IN A SCHOOL

69 To what extent are students engaged in the **WorLD** project able to read and write generally without assistance? (choose one answer)

To a large extent. Many of the students are able to read and write without help	**1**	V223		279
To a minimal extent. Only a few students can read and write	**2**			
Other. (specify)				

70 Where students have problems with reading and writing, indicate roughly the percentage range that experience such problems (choose one answer)

75% to 90%	**1**	V224		280
74% to 50%	**2**			
49% to 20%	**3**			
19% to 5%	**4**			
Other. (specify)				

71 To what extent are students able to access information from the Internet without assistance? (choose one answer)

To a large extent. Many of the students are able to access information without help	**1**	V225		281
To a minimal extent. Only a few students can access information without help	**2**			
Other. (specify)				

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72 To what extent are students able to read from the Internet? (choose one answer)

To a large extent. Many of the students are able to read form the Internet	**1**	V226	282
To a minimal extent. Only a few students can read	**2**		
Other. (specify)			

73 To what extent are students able to use information from the Internet? (choose one answer)

To a large extent. Many of the students are able to use information from the Internet	**1**	V227	283
To a minimal extent. Only a few students are able to use such information	**2**		
Other. (specify)			

74 If students experience problems with reading writing and using information from the Internet, what factors in your opinion are responsible for this? (choose one answer)

Lack of resources in the school	**1**	V228	284
Lack of resources at students' home environment	**2**		
Lack of experience with the use of The Internet	**3**		
Laziness	**4**		
Other. (specify)			

SECTION G: UTILIZATION OF MULTIMEDIA

Multimedia in the context of ***this questionnaire***, is **information** (data) in the formats of text, graphics, images (still and moving), **and sound** combined and generated by a computer.

75 Have you used a combination of any two of the above formats in any of the **WorLD** projects?

Yes	**1**	V229	285
No	**2**		

76 If you have which of the formats combined have you used?

V230		286-287
V231		288-289
V232		290-291
V233		292-293

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77 How do you think multimedia as a computer product/tool can help **WorLD** learners in the means listed below to improve upon their knowledge and skills?

Attract students to practice and acquire skills	**1**	V234		294
Stimulate their learning process	**2**	V235		295
Make up for inability to read effectively	**3**	V236		296
Enhance their concentration	**4**	V237		297
Eliminate passive learning	**5**	V238		298
Equip students with independent learning habits	**6**	V239		299
Build in students curiosity and the quest for knowledge	**7**	V240		300
Support their oral cultural background	**8**	V241		301
Other. (specify)		V242		302-303

78 For multimedia to be fully operative, it requires the following minimum listed equipment. Which of the equipment below do you have in your school?

At least a 486 PC with 540 Mb Hard disk	**1**	V243		304
Super VGA monitor	**2**	V244		305
Loud speakers/Sound blasters	**3**	V245		306
Digital camera	**4**	V246		307
Video Camera	**5**	V247		308
Page/ graphic Scanners	**6**	V248		309
Voice digitizers	**7**	V249		310
Windows operating system	**8**	V250		311
Other. (specify)		V251		312-313

79 With the computer skills you have acquired are you able to utilize fully multimedia for educating your learners?

Yes	**1**	V252		314
No	**2**			

80 If no which area of expertise do you think you need to improve upon?

Multimedia Web page design	**1**	V253		315
Multimedia Pedagogy	**2**	V254		316
Technical computer skills	**3**	V255		317
Other. (specify)		V256		318

SECTION H: BENEFITS AND CHALLENGES OF THE WorLD PROGRAMME

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81 In what way has the programme been of benefit you?

Introduced modern approaches to teaching and learning	**1**	V257		319
Introduced new insights into education	**2**	V258		320
Introduced new challenges to my professional development	**3**	V259		321
Ushered me into the global educational arena	**4**	V260		322
Enable me to develop myself as far as the new approach to education is concerned	**5**	V261		323
Enabled me to equip myself with computer and information skills	**6**	V262		324
		V263		325
Other. (specify)		V264		326-327

82 In what way(s) has the programme been of benefit to the school?

The school has received international recognition (Has been put on the Internet: Information superhighway)	**1**	V265		328
Modern educational equipment have become part of the schools' teaching and learning environment.	**2**	V266		329
Students are able to engage in collaborative learning with others far and wide	**3**	V267		330
Students acquire skills which they will use at work places or for further education	**4**	V268		331
Spill over benefits in the form of infrastructure and logistics have been made available	**5**	V269		332
Other. (specify)		V270		333-334

83 In what way(s) has the project been a challenge to the project teacher?

More work and added responsibility without additional pay	**1**	V271		335
Inability to fully discharge normal teaching duties	**2**	V272		336
Caused conflict with other members of staff	**3**	V273		337
Caused me un-refunded financial expenditure	**4**	V274		338
Caused conflict with school principal	**5**	V275		339
Other. (specify)		V276		340-341

84 In what way(s) has the programme been of a hindrance to the school?

Caused conflicts among teachers	**1**	V277		342
Students spend more time at the computer room at the expense of their examination subjects	**2**	V278		343
It is an expensive venture	**3**	V279		344
Other. (specify)		V280		345

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85 What problems do you anticipate in the future with the introduction of computers to the learning process in your school?

