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The cognitive and social influences of computer technology on profoundly deaf young children

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ABSTRACT

The cognitive and social influences of computer technology on profoundly deaf learners

CAPE TECHNIKON

Submitted by Linda Arnott for a Master of Education degree at Cape Technikon

Faculty of Education

This dissertation is located in the field of early childhood development. It is situated in the context of education for learners with language, cognitive, and social impairments. The study explores the cognitive and social "value-added" of computer technology on profoundly deaf young learners.

**THE COGNITIVE AND SOCIAL INFLUENCES OF
COMPUTER TECHNOLOGY ON PROFOUNDLY DEAF
YOUNG CHILDREN**

A Vygotskian theoretical framework was used to explore the efficacy of the computer as a tool for learning in the profoundly deaf. Social and collaborative learning with peers was

A thesis presented in fulfilment of the requirements for the degree
of

A case study was conducted with a cohort of seven profoundly deaf Grade R learners (aged 5-6 years) at a special needs school in the Western Cape. The study was an empirical investigation within a qualitative research paradigm, using observation and interviews. The report provides a descriptive account that makes use of illustrative vignettes.

MASTER OF EDUCATION

The study concludes that computer influences social development within the classroom. Computer was also able to scaffold children's understanding of mathematical tasks and thereby provide a cognitive influence on learning.

Linda Arnott

Supervisor: Prof. Maureen Robinson

Co-supervisor: Dr Wendy McMillan

July 2004

ABSTRACT

The cognitive and social influences of computer technology on profoundly Deaf young learners

Submitted by Linda Arnott for a Master of Education degree at Cape Technikon

This dissertation is located in the field of early childhood development. It is situated in the context of education for learners with special educational needs (ELSEN). The specific context was Deaf children who learn through the medium of South African Sign Language. The study is an investigation into the cognitive and social "value-addedness" of computer technology on profoundly deaf young learners.

A Vygotskian theoretical framework was used to explore the efficacy of the computer as a tool for learning in the profoundly Deaf. Social and collaborative learning with peers was investigated.

A case study was conducted with a cohort of seven profoundly Deaf Grade R learners (aged 5-6 years) at a special needs school in the Western Cape. The research methodology was an empirical investigation within a qualitative research paradigm, using observation and interviews. The report provides a descriptive account that makes use of illustrative vignettes.

The study concludes that the computer influences social development within the cohort. The computer was also able to scaffold children's understanding of mathematical tasks and thereby provide a cognitive influence on learning.

July 2004

DECLARATION

DEDICATION

I hereby declare that this dissertation, unless specifically indicated to the contrary in the text, is my own original work and that it has not been submitted for any degree at any other university.

Full name: **Linda Arnott**

Date: **July 2004**

Signed: ... *L. Arnott* ...

ACKNOWLEDGMENTS

DEDICATION

I would like to thank:

Louise Kietzmann 1883-1945

To my grandmother, who became deaf at an early age as a result of ossification of the small bones in her ears. She could, however, hear and communicate when driving a Ford Four on the gravel roads from Umgwali to King Williams Town as she drove her children back to boarding school.

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The principal, the educators and the learners for allowing me to research at their school so I could gain an insight into Deaf culture.

My family: Dave for giving me time and space to fulfil a lifelong dream. Nicholas and Christopher for encouragement.

The financial assistance of the Cape Technikon towards this research is hereby acknowledged. Conclusions drawn and opinions expressed are those of the author and not those of the institution.

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Cognitive development

Social development

Special educational needs

Collaborative learning

KEYWORDS

Early childhood development

Grade R/Reception year

Deaf

South African Sign Language

Computer technology

Vygotsky

Cognitive development

Social development

Special educational needs

Collaborative learning

Chapter 1

ORIENTATION TO THE STUDY

A rare opportunity that experimenting with computers has given us is a chance to focus on children as they explore a new medium. Because the medium is new and different, we are cautious, concerned, even sceptical. Therefore we observe more carefully, and from that observation emerges special insights that add to our understanding of how the young child reasons and what the young child seeks to invent. As we listen and question, we discover more often than not that we are the learners (Wright & Shade, 1994:3).

1.1 Introduction

This thesis focuses on the cognitive and social influences of computer technology on profoundly Deaf¹ young learners. In Chapter One I will provide an overview of the study.

In my work as a trainer of educators on a partnership programme between a multi-national Information Technology Corporation and a Western Cape non-governmental organisation, I was introduced to computers as an innovative way of teaching young children. I was a facilitator on an initiative to implement computer technology in the Reception year (Grade R) curriculum. Very soon I became aware of its success in early childhood classroom settings. The transferability of this assumption was contested when an educator at a school for learners with special educational needs attended the training. The learners were all profoundly Deaf. They communicated using South African Sign

¹ The use of the capital "D" denotes the language and cultural entity. It signifies belonging to Deaf culture (see DEAFSA, Deaf culture; Sacks, 1990; Lucas, 2001; Aarons & Akach 2002). It is in accordance with international convention in literature on Deafness.

Language (SASL). In the developing context of computer applications for young children, the introduction of computers to profoundly Deaf young learners provided an opportunity for a challenging empirical investigation.

1.2 Background to the research problem

A pedagogical tension exists between the methodological approach in early childhood development which is based on active discovery learning, and programmed computer technology (Bredekamp & Rosegrant, 1994:54). Bredekamp and Rosegrant (1994) argue that computer technology may be seen as instructional and formal. In informal education² more open-ended materials are used which allow the child to self-direct his/her learning. Early childhood development favours the approach of concrete and experientially based learning. Sand and water play would be examples of concrete and experiential learning opportunities that make use of open-ended materials. The very nature of both sand and water make these unstructured materials suitable for children to explore.

A commonly held assumption is that that the computer is not concrete and it requires symbolic competences (Sheingold, 1984:2). The keyboard on the computer is symbolically represented. The layout of the keyboard's design allows the use of icons and the alphabet; the computer requires symbolic understanding.

However, Clements (2002:160) argues that much of the young child's play is symbolic. Support for the use of computer technology also comes from Appel and O'Gara (2003:1) who argue that young children's

² Informal education refers to the years before formal schooling.

interaction with computer technology stimulates cognitive learning and provides a readiness for the future. They posit that computers give children a head start into a technological future (Appel & O'Gara, 2003:1).

Within the debate on the use of computers with young children there is still a dearth of literature on computers and children with barriers to learning. In research on the future directions of computer technology Judge (2001:1) argues that:

There still appears to be a paucity of empirical research regarding the use of computer technological intervention with young children who have disabilities.

The introduction of computers in South African Grade R classrooms increases the significance of this study. Computers may support special needs educational settings as an additional tool for learning. According to Judge (2001:1):

Computer applications can serve as an equaliser for a child with disabilities so that he or she can function in the same settings and in similar activities engaged in by typical young children.

In this thesis, I will draw on these debates to argue that there is a place for computers in special educational settings.

1.3 Statement of the problem

Proponents of technology claim that **all** children should be exposed to the advantages of technology (Clements, 2002:160). The special needs of deaf children and their barriers to learning need to be researched in the context of what computer technology offers as an aid to learning.

Susini and Tronconi (1990)³ call for the provision of tools which can improve the communication of Deaf children. They argue that:

Computers can serve as permanent aids for the deaf. Exploiting the visual-manual channel, the personal computer can be used in place of traditional education.

The young child who uses sign language is dependent on the signer/the educator for all educational input. Can computers mediate and assist the profoundly Deaf learner? Empirical evidence and literature suggest that computers can provide scaffolding for learning. Can they also do this for profoundly Deaf children? This clearly needs further investigation. Guralnick (1997:455) has called for "a second generation of research" which looks at what kind of intervention can ameliorate the problems of Deaf children.

1.4 The purpose of the research

My key concern centred on assessing the ability of the profoundly Deaf child to learn cognitively and socially from computer technology. The profoundly Deaf learner is dependent on the educator to mediate learning through South African Sign Language (SASL) which is a visual-spatial language. The computer itself is a visual technology that demands manual involvement. The sensory challenges faced by the young Deaf learner could be in opposition to the demands of the computer. The manual requirements of sign language may interfere with the manipulation of the computer mouse.

³ Where page numbers are omitted, articles were downloaded from vendors such as EbscoHost; page numbers of downloaded articles therefore do not correspond with those of the published journal articles, as cited in the Bibliography.

The computer gives instructions to hearing children but Deaf children require their instructions to be signed. The educational challenge was to scaffold the learner's ability to adapt to a new computer-based task.

1.5 The research question

This study was both exploratory and descriptive. The researcher intended exploring the ability of profoundly Deaf Grade R learners to benefit educationally from the use of computer technology and to describe whether and how the learners were influenced both socially and cognitively.

The primary research question arose from the challenges of Sign Language and computer mouse control as they are both used by profoundly Deaf children simultaneously. The research question is phrased in the following way:

Can computer technology add value to the education of profoundly Deaf young learners?

The auxiliary questions are designed to facilitate the answering of the research question:

Can computers provide a "scaffold" for learning in profoundly Deaf children?

Is there evidence of collaborative learning between Deaf children when they use the computer?

1.6 An overview of the study

Chapter 1 provides an introduction to the research. It outlines the rationale for the investigation into the cognitive and social influences of computer technology on profoundly Deaf young learners. The research question is explained and substantiated.

Chapter 2 surveys the literature pertaining to this study. A Vygotskian framework was selected as an effective theoretical tool. Vygotsky provides the conceptual tools which underpin this study.

The notion of the developmentally appropriate use of computer technology for young children has been explored in literature on early childhood development. There is, however, a dearth of literature pertaining to young children with special educational needs and computer technology.

A third intersecting theme reviewed in the literature is that of Deaf culture. According to the literature, the use of sign language is the binding aspect in the establishment of Deaf culture.

The literature review links these three intersecting themes.

Chapter 3 provides an exposé of the research design and methodology applied in this study. The use of a qualitative research design is motivated. Qualitative research allows for a "thick" description in the analysis of the research. Denzin (1989:83) describes the term as follows:

A thick description does more than record what a person is doing. It goes beyond mere fact and surface appearances. It presents detail,

Last context, emotion, and the webs of social relationships that join persons to one another

The application of the case study approach permitted in-depth analysis of individual learning responses. The descriptive study was considered a suitable tool as seven detailed cases were described.

Data was gathered by means of observation, semi-structured interviews and video recording. A field visit programme is provided in this chapter.

Semi-structured interviews were conducted with the three educators who worked with the Grade R class of 2003.

The analysis of data was an on-going process which began at the first observation. Later, data editing was conducted in order to reduce the data. Emerging themes were clustered to avoid overlapping.

Chapter 3 also includes an explanation of the validation of the data used in my study.

Chapter 4 describes the setting and contextualises my study. The unique educational provision of a school that teaches profoundly Deaf children through South African Sign language is described. The rights of learners in relation to the medium of instruction for educational purposes are expounded.

Chapter 4 also details the children's profiles and the special educational needs of the seven Grade R learners that make up the cohort. It introduces the educators that work with the Grade R learners.

Lastly, it provides a detailed explanation of the computer program, *Millie's Maths House*, used in this study.

Chapter 5 draws together the findings of the research and highlights the unique responses of children through the use of vignettes as descriptive analysis and interpretation. In the analysis the following findings emerged:

It was evident that the computer had a significant social influence on children's learning. The influences were, however, unique to individuals. The cognitive influences of computer technology had significant benefits for the mathematical and numerical learning of this cohort.

The computer encouraged and fostered unique opportunities for collaborative work between peers. It was evident that computer technology was able to provide a scaffold for young children's learning.

