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.