Cost of maintenance of the computer system may be out of reach of school (parents)	**1**	V281	346
Traditional culture and language will be lost	**2**	V282	347
Teachers who will not update their skills and knowledge will frustrate the system	**3**	V283	348
Other. (specify)		V284	349

86 What suggestions do you have to improve the use of computers for education in your school and the **WorLD** project in South Africa?

V285		350-351
V286		352-353
V287		354-355
V288		356-357
V289		358-359

Thank you for answering this questionnaire

Hillar Addo

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Appendix 5

Students' letter of introduction of questionnaire

SCHOOL OF INFORMATION TECHNOLOGY UNIVERSITY OF PRETORIA

QUESTIONNAIRE ON THE UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) IN EDUCATION FOCUSING ON THE WORLD LINKS FOR DEVELOPMENT (WorLd) PROGRAMME IN SOUTH AFRICA

I am a Doctoral Student in the School of Information Technology, University of Pretoria. I am pursuing a study of the World Links for Development (**WorLD**) programme in South Africa.

Your school has been selected as one that is participating keenly in the projects. I would be most grateful if you as a learner who has participated in the project would assist me by responding to the questions in this questionnaire and returning it to me as soon as possible.

Please answer the questions as honestly as possible.

Your answers will be treated confidentially.

INSTRUCTIONS

Please answer each question by drawing a neat circle around the appropriate number in a shaded box, or where asked for write your answer in the shaded space provided.

Thank you for your assistance

Hillar Addo

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Respondent	VR	1-2
School	VS	3-4

SECTION A: STUDENT BACKGROUND

1 I am a student

Male	**1**	V1	5
Female	**2**		

2 I am a

Black South African	**1**	V2	6
White South African	**2**		
Other: (specify)			

3 In what grade are you?

	V3	7-8

4 Have you ever used a computer before the **WorLD** project was introduced to your school?

Yes	**1**	V4	9
No	**2**		

5 Have you ever been trained to use a computer before the project?

Yes	**1**	V5	10
No	**2**		

6 Do you have a computer at home?

Yes	**1**	V6	11
No	**2**		

7 If "**yes**" to Question 6, does it function?

Yes	**1**	V7	12
No	**2**		

8 If you have a computer at home is it connected to the Internet

Yes	**1**	V8	13
No	**2**		

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SECTION B: TRAINING

9 How have you been trained for the **WorLD** programme? (choose one answer)

I have been trained very well	**1**	V9	14
I have been trained fairly well	**2**		
Training has been unsatisfactory	**3**		
I have had no training at all	**4**		
Other. (specify)			

10 If you have been trained, about how many hours per day did you spend in training for the project? (choose one answer)

2 hours	**1**	V10	15
3 hours	**2**		
4 hours	**3**		
More than 5 hours	**4**		
Other. (specify)			

11 How many days in total were you trained for the programme? (choose one answer)

2 days	**1**	V11	16
3 days	**2**		
4 days	**3**		
More than 5 days	**4**		
Other. (specify)			

12 Which of the listed application software have you been trained in?

Application software	Type/Product			
Word Processing	Microsoft Word	**1**	V12	17
	Other: (specify)		V13	18
Spreadsheets	Microsoft Excel	**2**	V14	19
	Other: (specify)		V15	20
Presentation graphics	Power Point	**3**	V16	21
Using the Internet World Wide Web (WWW)	Internet Explorer	**4**	V17	22
	Netscape	**5**	V18	23
Using the Internet e-Mail	Group Wise	**6**	V19	24
	Pegasus	**7**	V20	25
Database	Microsoft Access	**8**	V21	26
	Other: (specify)		V22	27
Desktop publishing		**9**	V23	28
Web design		**10**	V24	29-30
Information skills (Research)		**11**	V25	31-32
		12	V26	33-34
Programming skills		**13**	V27	35-36
Other: (specify)			V28	37-38

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13 For which of the following did you find the training to be unsatisfactory?