Chapter 6 presents a summary of the thesis and identifies the gaps and limitations of the study. It draws conclusions and suggests possible further research as continuity to this study.

1.7 Particular challenges of the research

There were a number of challenges in this study. The first challenge was to determine **how** profoundly Deaf children learn by means of computer technology. Van Scoter, Ellis and Railsback (2001:3) argue that new understandings may lie in the highly visual and animated way in which technology presents difficult-to-understand concepts. The mathematics computer program that was chosen for my research allowed

for observation of the cognitive influences of computers on conceptual learning.

The second challenge centred on the setting of the research. The challenge was to sign all the computer instructions to the learners. This posed an educational challenge to both the educator and the researcher. All instructions to the learners had to be mediated in SASL.

In a number of early intervention programmes, “mediated” or “structured” learning has been successful (Walker, Elliot & De Lacey, 1994:41). The Vygotskian construct of a socially shared cognition provided a conceptual answer for paired work at the computer.

Bruner (1986:74) draws on Vygotsky’s idea of the transmission of knowledge when he argues that Vygotsky believed:

the transmission of mind across history is effected by successive mental sharing that assures a passing on of ideas from the more able or advanced to the less so. And the medium in which the transmission occurs is language and its products: literacy, science, **technology**, [and] literature.

The mental sharing that Bruner alludes to is the collaborative approach applied in this study. The computer was used as a tool to support learning with the help of a peer. Vygotsky (1978:86) postulates that what one does with guidance today may be accomplished independently tomorrow.

The third challenge focused on appropriate educational interventions for Deaf children. In literature searches on this topic it became clear that all early intervention attempts for Deaf learners are focused on language development for children who cannot communicate. The

introduction of computer technology could provide an alternative and less frustrating way of learning about the world (Susini & Tronconi, 1990:215).

1.8 Definition of terms and concepts

There are terms and concepts used in this study that require a clear definition for the reader. They are as follows:

1.8.1 Early childhood development

An umbrella term which describes the education of children aged 0-9 years (Department of National Education, 2001a).

1.8.2 Grade R/ Reception year

The first year of the Foundation Phase during which learners aged 5-6 years are educated (Department of National Education, 2001a).

1.8.3 Profoundly Deaf

A hearing loss greater than 70 decibels (Guralnick, 1997:456).

1.8.4 Deafness

The use of the capital letter "D" denotes the language and cultural entity. It signifies belonging to a Deaf culture. The use of the lower case "d" refers only to the audiology of being deaf (Sacks, 1990:10).

1.8.5 South African Sign Language (SASL)

SASL is the primary medium of face-to-face communication used by the Deaf. SASL is a fully fledged language that is structurally and functionally the same as all other languages (DEAFSA. Sign Language).

1.8.6 Information and communication technology

The range of tools and techniques in information and communications technology (ICT) relating to computer-based hardware and software (Kennewell, Parkinson & Tanner, 2000:1).

1.8.7 Mediated learning

Mediated learning takes place when a more competent other guides the development of the learner. The development of cognitive functions occurs with nurturing and guidance by peers or adults who have already reached that level (Vygotsky, 1978:85).

1.8.8 Collaborative learning

The learning that takes place when the child interacts and co-operates with peers in his/her environment (Vygotsky, 1978:90). The social nature of learning allows children to “grow into the intellectual life of those around them” (Vygotsky, 1978:88).

1.9 Research design and methodology

The research design of this study was an empirical investigation within a qualitative research paradigm. The researcher sought meaning

through observations, interviews and immersion in both literature and data. Qualitative investigation is appropriate to the study as:

... the principal concern is an understanding of the way in which the individual creates, modifies and interprets the world in which he or she finds himself or herself (Cohen & Manion, 1994:8).

In this study it is the world of computers that is under investigation.

The sample was a cohort of seven Deaf Grade R learners at a special needs school in the Western Cape, serving socio-economically disadvantaged children.

An in-depth study took place with the Grade R learners at the school. It was classroom-based and took place during the normal daily programme.

A descriptive case study was appropriate for this methodological design as a few detailed cases are described (Neuman, 1997:331).

Other design principles such as conceptualisation, detailed descriptions, data sourcing and analysis were applied (Mouton, 2001:282). Conceptualising the case study required the formulation of guiding principles. Multiple sources of data were involved. These are detailed in Chapter 3 and briefly summarised in the next paragraphs.

Discussions with educators and staff were held at regular intervals, to record the children's use of the computer. Educators observed and recorded new skills the learners acquired on the computer.

Semi-structured interviews with the educators and the teaching assistant were conducted in July. An interview protocol was designed using

open-ended questions. The interview allowed the educator and the teacher assistant to provide evidence of the learners' conceptual learning.

Weekly observations were done at the school to monitor and record the cognitive and social influence of computer technology. An observation schedule was developed using criteria that reflected the research outcomes.

Relevant literature and available data was surveyed. In order to validate the research, triangulation of different methods was applied.

Hitchcock and Hughes (1995:104) refer to triangulation as ... the use of more than one method of data collection within a single study.

1.11 Conclusion

Hitchcock and Hughes (1995:105) argue that triangulation is a basic principle of social research.

The ethical considerations to conduct social research were addressed by seeking access to the school via the Western Cape Department of Education. Consent to research at this school was received from the principal and the educator. Letters were sent to the guardians/parents of the learners (in Xhosa and English) assuring them of confidentiality and anonymity and requesting permission to work with their children. Permission was granted at each of these levels.

1.10 The scope of the study

The study deals with the cognitive and social influences of computers on profoundly Deaf young learners. Research is limited to the Grade R class. Therefore, a limitation of this study is the choice of a narrowly defined age cohort. The age of 5-6 years does not embrace the full spectrum of early childhood education which is 0-9 years.

A second key limitation is not being able to explore the impact of socio-economic disadvantage on these learners. The scope of the study is limited to the influence of computers on profoundly Deaf learners and not on how it may intersect with home circumstances. The home circumstances of the children are, however, briefly outlined in the vignettes, to give the reader a sense of each child's social context.

1.11 Conclusion

Chapter 1 has outlined and provided an overview to this study. It is clear that computers create a challenge to both learners and educators in the 21st century. Their applications may even create a tension for the young learner being instructed in South African Sign Language.

In Chapter 2 I draw on the relevant literature to support the argument for the cognitive and social influences of computers on profoundly Deaf young learners. I also explore a suitable theoretical understanding to underpin my research study.

Chapter 2

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

In Chapter 2 my choice of a Vygotskian theoretical framework is explained. Vygotsky's ideas about learning and their applications to computer technology are discussed. Literature on the profoundly Deaf young learner is also reviewed. Vygotsky provides the conceptual tools to link his socio-cultural theory to Deaf culture. The pioneering approach Vygotsky took of locating research in the "field" as opposed to the "laboratory" is linked to the researcher's notion of qualitative research through unobtrusive observation of profoundly Deaf learners at school (Vygotsky, 1978:14). Vygotsky further argues that his research outcome was to explain the salient features of human behaviour. Bruner in the foreword to Vygotsky (1962) describes it as a theory of education.

Finally, the three separate issues, namely computers, profoundly Deaf young learners and Vygotskian theory, will be drawn together to illustrate their inter-relatedness as they apply to this scholarship.

2.2 Selected Vygotskian ideas are reviewed

The Vygotskian literature I have drawn on is *Thought and Language* (1962) and *Mind in Society: the development of higher psychological processes* (1978). The relationship between thought and language drawn from Vygotsky's (1962) theory is relevant to my research. His ideas on thought and language have a bearing on the young Deaf learner.

Vygotsky's unique concept, termed the zone of proximal development (ZPD), is an important tenet of Vygotskian theory. Vygotsky argues that children can be assisted through a zone of proximal development. The zone of proximal development is the distance between actual development of the child and the level of potential development with guidance from others (Vygotsky, 1978:86).

Vygotsky's third contention is that learning is inherently social (collaborative). Children are able to learn in social and cultural contexts from other members of that society. Knowledge is shared and skills are transferred (Vygotsky, 1978:86, Berk & Winsler, 1995:12).

The question which drives Vygotsky's theory provides a springboard for further inquiry. Vygotsky's (1978:13) central question in his empirical investigations was "What are the children doing? How are they trying to satisfy task demands?". It is through these questions that Vygotsky allows us to think about **how** children learn.

2.3 Language and thought

A unique feature of humankind is their ability to use language as a means of communication. In Vygotsky's (1962:41) research on thought and speech he refers to apes as possessing an "approaching intellect". However it is language that differentiates humans from apes (Vygotsky, 1962:48). Vygotsky posits that the role of language is also to organise higher mental functions (Vygotsky, 1978:23).

Vygotsky based his theories of thought and language development on the works of three important writers. They are Karl Buehler, William Stern and Jean Piaget's early works (Bruner, 1986:7). After drawing on the work of these researchers, Vygotsky concluded that "speech plays

an essential role in the organization of higher psychological functions” (Vygotsky, 1978:23).

Later, Vygotsky (1978:53) refers to a “higher behaviour” when the In his argument on the relationship between speech and tool use, Vygotsky states that maturation is secondary to the development of human behaviour (1978:19). Symbolic tools like counting, drawing, and writing may be used by people to assist cognitive functions. Children are able to repeat words and to behave as though they understand the meaning. It is the imitation of speech that is required to precede and mature into thoughtful conversation (Vygotsky, 1962:104). Clearly, children must use many words before meaningful conversation takes place.

he put her hands under a tap and said it was the “miracle of her comprehension of language” (1913:123)

Vygotsky (1978: 23) draws an analogy between tools and signs. In the analogy he presents a drawn schema that shows the relationship of sign and tool to the mediated activity. Mediated activity takes place when a more competent other guides the development of the learner. He contends that the mediated function comes to the fore and language is the mediated mode (1978:54). Berk and Winsler (1995) cite Vygotsky’s analogy and differentiate between symbolic tools and technical tools. They argue that:

always, and at once, both social and intellectual in function (Sacks, 1998:62).

A technical tool is a mediator of human influence on the surrounding environment (Berk & Winsler, 1995:21).

It is environment (Berk & Winsler, 1995:21). Vygotsky argues that speech cannot be activated without understanding. The child must be In the twenty-first century the computer is regarded as a technical tool used to aid increasingly complex cognitive functions. Signs on the other hand are socially constructed and serve the social purpose of sharing cultures between people. It is clear that Vygotsky believed that language shaped mental processes. These mental processes would be mediated by signs and tools. He refers to the work of Guillaume and

Meyerson (1930) to support his findings that speech is significant in the organisation of higher psychological functions (Vygotsky, 1978:23). Later, Vygotsky (1978:55) refers to a "higher behaviour" when the combination of sign and tool is applied in psychological activity.

Lee and Smagorinsky (2000:2) refer to speech as the "tool of tools". The realisation by children that all words have meaning and each object has its own name has been described by William Stern and cited by Vygotsky (1978:23) as "the greatest discovery in the child's life". Brown and Crone concur when they record the experience of Helen Keller, a blind and deaf mute [*sic*], who finger spelt the word water when she put her hands under a tap and said it was the "miracle of her comprehension of language" (1913:123).

Vygotsky suggests that prior to understanding the meaning of words the child's language is pre-intellectual. Until this conceptual development has taken place, the child only knows words that have been taught by other people (Vygotsky, 1962:43). Sacks agrees with this understanding when he says:

language is always, and at once, both social and intellectual in function (Sacks, 1990:62).

It is clear that language is a social construct. Vygotsky argues that speech cannot be activated without understanding. The child must be conceptually knowledgeable about the content of the conversation (1962:44). Vygotsky (1962:44) further states that:

thought and speech have different roots.

⁴ Ontogenisis refers to the evolution and development of the individual (Oreva, 1932:193).

In his research findings, Vygotsky established a pre-intellectual stage in speech development. However in the development of thought he refers to a pre-linguistic stage (Vygotsky, 1962:44). The one stage precedes the other; however the roots of each stage are different.

A child's understanding of the meaning of language is only possible after the realisation of significant development in both speech and thought. Children need to be guided towards the development of thought processes. Vygotsky termed the language of our thoughts our "inner speech" (Vygotsky, 1962:44). Therefore, inner language is the precursor to thought. According to Vygotsky, speech turns inward because of a change in its function. Our inner speech is used in higher cognitive functioning like problem-solving. Inner speech raises interesting questions for profoundly Deaf children who use a visual spatial language. In young deaf children language **appears** to be inner; however it is only silent. Their development of inner language will develop in the normal pattern which Vygotsky (1962) argues.

Vygotsky concludes his argument by stating that:

Ontogenetically,⁴ the relation between thought and speech development is much more intricate and obscure; but here too, we can distinguish two separate lines springing from two different genetic roots (Vygotsky, 1962:41).

Language has the function of communication in society while thought provides an internal mechanism for communicating with ourselves.

The link is argued by Cohen (2002:57) who posits that:

⁴ Ontogenesis refers to the evolution and development of the individual (Drever, 1952:193).

Vygotsky's theory [is] that children develop first as social beings and then as cognitive ones.

Cohen concurs with Vygotsky when he argues that the acquisition of language is the turning point in the child's development that leads to symbolic representation which creates a pathway for thoughts (Cohen, 2002:63). Once the child has internalised symbols, he/she will be able to use silent inner speech (Cohen, 2002:63). The use of self-directed speech will guide the child's actions (Berk & Winsler, 1995:34).

When children solve problems, Vygotsky (1978:26) posited that they use their eyes and hands with the aid of language. He expounded on the link between language, tool usage and how it affects perception and other sensory motor operations. He believed that attention plays a key role as a psychological structure which he said "underlies the use of tools" (Vygotsky 1978:35). This is significant in the use of computers by Deaf learners as this visual-manual activity at the computer is mediated by the educator through Sign Language. The Deaf child uses his/her eyes and hands for language. The maturation of several cognitive functions creates the readiness for learning in the young child and these are the challenges faced in the profoundly Deaf child's ability to become a successful learner. Vygotsky's key ideas on thought and language have a bearing on the educational situation and the use of the zone of proximal development as a tool for teaching.

2.4 The zone of proximal development (ZPD)

The zone of proximal development is central to Vygotsky's theory. Vygotsky (1978:84) examined the educational implications of his research findings on how young children learn. His findings led to a new concept, termed the zone of proximal development. From this

theoretical construct he proceeded to develop a new theory of learning. He said that learning and development are interrelated and occur from birth.

However, he argues that learning should be matched to the child's development level. Vygotsky (1978:85) postulates that what children do alone is an indicator of their cognitive ability. He goes on to refer to two levels. The first is the actual level of development which is the tasks done independently by the child. The second level is the level of potential development of the child (1978:85). The subsequent level would be reached by means of tasks supported or assisted by others. The distance between the two levels is termed the zone of proximal development.

Vygotsky argued that learning is aroused by interaction with people. The social nature of our learning is fundamental to Vygotskian theory (Cohen, 2002:69).

According to Vygotsky, the ZPD is linked to the social assistance one receives when "growing into the intellectual life of those around them" (1978:88). Vygotsky referred to cognitive functions that are in an "embryonic state" (1978:86). Development of these functions occurs with nurturing and guidance by peers or adults who have already reached that level:

The functions could be termed the "buds" or "flowers" of development... the zone of proximal development characterizes mental development prospectively (Vygotsky, 1978:87).

¹ The word collaboration comes from the Latin word *collaborare*, which means to labour or to work together.

The concept of ZPD allows us to understand how the computer and peers could support the profoundly Deaf young learner and assist him/her to move to his/her potential level of development.

2.4.1 Studies using the zone of proximal development

Vygotsky (1978:86) cites McCarthy's (1930) work on the abilities of 3-5 year olds. In Dorothea McCarthy's findings of two groups of children, she concluded that what the children could do in collaboration⁵ at 3-5 years of age they could do independently at 5-7 years of age. The findings provide support for the use of collaboration in computer applications. McCarthy (1930) argues in favour of the zone of proximal development as she explains that:

... if we determine the maturing functions, we can predict what will happen to these children between 5 and 7, provided the same developmental conditions are maintained (McCarthy in Vygotsky, 1978:87).

Cohen (2002:68) too, cites a study done by Roazzi and Bryant (1998) using children aged four to five-and-a-half, that involved collaboration with older children in solving a problem. Roazzi and Bryant found that social co-operation helped younger children to solve the problems that they were unable to do alone. The study confirms the existence of the zone of proximal development (Cohen, 2002:69).

Vygotskian applications were used in the following two studies on computer technology. The theories of Vygotsky (1978) and Bruner (1986) were used in Brooker and Siraj-Blatchford's (2002) analysis of their findings.

⁵ The word collaboration comes from the Latin word *collabare*, which means to labour or to work together.

Their research highlights the way in which the computer and parental involvement scaffold learning. Brooker and Siraj-Blatchford describe how young children of mixed ethnic backgrounds learn from the computer. The research considered the factors in young children's home background and their early experiences with information and communications technology (ICT). Their study focuses on differential experiences of ICT. In the research findings the researchers observed that having a computer at home did not indicate transference of knowledge "in any straightforward way into school" (2002:260).

Sheingold (1984) also applied a Vygotskian conceptual framework to her study on the use of computers by young children. She explored how computers could assist children to proceed through a zone of proximal development. She uses Vygotsky's argument to examine whether instruction should precede development in the use of the computer as a tutoring system.

Vygotsky argued that learning is firstly mediated by people and Haugland, & Wright (1997:14) postulate that opportunities for scaffolding learning are evident as children explore letters and words by typing them on the computer before they possess the manual dexterity to form letters or words using a pencil. They cite the research of Sheingold which assisted children to do computer-based tasks which would otherwise be extremely difficult (1997:14).

Muma and Teller (2001:33) echo the Vygotskyian perspective of learning which begins firstly on a social level and later on a cognitive level. Brown, cited in Muma and Teller (2001:31), terms Vygotsky's theory "a process of cognitive socialisation". There are indications that relationships between people can influence the development of cognitive skills. Vygotsky argued that children "grow into the intellectual life of those around them" (1978:88). Berk and Winsler reinforce this idea when they refer to the "social embeddedness of

2.5 Socio-cultural theory

Mind in Society: the development of higher psychological processes (Vygotsky, 1978) is the work which underpins Vygotsky's socio-cultural theory. Vygotsky's thinking and socio-cultural theory has its roots in Marxist theory. It is in this book that Vygotsky claims that knowledge is constructed both socially and historically (Vygotsky, 1978:7). In his socio-cultural theory, Vygotsky explores the notion that our social experiences shape our world view (Berk & Winsler, 1995).

Berk and Winsler (1995:5) cite Vygotsky's two lines of development as being a line of physiological growth and a "cultural line" which requires development to take place using cultural tools. Vygotsky's idea about the cultural line has a bearing on Deaf culture where Sign Language is the binding cultural tool.

Vygotsky argued that learning is firstly mediated by people and cultures, which is known as the interpsychological plane. It is through language that culture is transmitted (Lee & Smagorinsky, 2000:2). Learning is later internalised by the child and that is termed the intrapsychological plane (Lee & Smagorinsky, 2000:2). Clearly, it is language that provides the link between the two planes.

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cognitive skills” (1995:14). The notion of children firstly developing as social beings and only later as cognitive ones is echoed by Cohen (2002:57).

Social cognition is a mode of learning that occurs by means of a tutored process known as scaffolding (Bruner, 1986:74). Scaffolding refers to the support and guidance we receive from others to facilitate our learning to the next level. Scaffolding was not a term used by Vygotsky but has become synonymous with his ideas on facilitation. Bruner explains the process of scaffolding whereby someone who possesses the knowledge attempts to transmit it to the child (1986:75).

Bruner posits that the transmission of ideas and knowledge happens through language and related literacies, for example, technology (1986:74). Bruner draws on the Vygotskian notion that language and the sharing thereof (narrative) “reflects our history” (1986:78).

Burgess (1993:4) uses Vygotsky’s theory when he presents two interpretations of social constructivism. The first interpretation emphasises interaction as opposed to society. The proponents of this approach value both history and culture as being significant. The second interpretation regards cultural politics as being central to learning.

Burgess (1993) reinforces his argument in a book entitled *Charting the Agenda: Educational Activity After Vygotsky*. He says:

To read Vygotsky is to work one’s way among competing analyses. One sets out in a familiar landscape, but the known comes into focus against arguments having larger implications. Beyond lie the huge horizons of the theory of human development and human history ... Fundamentally the argument is methodological (1993:1).

The methodology that Vygotsky presents allowed me to explore the theoretical significance for Deaf culture. Bernstein (1993:xxiii) argues that Vygotsky did not provide a complete theory but rather that his work serves as a “catalyst”. In many ways these fluid conceptual tools allow researchers to shape new methods of applying Vygotsky’s theories to their work.

Finally, it was Bruner (1962:5) in the introduction to the well known work by Vygotsky, *Thought and Language* (1962), who credited Vygotsky with a “highly original and thoughtful theory of intellectual development”.

Having located my research within a theoretical framework, I now wish to explore whether the linguistic and socio-cultural theories of Vygotsky can serve as theoretical tools for understanding learning in a school where the use of South African Sign Language (SASL) is central to teaching and learning.

2.6 The profoundly Deaf child

In this section I have used the lower case “d” to discuss deafness in the audiological sense of being deaf. The capital “D” will be used to denote the language and cultural aspects of Deaf culture.

In defining the deaf population, Caldron and Greenberg, (1997:456) use the identifying terms *deafness*, *hearing impaired* and *hard of hearing*. A hearing loss of greater than 70 decibels is described as “severe to profound”. Deaf Federation of South Africa argues that deaf people are an “audiologically definable group” (DEAFSA. Deaf Culture, n.d.(b)). In both instances these definitions may be regarded as medical definitions.

There are, however, more holistic views of the Deaf population. Aarons and Akach (2002:154) state that there is the:

ambiguous situation of the Deaf with regard to disability. Deafness is universally regarded as a physical disability, and most often classified along with blindness and other physical disabilities. However, there is a sense in which Deaf people regard themselves as being members of an oppressed linguistic minority. ... In this sense, Deaf people see themselves not as disabled, but as oppressed, marginalised and disempowered.

Muthukrishna (2001:148) uses the term "deaf" to denote the physical or aural characteristics of the person. She goes on to present four possible models that are applied when defining deafness. Schlesinger and Meadow (1972), cited by Sacks (1990:63), describe an integrated view of deafness when they say:

Profound childhood deafness is more than a medical diagnosis; it is a cultural phenomenon in which social, emotional, linguistic, and intellectual patterns and problems are inextricably bound together.

In early childhood development the dominant philosophical stance of educators is one of whole child development. Therefore, the argument presented by Schlesinger and Meadow (1972) is favoured.