Microsoft Word	**1**	V29		39
Microsoft Excel	**2**	V30		40
Power Point	**3**	V31		41
Internet Explorer	**4**	V32		42
Netscape	**5**	V33		43
Group Wise	**6**	V34		44
Pegasus	**7**	V35		45
Microsoft Access	**8**	V36		46
Desktop publishing	**9**	V37		47
Web design	**10**	V38		48-49
Information skills (Research)	**11**	V39		50-51
Programming skills	**12**	V40		52-53
Other. (specify)		V41		54-55

14 Which of the following systems have you been trained in?

System	Type/Product/Explanation			
Hardware	Physical identification of computer Components and how these function in the computer system	**1**	V42	56
Operating System Software	MS DOS	**2**	V43	57
	Windows 95	**3**	V44	58
	Windows 98	**4**	V45	59
	Windows 2000	**5**	V46	60
	Windows NT	**6**	V47	61
	UNIX	**7**	V48	62
Networking	Networking systems & procedures	**8**	V49	63
None		**9**	V50	64
Other: (specify)			V51	65-66

15 For which of the following did you find the training to be unsatisfactory?

Hardware	**1**	V52		67
MS DOS	**2**	V53		68
Windows 95	**3**	V54		69
Windows 98	**4**	V55		70
Windows 2000	**5**	V56		71
Windows NT	**6**	V57		72
UNIX	**7**	V58		73
Networking	**8**	V59		74
Other. (specify)		V60		75-76

16 To what extent have you had a computer to practice after training sessions? (choose one answer)

I **always** had a computer to practice on	**1**	V61		77
I **sometimes** had a computer to practice on	**2**			
I **seldom** had a computer to practice on	**3**			
I **never** had a computer to practice on	**4**			

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Other. (specify)

17 To what extent have you been trained for collaborative school project? (choose one answer)

I have been trained **very well**	**1**	V62 ☐ 78
I have been trained **fairly well**	**2**	
Training has been **unsatisfactory**	**3**	
I have had **no training** at all	**4**	
Other. (specify)		

SECTION C: LANGUAGE PROFICIENCY

18 Which of the following do you prefer as a means of communication at school? (choose one answer)

English	**1**	V63 ☐ 79
Local language	**2**	
Other. (specify)		

19 How do you rate your ability to read English texts from books? (choose one answer)

Excellent - Above 75%	**1**	V64 ☐☐ 80-81
Very Good – 60% to 74%	**2**	
Good – 50% to 59%	**3**	
Fair – 40% to 49%	**4**	
Poor – 20% to 39%	**5**	
Very Poor – 0% to 10%	**6**	
Other. (specify)		

20 How do you rate your ability to read English texts from computers? (choose one answer)

Excellent - Above 75%	**1**	V65 ☐☐ 82-83
Very Good – 60% to 74%	**2**	
Good – 50% to 59%	**3**	
Fair – 40% to 49%	**4**	
Poor – 20% to 39%	**5**	
Very Poor – 0% to 10%	**6**	
Other. (specify)		

21 If your reading is not good what reasons do you think are responsible? (choose one answer)

Lack of reading material at school	**1**	V66 ☐ 84
Lack of reading material at home	**2**	
Use of the local language sometimes as a means of instruction at school	**3**	

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Use of the local language as a means of communication mostly between teachers and students and between students	**4**
Other. (specify)	

22 How often have you used information from computers for class exercises? (choose one answer)

Very often	**1**	V67 ☐ 85
Often	**2**	
Not often	**3**	
Not at all	**4**	
Other. (specify)		

23 How many collaborative projects have you been involve in? (choose one answer)

One	**1**	V68 ☐ 86
Two	**2**	
Three	**3**	
None	**4**	
Other. (specify)		

24 Do you enjoy using computers for your studies?

Yes	**1**	V69 ☐ 87
No	**2**	

SECTION D: UTILIZATION OF MULTIMEDIA

25 Do you have a television at home?

Yes	**1**	V70 ☐ 88
No	**2**	

26 How often do you view television (choose one answer)

Very often	**1**	V71 ☐ 89
Often	**2**	
Not often	**3**	
Not at all	**4**	
Other. (specify)		

27 Which of the following do you prefer in the process of using computers for learning? (choose one answer)

Pictures alone	**1**	V72 ☐ 90
Pictures with text	**2**	
Picture, text and sound	**3**	

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Text alone	**4**
Sound alone	**5**
Other. (specify)	

SECTION E: ADVANTAGES AND CHALLENGES

28 In what way do you think the computer as a tool helps you to improve upon your studies? (choose one answer)

I am able to concentrate on what I was doing at a time	**1**	V73 91-92
I enjoy using the computer to learn	**2**	
I am able to communicate and share knowledge	**3**	
I am able to access lots of information	**4**	
I am able to develop learning skills	**5**	
I have a lot of fun working with computers	**6**	
Other. (specify)		

29 What is the **most** important thing you should do to derive the full benefit from learning with computers?

Read more about computers to know about what they can do and their limitations	**1**	V74 93
Learn computer programming in order to understand how They function	**2**	
Practice to learn the correct use of many application programs	**3**	
Other. (specify)		

30 What suggestions do you have which will help improve upon the project in your school and in South Africa as a whole?

V75 94-95
V76 96-97
V77 98-99

Thank you for answering the questions

Hillar Addo