The medical model has been referred to in the previous paragraph as it concerns itself with the audiology and medical perspectives of deafness. In most cases it is a medical practitioner who first identifies the hearing loss and it is appropriate that physical conditions receive priority. The medical model has, however, been termed a deficit approach as it seeks only to deal with the physical condition and medical ways of overcoming these deficits (Muthukrishna,

2001:149). Caldron and Greenberg (1997:455) argue that many studies of the deaf focus on language development and more research needs to be done in ameliorating the problems of the deaf. Although their argument may be viewed as based on a medical model, it is inextricably linked to the holistic development of the profoundly deaf learner. It is extremely difficult to educate the deaf without having a clear understanding of the pathology of deafness. The issue of early identification and intervention will be explored later in this chapter.

Muthukrishna (2001) postulates that the second model, termed the social model, attempts to normalise deafness in order to allow deaf people to fit into a speaking and hearing society. The social model assumes that the person has the potential to acquire a spoken language. It, too, may be seen as a deficit model of deafness. Knight (1998:148) explains the social model in terms of the “disablement” of deaf people in a speaking society. She posits that this in turn leads to further “disablement” in schooling and in employment possibilities.

The linguistic model is the third model. Here the emphasis is on the language choices of the deaf. If they are able to acquire language it is usually the language of their community. That would be the home language. In the profoundly Deaf, sign language would be the language of choice. The linguistic choices would include oralism, total communication or bilingualism. Oralism is the development of expressive language. It aims to develop speech and makes use of lip reading. When using total communication, the learner is exposed to all methods of language tuition. They include Sign Language, speech reading and finger spelling (Muthukrishna, 2001:153). Bilingualism is most favoured by the Deaf. Sign language is the first language and the second language is the spoken and written language of the dominant culture in which they reside. In South Africa, the dominant culture is

seldom the majority. English is regarded as a powerful language but English speakers are not in the majority.

2.7 Deaf culture

The fourth and last model allows us to think about Deaf culture. Muthukrishna (2001:150) presents it as the cultural model. The choice of Deaf culture implies belonging to a cultural group that you may not have been born into. Deaf culture has its own norms, values and history which are passed from generation to generation (DEAFSA. Deaf Culture, n.d.(b)). Usually Deaf culture is mediated at school. According to DEAFSA:

The school forms a very important collective base which is for Deaf people the equivalent of home in geographical terms (DEAFSA, n.d.(b)).

From a cultural view the term *Deaf* using a capital letter “D” refers to people belonging to a group of people using Sign Language and sharing a common culture (Caldron & Greenberg 1997:456). This group of people are different from deaf people who wear hearing aids and communicate using spoken language. Sign Language is seen as the binding factor of the deaf community and the culture would largely be shaped by the signed communication system (Lucas, 2001:2).

2.8 Sign Language

...*Deafness is primarily a visual experience* (Erting, 1994:3).

According to DEAFSA, Sign Language occurs spontaneously out of a need to interact with other Deaf people. It is a visual mode of communication that involves gestures (DEAFSA. Sign Language, n.d.(c)).

DEAFSA postulates that:

[i]t is processed using the hands, face, head and upper torso and it is processed by the eyes (DEAFSA. Sign Language, n.d.(c)).

An important fact is that Sign Language is neither universal nor is it an international language. In South Africa the child learns South African Sign Language (SASL). In a country like South Africa it is regarded as a developing language since new vocabulary is required in a constantly changing and growing nation.

Lucas (2001:15), however, postulates that the apartheid legacy of South Africa has created lexical differences in South African Sign Language. These differences arose as a result of the forced divisions imposed on South African society. There are regional differences in SASL but the grammatical structure of the language is the same throughout the country. Clearly, Sign Language is necessary for Deaf people to communicate.

Sociolinguistic research on Sign Languages has aided the recognition of Sign Languages as *real languages* (Lucas, 2001:7). DEAFSA have termed SASL a *living language*.

Erting (1994:2) argues that young Deaf children who use Sign Language face many social and cognitive challenges. She says:

Preschool deaf children who sign and interact with hearing adults, other deaf children, and deaf adults must make sense out of a complex linguistic and social environment. At the same time they are faced with the social and cognitive tasks common to childhood, including the acquisition of language and communicative skills and creation of a basic social identity.

Sign Language does not have a written form. However, Sign Language has the capacity to express all that “natural human language is capable of expressing with all its subtlety and complexity” (DEAFSA. Sign Language, n.d.(c)).

MacSweeney (1998) describes the neurology of deafness in a book titled *Issues in Deaf Education*. She explores the processing of language by the human brain. Language that is heard will be processed in the left hemisphere and signed language which is at once visual and spatial will be dealt with in the right hemisphere. She argues that deaf infants pay greater attention to their visual environment and show *superior* visual perception (1998:20).

The complexity of the visual processing of a language is further explored by Wood *et al.* (1986) and cited by Sacks (1990). They write:

[i]magine a deaf baby with little or no awareness of sound ... When he[*sic*] looks at an object or event, he receives none of the “mood music” that accompanies the social experience of a hearing baby. Suppose he looks from an object of his attention to turn to an adult who is “sharing” the experience with him and the adult talks about what he has just been looking at. Does the infant even realize that communication is taking place? To discover the relationship between a word and its referent, the deaf infant has to remember something he has just observed and relate this to another observation ... The deaf baby has to do much more, “discovering” the relationship between two very different visual experiences that are displaced in time.

The illustration of the deaf baby provides an understanding of thought and language in the Deaf. It also serves the purpose of being a powerful aid for researching young Deaf learners.

In a longitudinal study cited by Caldron and Greenberg there is evidence that deaf infants needed "more visual contact" with their mothers and were less likely to display "avert gazing" (1997:470). The need to capitalise on the strong visual abilities of deaf children is obvious. MacSweeney (1998:23) postulates that the argument of sensory compensation seems conclusive. Sensory compensation is a term used to describe how receptors (eyes or ears) work in the absence of each other.

2.9 Early identification and intervention

The book which provides benchmarks on early identification of and intervention for the Deaf is a medical resource entitled *The Effectiveness of Early Intervention* (Guralnick, 1997). Much has been written on deaf children from a medical vantage point because it is usually the point of detection and/or diagnosis. In Chapter 1 and Chapter 2 Guralnick explores the field of early intervention effectiveness. Guralnick (1997:3) contends that early detection may "prevent or minimise" developmental problems. The late detection of deafness in some learners in my cohort made it significant to explore early identification and intervention.

The term early intervention is used to refer to the goal of reducing developmental problems of children at risk.

Guralnick (1997:3) postulates that:

as a result of biological or environmental factors ... this preventative philosophy extends to children with established disabilities.

The significance of early identification is critical for education if benefits are to be realised. Boothroyd (1982:7) refers to a "critical age" in terms of neurological readiness for learning.

Guralnick (1997:3) argues that the early years provide a window of opportunity for supporting families and are an opportune time for guiding child development. He delineates a number of factors which place families at risk. These include the level of parental education, cultural beliefs and the marital relationship. The term "at risk" may be dependent on the findings of a measurement known as a risk index. He goes on to argue that chronic poverty alone may place a family at risk (1997:11). Marschark (1993) cited in Guralnick suggests that there is a link between deafness, low socio-economic status and non-Caucasian families (1997:457). Caldron and Greenberg (1997:458) concur with this statement since they found the occurrence of deafness being more frequent in low-income families.

Although deafness is the primary problem in many children it is evident that secondary impairments may develop in profoundly deaf young children. Strong *et al.* cited in Caldron and Greenberg found that identification of deafness was earlier and timely if there was a secondary disability (1997:458). Conceptually it is important to explore these links as they have a bearing on my research. In some instances the homes of these children do not support their deafness both from a social and a medical point of view.

Bryant and Maxwell (1997:23) believe that early intervention improves the development of all children from disadvantaged families. In their findings there is evidence of success in early intervention programmes for children from low socio-economic families but this is often undermined by their attendance at low socio-economic status schools

(1997:42). This allows us to understand how Deafness and poverty intersect. Boothroyd (1982:2) argues that we need to focus on prevention rather than remediation.

Researching the efficacy of early intervention, Caldron and Greenberg (1997:458) found a six-month delay was evident in the commencement of early intervention programmes. Caldron and Greenberg call for both educational and curriculum intervention programmes to be researched. They say that:

... if early intervention programmes are to succeed, they will need to establish strong network ties with other early intervention programmes to cross-fertilize skills and share expertise, resources and training (1997:477).

The following two approaches of *neverstreaming* and the asset-based approach provide an understanding of appropriate early intervention.

Bryant and Maxwell (1997:42) cite Slavin (1991) who uses the term *neverstreaming* to refer to using the child's strengths and building on them. Recent research refutes the medical model and looks to an asset-based approach in intervention. The asset-based approach is driven by relationships and partnerships (Eloff & Ebersohn, 2001:149). Eloff and Ebersohn (2001:155) argue that the asset-based approach is more suitable in South Africa where the social context emphasises capacity building and ownership. They argue that:

[a]s with the rest of the asset-based approach the relationships that are developed while taking this approach, should be based on the strengths and talents of the individuals involved, and not on the weaknesses and problems. Relationships need to be built and rebuilt constantly (Eloff & Ebersohn, 2001:149).

The asset-based approach, Deaf culture and Vygotsky's socio-cultural theory have strong links. All have social origins.

2.10 Computers in early childhood development

In my research there is a third intersecting factor, namely that of computer technology. This section reviews the literature pertaining to computers in early childhood development.

There has been very little research done in the field of early childhood development in South Africa. The research that has been done is in aspects of policy, teacher education and classroom practice (see Koopman, 1991; McMillan, 1991; Brummer, 1993). There is no evidence of research on computer technology and young children.

In many countries, the computer has been available and used at some schools since 1976 (Tsantis, Wright & Thouvenelle, 1989). In South Africa, the installation of computers in early childhood development settings is a recent occurrence. A further lag in technology is reflected in the 2001 Census where it is reported that only 8.6% of households in South Africa have a computer (Anon., 2003:1). In a national survey done on information communication technology in South African schools, using both qualitative and quantitative research, there is not a single mention of computer technology in early childhood development settings (Lundall & Howell, 2000). This is despite the fact that the Grade R classes are a part of the Foundation Phase.

At the 2nd International Conference on Early Childhood Development held in Asmara, Eritrea in 2002, a Framework for Action was tabled. One of the declarations in the preamble refers to technology in early childhood development. It recognises "the great importance of

institutional capacity building and networking, in particular at the community level, for ECD and the vital role of information technology in this endeavour” (Asmara Early Childhood Conference Documents, 2002:4). These developments are of importance to developing countries. However, the omission of a call for technology for young children at preschool level demonstrates the unrecognised potential of computers in early education.

The National Association for the Education of Young Children (NAEYC) in the USA released a position statement on “Technology and Young Children - Ages 3 through 8” in April 1996. In it, issues were raised that are linked to the developmentally appropriate use of computers for young children. The role of the educator is seen as being central to good practice. The Association argues for the elimination of stereotyping in the use of computers, equal access to technology for all children and the integration of technology into the early childhood development curriculum. NAEYC continues to research best practices for technology in early childhood settings (Fischer & Gillespie, 2003).

Educators may have knowledge and skills about computer technology; however they also need to approach technology with the right attitude. Teachers of young children need to engage with technology as they seek to create an environment for active play and exploration. Bredekamp and Rosegrant (1994:60) refer to the educator as a “co-constructor of knowledge with children”. Children and educators can learn new technologies together. Brown (2000:5) calls on educators to examine their personal attitudes in relation to the access and use of computers.

A pedagogical tension exists between the process-oriented methodological approach in early childhood development which is based on active and discovery learning, and programmed computer technology

which may be seen as instructional and formal. Williams (1984:40) argues that in a curriculum that values play as a means of learning and has resisted structured forms of teaching like worksheets, a cautious approach must be taken to the introduction of computer technology.

In informal education more open-ended materials are used which allow the child to self-direct his/her learning. Sand and water play would be examples of open-ended materials. They are unstructured materials that allow freedom with which to create. It is the replacement of these activities by technology that has created concern in early childhood educators. Bredekamp and Rosegrant (1994:54) cite a letter sent to NAEYC (1994):

Let us not let our adult excitement with what computers can do in the adult workplace deter us from offering to children the squishiness of making mud pies, the scent of peppermint extract when making cookies, and the feel of balancing a block on top of a tower. Children deserve to have a rich and varied childhood. The adult world of the plastic workplace comes all too soon ...

Bredekamp and Rosegrant (1994:54) argue in favour of the additive approach. Teachers should not attempt to use computers to replace anything in the early childhood curriculum. Williams (1984:40) agrees when she states that consideration should be given to both the computer as an "additional resource" as well as our being cognisant of the societal pressure of the digital world that we live in.

In answer to the question of what place computers have in early childhood development settings, Tsantis *et al.* (1989) argue for equity and empowerment. The improvement in the child's self-esteem after having mastered some computer skills was reported in a partnership programme with Head Start and IBM (1998:21). Tsantis *et al.* (1989:21)

highlight the “increasingly high comfort level with technology of children from advantaged backgrounds”. The “digital divide” has been termed a “societal divide in which technology will either improve the life chances ... or continue to widen the gap between children who have access to technology ... and those who do not” (Brown, 2000:2).

The argument for access is compounded by issues such as race, gender and disability. Brown pursues the argument of equity as it concerns itself with the opportunity to learn “with” and “about” computers. The absence of computers may, according to Brown, disadvantage people’s ability to function in a technological society, be a barrier to gainful employment and influence attitudes to learning. Brown (2000:1) argues for equal access to computers, both for girls as well as for people with disabilities.

Bowman and Beyers (1994:20) voice a concern about the “social context in which technology is embedded”. The way in which access to technology is structured, they say, may cause deep divides in our society. Brown (2000:1) concurs when she says that “technology has the power to polarize society and prevent different people from participating equally in society”.

Another argument against computers in ECD is the commonly held assumption is that computer tasks are not concrete and they require symbolic competences (Sheingold, 1984:2). Symbolic competences are the abstract thought processes required for written literacies. Clements (2002:160) argues that much of the young child’s play is symbolic. Symbolic play is seen in the imaginative and fantasy play of young children. Fischer and Gillespie acknowledge that the strength of the computer is its potential to bridge the gap between concrete and abstract thinking and learning (2003:88).

Support for the use of computer technology also comes from Appel and O'Gara (2003:1) who argue that young children's interaction with technology stimulates cognitive learning and provides a readiness for the future. According to Williams, adults promoted cognitive and social learning in many child-selected activities so it was natural to do the same for computer-based learning (1984:40). Proponents of technology claim that all children should be exposed to the advantages of technology (Clements, 2002:160).

McCraw and Meyer (1995) argue for optimal use of computers in early childhood settings. They highlight three key components. These are a suitable location of the computer "in the classroom" (1995:1), teacher training, knowledge of the program, attitudes and the use of appropriate software. Proponents of locating the computer in the classroom differ from the formal primary school approach of using a laboratory where children use the computer simultaneously for a computer lesson. The National Center for Education Statistics (USA) reported in 1995 that computers are placed in classrooms only 38.1% of the time. Schools favour libraries, media centres, administrative offices or laboratories. These choices all have limited access and are clearly locations where young children are unlikely to function optimally. Bredekamp and Rosegrant (1994:60) agree that the computer should be located in the classroom for younger children. In that way the computer becomes one of several activity choices.

2.11 The benefits of ICT in early childhood development

Williams (1984:42) reports on the social outcomes of computers in early childhood settings. She observed sharing, turn taking and children assisting one another while using the computer. She also states that

after a year the computer was a natural learning tool in child-selected activities. Clements (1994:43) refers to the computer as “the social machine”. He argues that children co-operate and communicate at the computer. He claims that they interact more frequently, preferring the guidance of peers to that of educators (1994:43).

Char and Forman (1994:174) describe the appropriateness of using technology to support the social dynamics of interaction. They argue that in fostering collaboration and paired working at the computer, computers can support children’s reflection about social behaviour (Char & Forman, 1994:175).

Romeo, Edwards, McNamara, Walker and Zinguras (2003:336) argue that teachers’ beliefs about collaboration in learning and social development affect children’s collaboration. In their research on touchscreen technology (touching the screen of the monitor is the input device), they found negative collaboration between children, whereas the use of a mouse (one input device) encouraged positive collaboration.

In the conclusion of their report, Brooker and Siraj-Blatchford (2002:270) argue that:

the nursery computer seems to provide an extremely valuable means by which these new forms of learning activity may be achieved.

Clearly, strong arguments exist for seeing computer applications as having the ability to encourage collaborative learning.

2.12 Conclusion

Chapter 3

In Chapter 2 I firstly reviewed two seminal works by Lev Vygotsky, as they apply to this study. I then located the central themes of the profoundly Deaf child and computer technology in both international and South African literature. I turn now to describing the appropriate research methodologies for my study.

The methodology used for the study of the influences of computers on the profoundly Deaf Grade R learner. The study was exploratory in nature owing to the innovativeness of information communication technology (ICT) in early childhood settings. The application of a case study is used to explore the influences of computer technology as a learning tool for a cohort of seven profoundly Deaf children.

In the first part of this chapter, I discuss the qualitative research design and explore the ethical considerations of researching young Deaf learners. I then describe the sample and the data gathering process. The constraints of researching the Deaf are outlined and the analysis of the data is explained.

In the final chapter of the research study, I will reflect on the appropriateness of the chosen research method.

3.2 A qualitative research design

After completing the literature review, as described in Chapter 2, I began looking for an appropriate methodology for my study. Hitchcock and Hughes (1995:92) argue that the theoretical review process leads to establishing "a rationale for that choice of research methodology".

Chapter 3

RESEARCH METHODOLOGY

3.1 Locating the study methodologically

In this chapter I describe the research methodology used for the study of the influences of computers on the profoundly Deaf Grade R learner. The study was exploratory in nature owing to the innovativeness of information communication technology (ICT) in early childhood settings. The application of a case study is used to explore the influences of computer technology as a learning tool for a cohort of seven profoundly Deaf children.

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3.2 A qualitative research design

After completing the literature review, as described in Chapter 2, I began looking for an appropriate methodology for my study. Hitchcock and Hughes (1995:92) argue that the theoretical review process leads to establishing “a rationale for that choice of research methodology”.

The methodology applied to my thesis is an empirical investigation within a qualitative research paradigm. Empirical investigations are based on observation and not solely on theory (Concise Oxford dictionary of current English, 1979:338). I sought meaning through observation, interviews and immersion in both documents and data. Neuman (1997:7) argues that the data is the “empirical evidence that one gathers carefully according to rules or procedures. The data can be quantitative (i.e., expressed as numbers) or qualitative (i.e., expressed as words, pictures, objects)”. The choice of a qualitative research paradigm is based on the rationale presented by Kerfoot and Winberg (1997:18). They argue that it is an appropriate method for:

Bogdan (1999) finding out about aspects of the learning process or to assess the impact of different ways of teaching and learning. Qualitative research involves finding out about people’s perceptions, the way in which different people respond to **educational innovation** [emphasis in original], the way they understand their contexts, etc.

Walcott (1994:119) Computer technology is presently regarded as an educational innovation in early childhood development. A qualitative investigation is appropriate for this study as “the principal concern is an understanding of the way in which the individual creates, modifies and interprets the world in which he or she finds himself or herself” (Cohen & Manion, 1994:8). In this instance it is the world of the profoundly Deaf young learner. Wiersma (1995:12) notes that qualitative research occurs in natural settings. The classroom would be a natural setting in educational research.

Another important aspect of qualitative research is that the context is critical. According to Bogdan and Biklen (1998:5), qualitative researchers go to the setting “because they are concerned with context”.

Neuman (1997:331) contends that in order to understand the social world a qualitative researcher places emphasis on the social context. A definition of qualitative research which I favour is offered by Winberg (1997:26): “[Qualitative research is] research that focuses on understanding through contextualised data collection, interpretation and planning for action.” In my study the context of technology and profound Deafness were central to the research. The holistic nature of qualitative research requires the researcher to observe people in their contexts (Winberg, 1997:41). I conducted the fieldwork at the research site to observe the children in their own environment. The context of this research study is described in Chapter 4.

Bogdan and Biklen argue that qualitative research is descriptive (1998:5). They go on to describe the types of data that are gathered in descriptive research, namely videotapes, interview transcripts, field notes, photographs and other appropriate documents.

Wolcott (1994:119) favours three methods for fieldwork. They are “enumeration, participant observation and interviewing”. I have applied these three categories to my fieldwork. Under the term “enumeration,” Wolcott (1994:119) includes the use of photographing the school. This I have done and inserted into Chapter 4. He also refers to the collecting of records. I was able to gather enrolment forms and medical histories of each of the participants in order to develop the subjects’ profiles.

If the research setting presented is what Stake (1995:2) calls a “bounded system”, then I was obliged to use the case study approach. Stake (1995:2) posits that “the case could be a child. It could be a classroom of children”.

According to Bogdan and Bilken there are three foci in a case study. In the context of education these are firstly the place, which is usually the classroom, secondly, the particular group of people to be studied, and thirdly, the activity to be researched (1998:55). In my research these three foci are clearly evident. All three criteria of the case study were bound together in my research. They were the classroom (Grade R), the specific group (young Deaf learners), and the activity (the computer).

Simons (1989:116) makes the point that:

... a case study is not a method as is sometimes assumed, but a focus of study, whether that focus be a single classroom, institution or system. The essential feature is the case.

A descriptive study was appropriate for this methodological design. The reason for a descriptive study came from Bassey (1999:24):

3.3 Case-study is the way of the artist, who achieves greatness when through the portrayal of a single instance locked in time and circumstance, he [*sic*] communicates enduring truths about the human condition.

Although the research group represents a microcosm of Deaf culture, there may be applications at a macro level. There will also be a degree of generalisability at a macro level. The case study allows for immersion in data and creates familiarity with a culture, in this instance Deaf culture. Neuman (1997:30) argues that case-study research creates inquiry about the characteristic traits of a case. Walton (1992:122) says that “[c]ase studies are likely to produce the best theory”.

Denscombe (1998:30) argues that “what a case study can do that a survey normally cannot is to study things in detail”. Research in my

project was classroom-based during the normal daily programme.⁶ An in-depth study took place within the school.

According to Yin (1994:31), the case occurs naturally:

It exists prior to the research project and, it is hoped, continues to exist once the research has finished.

Drawing on Mouton's (2001) argument, other design principles such as conceptualisation, detailed descriptions, data sourcing and analysis were applied (Mouton, 2001:282). Conceptualising the case study requires the formulation of guiding principles. Denscombe (1998:31) makes the point that the use of a variety of sources is one of the strengths of the case study method. Observations, interviews and document analysis were all sources of data gathering. In my study multiple sources of data were collected.

3.3 Gaining access and ethical considerations

There were two ethical considerations linked to my research study. The first was that of working with the Deaf and the second was that of working with young children. Drawing on these considerations I was mindful of appropriate procedural requirements.

According to Heslop (2003:37), the ethical issues of research are linked to concerns about appropriate ways of conducting an inquiry. He argues that:

⁶ A daily programme covers all the activities provided in a preschool throughout the day. The daily programme seeks a balance between child-selected activities and teacher-directed activities. It follows the child's natural body rhythms of eating, resting and daily ablutions.

Bogdan... many ethical issues involve a balance between two values: the need for the pursuit of scientific knowledge and the rights of those being studied.

Simons (1989:114) contends that "all human research has ethical dimensions". It is a balance of these values and ethical issues that I have adhered to.

The ethical considerations of research are to obtain consent for participation in the study, to ensure anonymity and to address issues of confidentiality (Heslop, 2003:38). Permission to conduct research was firstly sought via the Western Cape Department of Education. A meeting was held with the educator of the Grade R class to discuss conducting the research in her classroom. Establishing a rapport with her was essential as she would be working closely with me on a weekly basis. A meeting was arranged in mid-January 2003 with the principal of the school where the research was to be located, to seek consent to work at his school. Access was granted from the principal after he had conferred with both the educator and the Department of Education. Permission was granted at each of these levels.

In the case of young children, voluntary consent cannot be given. Therefore consent must be sought from guardians (Heslop, 2003:38). According to Cohen and Manion (1994:352), seeking informed consent to work with young children involves permission being granted by those adults responsible for the children. The next task was to send letters to the guardians/parents of the learners assuring them of confidentiality and anonymity and requesting permission to work with their children. This was done in Xhosa or English depending on the parents' home language. Usually parents grant permission; however, in one instance a guardian acting *in loco parentis* signed the form. A copy of the letter is inserted as Appendix A.

Bogdan and Biklen (1998:44) argue that a number of ethical principles need to be adhered to. These include the protection of the subject's identity. All subjects must be treated with respect, and cooperation to be involved in the research must be sought, preferably in writing.

All personal names have been changed to ensure anonymity of the participants in this research study. An attempt was made to choose and use pseudonyms that reflected the home background of the participants.

3.4 A description of the sample

The subjects were seven profoundly Deaf Grade R learners at a special needs school in the Western Cape. There were three girls and four boys in the cohort with a mean age of six years and two months. The age range was between five years and five months and six years and nine months on 1 February 2003.

3.5 Gathering the data

In this section I will describe the different methods of collecting the data for my study. Data for my study was obtained only by means of appropriate qualitative methods (Wolcott, 1994:119). These included observations, interviews, journaling and informal meetings with involved educators. Videotapes recorded the children's collaborative work on the computer.

3.5.1 Observations

According to Denscombe (1998:139), there are two kinds of observation used in social science research. He argues that the first kind produces quantitative data and is termed "systematic observation". The second

type is "participant observation" (1998:139). Denscombe states that participant observation usually produces qualitative data and "helps to understand culture and processes of the group being investigated" (1998:139).

Kerfoot and Winberg (1997:62) provide guidelines for conducting observations. They suggest that one should observe a stream of behaviour, create a vivid picture of what you see, record observations carefully and in as much detail as possible and be as objective as possible (1997:63).

Drawing on the guidelines of Kerfoot and Winberg (1997), I was able to frame the requirements for recording my field notes.

Firstly, it is important to clarify my role as an observer. Scott and Usher (1996:144) cite Gold's work on the four types of participant observation. I have chosen the second role which is the *participant-as-observer*. My role involved guiding the educator in the use of the computer and in ways to integrate the computer learning into the curriculum. This often required guiding the learners during the computer sessions and playing the role of the educator. Scott and Usher (1996:144) call this the *open stance*. They go on to argue that the purpose of the research may be unclear at this stage and they suggest that purpose emerges as initial data is collected (1996:145). In my case this is reflected in the initial informal observations.

Bogdan and Biklen contend that a funnel approach is necessary to narrow the research as early analysis in the field is applied (1998:158). An example of my involvement in the research was when I became

aware that the educator's groupings of children were too large. I advised the educator to restructure the grouping.

First Quarter

Weekly observation began at the school in February 2003 to monitor the cognitive and social influences of computer technology on Grade R learners. For the purpose of this research study, ten field visits have been selected for analysis, despite many more visits having been done. The field visits that were not included were when the new educator was grappling with her understanding of computer technology in ECD. Certain other observations were rejected because some learners had advanced into the literacy program on the computer which was not part of my research. A field visit programme is included overleaf as follows:

	09 April	Meet new teacher
Wednesday	16 April	Observation
Wednesday	23 April	Observation
Wednesday	30 April	Observation
Wednesday	07 May	Observation
Wednesday	21 May	Observation
Wednesday	28 May	Observation (Videotaped)
Wednesday	04 June	Observation (Videotaped)

Observations were usually conducted on a Wednesday at the request of the school. The educators also requested the time slot of 11:00. Each of the seven Grade R learners was observed for fifteen minutes per

Field Visit Programme for 2003

First Quarter

Wednesday 12 February Observation (Videotaped)

Monday 17 February Observation (Videotaped)

Monday 03 March Observation

Second Quarter

Wednesday 09 April Meet new teacher

Wednesday 16 April Observation

Wednesday 23 April Observation

Wednesday 30 April Observation

Wednesday 07 May Observation

Wednesday 21 May Observation

Wednesday 28 May Observation (Videotaped)

Wednesday 04 June Observation (Videotaped)

Observations were usually conducted on a Wednesday at the request of the school. The educators also requested the time slot of 11:00. Each of the seven Grade R learners was observed for fifteen minutes per

week over a 14-week period. The short observation times were to accommodate the short attention span of the young child.

On the first day of my observations (12 February 2003), the computer was introduced to the group by Bernadette, the educator and the children's response was videotaped. Initially, I chose not to have an observation schedule. However, the literature review, together with the events in the first two sessions, led me to frame the questions in the observation schedule. The connection with the theory was made in the third session. It was the moment of crystallisation. Focused observation using clarified categories took place in the subsequent observation sessions. The research questions are divided into two categories and are as follows:

Cognitive

3.5.2 Videotaping

- 1) How does the teacher move the child to the next level of performance? Is this assisted performance/scaffolding?
- 2) Is there evidence of a higher level of cognitive functioning?

Social

- 1) Could the child talk/communicate about their experiences on the computer?
- 2) How does the young child respond to computer technology?
- 3) Is there evidence of collaboration between the children with regard to computer technology?

A copy of the observation schedule is inserted as Appendix B. The observation schedule supplemented my field notes to record events and impressions which were captured by the categories in the observation schedule.

A system of how the observations progressed was structured by the researcher. An experimental approach (Neuman, 1997:331) was taken as the educator worked first with three learners at a time. The grouping was too large and children became distracted as they waited their turn. Then we worked with one learner and the educator. Learners seemed tense in this situation as though they were being tested. Finally, she tried placing two learners together and working collaboratively. Pairs of children were changed as we sought groupings that allowed optimal learning to take place. The paired groups were changed regularly.

3.5.2 Videotaping

Hopkins (1992:132) suggests that there are advantages to using videotape recordings for accurate data gathering. He argues that in analysis the visual material allows for detailed examination "of a specific teaching episode" (1992:132). In my study, the first two observation sessions and the final two were videotaped. Outside audiovisual assistance was used so that I could continue to do observations and record field notes. A total of four tapes were video recorded. According to Hitchcock and Hughes (1995:314), the collection and analysis of visual recordings is appropriate in qualitative research. They argue that "visual records of all kinds may help the researcher to develop a closer feel and appreciation of the setting" (1995:178). The video allowed for three sources of data to be captured on the same event, namely observations, field notes and videotapes.

For the purpose of my case study, it was necessary to transcribe and translate the videotapes into English with the aid of a sign language interpreter. The interpreter and the educator ensured that subtle sign language clues were not overlooked. Erting (1994:62), in her study of Deafness, communication and social identity, describes some of her research constraints as a "non signer/researcher". She, too, employed the services of an interpreter to corroborate evidence.

3.5.3 Semi-structured interviews

The observations were completed in June 2003 before the winter school vacation. On my reflecting on the data gathered, it became clear from the constructed themes that evidence was emerging. The emerging ideas influenced the design of the open-ended questions for the semi-structured interviews.

According to Denscombe (1998:112), there are three types of interviews. They are structured, semi-structured and unstructured. Denscombe (1998:112) contends that:

in the semi-structured interview the interviewer is prepared to be flexible in terms of the order in which topics are considered, and perhaps more significantly, to let the interviewee develop ideas and speak more widely on the issues raised by the researcher. The answers are open-ended, and there is more emphasis on the interviewee elaborating points of interest.

The choice of the semi-structured interview was influenced by my reading. Borg (1987:110) argues that the interview is an appropriate tool for descriptive research. It was also evident that most educational qualitative researchers favour the semi-structured interview (Hitchcock & Hughes, 1995:83).

Bogdan and Biklen (1998:71) suggest that:

In keeping with qualitative tradition of attempting to capture subjects' own words and letting analysis emerge, interview schedules ... allow for open-ended responses.

My intentions were to provide a non-threatening opportunity to engage the educators in conversation around their experiences with computer technology in early childhood development. In order to structure that dialogue an interview protocol was designed using semi-structured questions. It is argued that to gain neutrality in the researcher's response and to ensure consistency in the data gathering process, it is useful to develop an interview schedule (Tuckman, 1994:372). The choice of question format that made up the protocol would influence the response. Tuckman (1994:216) makes the point that certain question forms will elicit certain responses. Some of Tuckman's key assertions were applied. These were the choice of indirect and non-specific questions. Tuckman (1994:217) argues that "by making the purpose of the question less obvious, the indirect approach is more likely to engender frank and open responses". In the case of non-specific questions, the respondent is less alarmed and more likely to reply with the requested information (Tuckman, 1994:217).

A total of nine questions was compiled. The opening question attempted to relax the interviewee and provided the interviewees with an opportunity to talk about what they know and do best, i.e., their role as teachers. The very broad and final question was completely unstructured to allow the interviewees to say exactly what they desired. Tuckman (1994:218) refers to the unstructured response as allowing interviewees to give their own replies.

The other questions posed attempted to clarify what I was trying to understand from this unique context. They had strong links to the observation schedules. The questions sought to encapsulate observations made by the staff when I was not present. Computer use by the children took place as children self-selected it as an activity during the daily programme. The educator also used the computer in a micro-teaching mode. The educators were able to gather their own data with regard to the computer as a learning tool.

The interview protocol was as follows:

- 1) Describe your role as an educator of profoundly Deaf young children.
- 2) Has the use of the computer changed what you see as your role? If yes, please explain.
- 3) How do you feel about having computer technology as part of your Grade R curriculum?
- 4) Has the computer had any social influences on the children? If yes, can you describe these?
- 5) Do you feel that it has added to the communication between the children? How and when?
- 6) In your opinion, what contribution has the computer made to the cognitive development of this group of profoundly Deaf children?
 - 7.1) Did you observe children assisting or collaborating with one another?
 - 7.2) Do you think this collaboration supported the learning of the child using the computer?

8) Are you able to relate observed incidents (both positive and negative) directly linked to the computer and what it has to offer?

9) Is there anything else you wish to add?

A copy of the semi-structured schedule is attached as Appendix C.

Dates and times for the semi-structured interview with the two educators and the teaching assistant were agreed upon. They were conducted in July 2003. In total, three interviews were conducted over a period of seven days. The interviewees selected were all directly involved with the computer program and the Grade R class. Bernadette was the Grade R educator from January to March. Leila took up the position in April when Bernadette left the school. The third interviewee, Lesley, was the Sign Language interpreter and often facilitated the computer sessions with the children if the educator was busy.

Denscombe (1998:119) suggests that it is important to:

... contact interviewees in advance. This also allows both parties to arrange a mutually convenient time for the interview ... The researcher needs to make a bid for an agreed length of time ... The researcher needs to get a location for the interview in which they will not be disturbed, which offers privacy, which has fairly good acoustics and which is reasonably quiet.

The interview with Bernadette was conducted in my home as she had left the school to take up her new post. On being given several options of a venue, she chose my home. The other two interview sessions were conducted at the school on consecutive days while the children were having their daily rest period. This allowed one staff member to be

released from her duties. Again, the choice of time and venue was negotiated and decided on by the staff. The interview sessions were designed to be not longer than one hour.

Permission to conduct recorded interviews was sought from respondents. Permission was granted by the interviewees to record the interviews on audiotape. According to Denscombe (1998:122) "the audio tape-recording is the standard method of capturing interview data". Anonymity and confidentiality were discussed with the respondents at the start of the interview. Interviewees were also given the liberty of switching off the tape if they wished to talk off the record. Denscombe (1998:124) contends that "the process of recording has a bearing on the freedom with which people speak ...". One participant chose the option of switching off the tape-recorder for the final question.

Participants were given a copy of the questions at the start of the interview. I took the decision not to give the participants the protocol before the time so as to get a more spontaneous response. In order to focus on the interview, salient points that I wished to highlight later were unobtrusively recorded in a space provided on my form. Notes were also made in my journal immediately after the session. I transcribed the interviews within the week following the actual interview. The value of transcription is argued by Denscombe (1998:130) as bringing the researcher "closer to the data". Transcription proved to be an aid to analysis of data as it was easier to work within a written format. The interview data allowed the researcher to corroborate findings obtained in the observations.

3.6 Validation of the data

In order to validate the research findings, triangulation was applied. Hitchcock and Hughes (1995:104) refer to triangulation as "... the use of more than one method of data collection within a single study". Cohen and Manion expand the definition of triangulation as they say it is "the use of two or more methods of data collection in the study of some aspect of human behaviour" (1994:233). In my study I have used observations, interviews and video recordings.

Kerfoot and Winberg argue that "triangulation is the process of gaining different perspectives on the same event" (1997:19). In this study, more than two methods of data collection were applied in order to obtain different vantage points. Observation and interviews were the principal method of data collection. According to Cohen and Manion, (1994:241) triangulation is especially useful in case studies. It allows for multiplicity of perspectives.

Proponents of this position (Hitchcock & Hughes, 1995:105) argue that triangulation is a basic principle of social research because the use of triangulation ensures objectivity and helps mitigate bias in research.

3.7 Journal keeping

In an attempt to map my research progress and to develop a reflective stance to my work, a journal was begun as a research tool. It began as a suggestion during the first meeting with my supervisor in January 2003 and has become a written record of my work. It has also served as a tool for supplementing my field notes. Carl Rogers (1961:275) had this to say about journal keeping:

It seems to mean letting my experience carry me on, in a direction which appears to be forward, toward goals that I can but dimly define, as I try to understand at least the current meaning of [my] experience.

The method I chose was a daily recording in a small hard-covered note book. All entries were dated and both days and weeks were numbered. On the days I spent doing observation and/or interviews there was evidence of more detailed descriptive writing about my research. Here, not only practice was recorded but also attitudes and feelings. Hobson (2001:23) refers to the daily log as “an attempt to describe the essence of a particular day”.

Lytle and Cochran-Smith (1990:86) say that journals “intermingle description, record-keeping, commentary and analysis”. In the data analysis of this study it has been an invaluable tool for cross-referencing and validating other recordings.

3.8 The researcher effect

I include a section on what Denscombe (1998:74) calls the “researcher’s self”. He argues that “[t]here needs to be a public account of the self which explores the role of the researcher’s self” (Denscombe, 1998:74). Having worked for the non-governmental organisation that was doing the work on behalf of the ICT corporate donor, I was aware of my influence on the respondents as we had selected the school to be the recipient of the computer unit. I had trained Bernadette on the appropriate use of the computer and ways of using the content on the computer programs within the early childhood curriculum. The school was still on the monitoring of implementation and follow-up phase required by the donor. My concern centred around their feelings of gratitude to the donor and being afraid to constructively engage in

objective debate about the benefits or pitfalls of ICT. I was anxious to allay those fears by assuring the interviewees of the anonymity of their responses. The research study I had undertaken was neither initiated nor funded by the corporate donor.

Hitchcock and Hughes (1995:165) also warn of possible personal characteristics that may influence the interviewee. These include race, age, gender and class. Of these, my seniority and educational background may have been an influence as the two educators appeared guarded in their responses. I had been in the ECD field for more than twenty years. As will be explained in Chapter 4, the audiologist /educators are not Foundation Phase educators, but their skills are in language and hearing.

I developed a good rapport with the staff and had a positive effect on the teaching situation. I was invited to school functions, assisted with school outings and attended children's birthday parties at school. I had a sense of feeling acknowledged and trusted in my role as researcher. The children gave me a sign name. It was my initial "L", together with the sign word for "computer".

Having gathered the data, I began the preparation for data analysis. It began with editing the data.

3.9 Data editing

According to Cohen and Manion (1994:101), it is advisable to reduce or edit the data prior to analysis. They refer to three tasks in the editing process. The first task is *completedness*. Completedness is a random scan to ensure that all questions have been answered. I was able to do

this as soon as the audiotapes were transcribed and a cross-check could be done to compare the written script to the audiotape.

Secondly Cohen and Manion (1994:101), refer to *accuracy*. Accuracy refers to both the responses of interviewees and the recording of responses. In the case of open-ended questions it is not easy to check accuracy of responses as there are no right or wrong answers. However interpretational nuances could be detected when interviewees chose a particular stance in their replies.

According to Cohen and Manion (1994:101) the third process is *uniformity*. Uniformity refers to the interpretation of instructions and questions in the same way. I was aware of the same question being able to elicit different responses to open-ended questions.

A second view on data editing is offered by De Vos *et al.* (2002:343). They (2002:343) refer to "data management". They say it is the initial stage of analysis that begins as the researcher leaves the research site. In this process of data editing it is necessary to develop a filing system or method of coding the data in order to facilitate the process of analysis. In my research the labelling and dating of audiovisual material was done on the day of collection. Document envelopes were used to store field notes. The field notes were worked with in two separate ways.

Firstly I recorded the collaborative working group of children on that particular day. Children worked in pairs and a commentary of their activities on the computer was recorded. Next, I separated each child's unique response to the computer session of that same day. Field notes and journal entries were transferred to the observation schedules. All notes were dated and filed in separate pockets, as well as being stored

on the computer. The organisation and recording of data was to make the process of analysis more manageable. There were, however, some limitations to organising my data. I wish to highlight Sign Language as being the most challenging.

3.10 Constraints of researching Deaf young children

One of the challenges of doing research with profoundly Deaf learners was their use of Sign Language. In descriptive data a qualitative researcher usually has excerpts of dialogue from observations. Wolcott (1994:404) uses the descriptive term of Peshkin when he quotes the term "*fat* data... It includes an abundance of direct quotations". This type of dialogue is often used in descriptive analysis for the purpose of letting respondents "speak for themselves" (Wolcott, 1994:10). It was difficult to record signed dialogue in my field notes. The "dialogue" obtained was gleaned later from the Sign Language interpreter and the educator who assisted in the transcribing of the videotapes.

I attended two Sign Language lessons and managed to acquire the rudimentary sign terms linked to the computer. My limited Sign Language skills were largely "functional", i.e., greetings, words of praise, names and a few verbs. Language has been central to this study and as Vygotsky (1978:89) argues "the acquisition of language can provide a paradigm for the entire problem of the relation between learning and development". The observation of cognitive and social learning required the presence of the teacher who would interpret for the researcher.

A second disadvantage lay in not being able to interpret the fine nuances of tone and expression. Children fortunately communicate emotions in a spontaneous way using body language. So when children

left the room skipping, it could be interpreted as a sign of feeling good about their achievements. Conversely one of the little girls always left the computer session with slumped shoulders and a hanging head, not because she did not achieve but because she did not want to stop working at the computer. These understandings of children's body language were acquired from many years of working with young children. It was because of my experience that I presumed to interpret children's responses.

3.11 Analysis of qualitative data

Wiersma (1995:218) defines data analysis in qualitative research as:

... a process of categorization, description, and synthesis. Data reduction is necessary for the description and interpretation of the phenomenon under study.

At the outset I wish to highlight that my analysis has been a continuous and developmental process. Wolcott (1994:16) argues that "data are tainted with an analytical or interpretative cast in the very process of becoming data". As an early childhood educator for many years it was my experience and prior knowledge that provided the source of critical engagement which structured and restructured the path of my research.

The organic nature of exploratory research is acknowledged by Hitchcock and Hughes (1989:303) as they argue that "qualitative research is not prescriptive, but it is rather creative and open-ended and therefore operates in a different manner". The search for collaboration amongst children called for the researcher to intervene in the grouping of children as they engaged with information and communication technology. The intervention was in a quest to follow ideas, patterns

and instincts. Hitchcock and Hughes argue in favour of this approach to qualitative data analysis when they say “qualitative research is not about the verification of existing theories ... but rather with discovery” (1989:297). Winberg (1997:11) contends that analysis answers the “why” questions of research.

What followed was the more formal approach of sifting through the data. Having selected a Vygotskian theoretical approach to shape the research methodology, a detailed grounding of theory was applied to the analysis (Hitchcock & Hughes, 1989:297). The organisation of data for analysis was described in the section on data editing. Wiersma (1995:218) suggests the sequence of analysis and interpretation is firstly to reduce the data, then to organise the data and make connections to the theory. The last task is to engage in the descriptive process.

As a sequel to the editing, I engaged in modes of case study analysis suggested by Yin (1994) and cited by Babbie and Mouton (2001:283). Yin proposes a mode of “pattern matching”. Pattern matching involves making connections between theory and data. Using the literature review, I began plotting the categories in the data. This involved reading and re-reading the field notes and interviews. A valuable source of information was the videotapes. They provided raw data for validation. They were viewed frequently as a means of corroboration.

In the second phase, I began the task of “explanation building” (Babbie & Mouton, 2001:283). Explanation building involves the generating of themes or notions with regard to the case. I began developing the descriptive explanation for the empirical data. Wolcott (1994:24) uses the term “transforming data” for the descriptive process. I also explored the possibility of using computer analysis for my interviews. The

program was appropriate for qualitative research and operated on a code-based theory. The program could look for patterns and develop root words. Given that I only had three interviews, I felt the time was better utilised doing the analysis manually. Having mapped the methodological process, I was ready for the reporting stage of the research study. Stake (1995:128) provided the way forward to an alternative approach for case study reporting. He argues that:

The case is not a problem or a hypothesis. It is useful for the writer to contemplate certain alternatives such as those suggested here, then to work out his or her own approach. Included in the report often are one or several vignettes, briefly described episodes to illustrate an aspect of the case, perhaps one of the issues. A vignette often is an extreme representation, quite atypical.

The analysis chapter is presented as a series of descriptive vignettes that allows the data to speak for itself. The vignettes were selected to illustrate the cognitive and social influences of computer technology on profoundly Deaf young learners.

3.12 Conclusion

Chapter 3 has focused on the research methodology selected for my thesis. It has positioned the research in a learning context. This chapter has described the process of how the research was conducted.

The next chapter will focus on contextualising computer technology in education for learners with special educational needs (ELSEN).

CONTEXTUALISING COMPUTER TECHNOLOGY IN EDUCATION FOR LEARNERS WITH SPECIAL EDUCATIONAL NEEDS (ELSEN)

4.1 Introduction

The purpose of Chapter 4 is to contextualise my research. In this chapter I firstly explore my computer research study and the context in which it is located by providing an analysis of the computer intervention. Then, I describe the educational setting where the computer project took place. The educational setting is unique because it is an initial experience into Deaf culture for young learners. Lastly, I provide vignettes of the educators and sketch a profile of each research participant involved in the study.

4.2 Background to the project

The computer project for early childhood development on which I was working was the first of its kind in South Africa. The research undertaken is located within the computer project.

If, as Heslop (2003:8) argues, scientific research is “solution-seeking”, then in my work as a trainer, I had become a “solution-seeker”. The computer program on which I was training educators had aroused a curiosity which became the source of my research.

In January 2000 the non-governmental organisation based in Cape Town, where I was employed, was approached by a multinational IT corporation to conduct a pilot study on the

Kidsmart Young Explorer Children's Computer Unit. The non-governmental sector in South Africa undertakes work on behalf of corporations which are not within the ambit of national government.

4.3 Exploring the appropriateness of computer technology

My role in the pilot was to train the educators in appropriate integration of computer technology into the Grade R curriculum and to execute some aspects of the evaluation for the pilot study.

The project had four phases. The first phase involved the identification of sites. The second phase was to train the teachers to use the computer and to integrate its learning potential into the curriculum. At the conclusion of training the schools were ready for the third phase, namely having the computers installed. The last phase involved the evaluation of the pilot study.

For the pilot study, five sites were selected. Four were in the Western Cape and one was in Gauteng. The criteria to be used for selection were set out by the donor. These included redressing past social inequities and selecting community-based sites situated close to primary schools.

The success of this pilot study led to further donations being made to Grade R classes in 2001/2002.

At present, selected Grade R educators in all of the nine provinces have been trained and computers have been installed in their classes. There are now a total of three hundred units in South Africa.

I met the educator of the Deaf school at one of the training sessions for educators with special needs learners.

Bernadette was the Grade R educator at a small school for profoundly Deaf learners. The children were taught using South African Sign Language.

4.3 Exploring the appropriateness of computer technology for the Deaf

It was the challenge of combining computers with Sign Language that triggered the research question formulated in the study: "Can computer technology add value to the educational challenges faced by the profoundly Deaf?"

My concern was centred on the developmental appropriateness of using computer technology in a complex educational setting. It could well prove to be "miseducation" (Elkind, 1993). The debate around the appropriate use of technology in Grade R was expounded upon in Chapter 2.

There was an additional concern that low tolerance and frustration with the technological challenge could result in destructive behaviour by the learners. Instinctively, I felt that having been educated through mediation (SASL) by people, the learners should be ready for mediated learning by a machine.

The visual and animated presentation of the software would also be attractive to profoundly Deaf learners. My concerns were both for the educator and for the learners. Could the success signalled in the pilot project be transferred to children with barriers to learning? Computer technology would harness the strengths of the Deaf as it integrated the visual-manual modalities.

Caldron and Greenberg (1997:476) argue in favour of computers for the Deaf when they say that:

... Deaf children can acquire skills at a rate similar to hearing children if provided with appropriate channels for instruction and experience. In most cases, this is conducted through a visual channel with the use of manual communication.

The computer is essentially a visual machine and could provide an appropriate channel for learning in the Deaf.

4.4 The computer unit

The computer used in my study comprises two components, namely furniture features and a built-in personal computer. The colourful furniture is child-friendly in appearance and also in its size. It has two mouse pads. One is for left-handed children and one is for right-handed children. The keyboard has a flat surface with 99 keys. The bench can accommodate two children sitting in front of the desk. A photograph of the Kidsmart Young Explorer Computer Unit appears below.



Figure 4.1 The Kidsmart Young Explorer Computer Unit

The personal computer has both hardware and software. The hardware comprises the monitor and the hard drive which has a lock-up facility behind the unit. This is to prevent curious young children from fiddling with the computer's hard drive.

4.5 The computer program

The educational software that we used in the pilot project was the *Early Learning House Series* by *Riverdeep*, which has five programs. The choice of software was made by the donor after extensive research in America (Tsantis *et al.*, 1989). I have selected only one program out of the *Early Learning House Series* to research. It is called Millie's Maths House. The activities within Millie's Maths House help to build the foundations for mathematical concepts such as problem-solving, counting, addition, subtraction and patterns, and aid the development of thinking skills in young learners.

Millie's Maths House has seven activities:

1. Little, Middle and Big
2. Mouse House
3. What's My Number
4. Bing and Boing
5. Build-a-Bug
6. Number Machine
7. Cookie Factory

Once the *Early Learning House Series* has been opened, the child will click on the icon of a cow, depicting Millie's Maths House. A house will then appear on the screen. There are seven activity rooms in the house. The child clicks on the room he/she wishes to enter. Figure 4.2 is an illustration of the rooms of the house.

allows for divergent thinking as there are many possible



Figure 4.2 Millie's Maths House

Activities are sequentially graded from left to right and from the simple to the complex in a mathematically logical sequence.

The first activity introduces a size sequence. *Little, Middle and Big* need to find their shoes. The learner clicks on the shoes arranged in a cupboard and matches them to Little, Middle or Big. The characters' facial expressions show whether they are happy with the learner's choice or not.

There are two modes of activity and the child can choose whether he/she wants a question-and-answer mode or an explore-and-discover mode. In the explore-and-discover mode the child is provided with a random selection of shoes. This

allows for divergent thinking as there are many possible answers. The child is in control of the choices that are made.

The other mode is a question-and-answer mode. The child clicks on the spider in the picture frame. This section introduces the characters and asks the learner to find the appropriate shoes. The characters display pleasure and delighted facial expressions if the shoe size is correct. Incorrect choices are given disappointed responses. This adds humour to the errors.

The second activity of the house is the *Mouse House*. Here the child selects geometric shapes to build a picture according to a given design. A new computer skill is introduced when children practise how to click and drag shapes that match onto the given blueprint.

There is an explore-and-discover mode that provides a box of shapes and a work space alongside so the child can drag shapes into the work area to build his/her own creation.

In the question-and-answer mode of this activity, the mouse in the house requests the geometric shapes and tells the learner when the design is complete. On completion, the mice move into the house while jumping with joy, celebrating the completion of the house.

What's My Number only has a question-and-answer mode. It emphasises number recognition from 0 to 10. The duck asks the question "Can you put the same number of objects on your stage as I put on mine?" The learner drags the number of objects that Dorothy Duck requests. Dorothy Duck checks the number of objects with the displayed numeral and if it is correct she rewards the child with the (activity) action linked to the object,

e.g., jacks jump out of boxes and helicopters take off in full flight. Dorothy Duck won't let the curtain open on these features until the numbers are identical.

The Number Machine is a cash register with keys from 0 to 10. *Bing and Boing* is the last activity shown on the top storey of Millie's Maths House. They are bouncing friends that complete patterns by repeating parts of the pattern to make up the whole sequence. In the explore-and-discover mode the child selects from one to three symbols to make a pattern. Bing (the character) repeats the pattern. Once again the explore-and-discover mode has allowed freedom of choice and an opportunity to be creative in pattern making.

In the question-and-answer mode of this activity the child clicks on Boing and watches what pattern he makes. Boing asks the question, "What comes next?" The child is rewarded with a smiling face if he/she completes the correct patterns. Incorrect patterns are stopped and the man asks the child to try again. He shows a dissatisfied facial expression. Up to five pattern sequences can be made.

Build-a-Bug allows children to explore numbers creatively as they build up the creature using the body parts provided. The bug is represented as a fat pink caterpillar. The body parts requested are from 1 up to 10 parts. They are eyes, ears, antennae, spots, feet and tails.

In the first mode, namely the explore-and-discover mode, the learner clicks to choose the body parts and also chooses to move the parts onto the bug's body, then clicks on the number to choose how many parts they wish to use.

In the question-and-answer mode a rabbit scrolls down a card and reads the request "make a bug with five ears and two tails".

If the child matches the number and body parts correctly, a new bug appears.

The Number Machine is a cash register with keys from 0 to 10. The child clicks on any key and the drawer opens as bugs or small animals pop up counting aloud to match the number on the top display board.

There is only one mode of operation in this activity. It is the question-and-answer mode. In the question-and-answer mode Annie the worm asks for a number. If the child chooses the correct number on the cash register the drawer opens and the bugs pop out.

The last of the seven activities is called the *Cookie Factory*. In the *Cookie Factory*, there are also two modes. In the explore-and-discover mode the learner must click on the pipe and a cookie rolls down the chute. By pulling on the lever the conveyor belt rolls the cookie along. The child must decorate the cookie with jellybeans by pressing on the bean dispenser as many times as he/she likes. Cookies are sorted into bins numbered 1-10 and are sorted according to how many beans are put on them.

In the question-and-answer mode the child needs to click on the horse and he requests "Put three jelly beans on my cookie please". If the number of beans is correct, the horse eats the cookie.

If not, he says, "This one is for you, froggie." The frog then gobbles the cookie.

Both skills and knowledge are carefully graded from one activity to the next. In the first activity the child learns the

concept of size. In the next activity the child learns size and shape. Gradually earlier learning is reinforced and new learning is introduced.

After describing the pilot study and the computer program I turn now to the research setting.

4.6 Background to the research site

The school selected as the research site is one of the Grade R classes identified late in 2002. It is a special needs school for profoundly Deaf children. These children and their families face both economic and societal challenges because they come from historically disadvantaged groups. Some of the children in this group reside and are raised in women-headed households. These households are historically the most disadvantaged sector of South African society. In some instances there is evidence of poor nutrition, although supplementary feeding is provided at the school.

In many cases the primary barrier to learning of deafness can be linked to unattended medical conditions that may have been ameliorated if the condition had been addressed in time. Assistive hearing devices/aids are not an option for these children because of the high cost of frequent replacement due to the physical growth of the young child. Hearing aids are not regarded as a necessity in families where unemployment and poverty are pervasive. The most effective method of teaching these silent children would be the introduction of South African Sign Language (SASL). This method of teaching is echoed by DEAFSA (Sign Language, n.d.(c)) who argue that:

² Sign argot is a colloquial form of sign language developed by communities

The majority of Deaf people acquire Sign Language at school. Sign Language is the first language of the majority of Deaf children.

A local children's hospital identified these children as needing early intervention. It resulted in the proposal to establish this small school on the hospital grounds. It was undertaken in 1997 by a university's speech and hearing department, together with other social investment groups.

In 1999 the school relocated to a nearby Hard of Hearing School and is presently situated in a small house on their property. The children are kept separate from the hearing (audio-receptive) children as they will learn better if they only use Sign Language rather than the total communication approach used by the other children. The children must establish Sign Language as a first language. This is an international trend as Johnson (1999:4) argues that:

... sign language must be established as a first language of deaf children because it is the language these children can most naturally acquire.

Another possible reason for the separation is explained by David Wright. The development of a sign argot⁷ is graphically documented by the South African deaf writer and poet David Wright, who attended a school for the deaf where the use of sign language was prohibited. He is cited by Sacks (1990:13) in his description of playground behaviour as saying:

Absolutely engrossing pandemonium ... I begin to sort out what is going on. The seemingly corybantic brandishing of hands and arms reduces itself to a convention, a code which as yet conveys nothing.

⁷ Sign argot is a colloquial form of sign language developed by communities

It is in fact a kind of vernacular. The school has evolved its own peculiar language or argot, though not a verbal one ... All communications were supposed to be oral. Our own sign-argot was of course prohibited ...

This illustration reinforces the argument of Sign Language being a natural choice of language for the Deaf.

Presently the school has an enrolment of 29 learners up to and including Grade 3. It now receives an annual budget from the Western Cape Education Department.

Sign Language is not a universal language and even in South Africa there is a debate about "the diversity of South African Sign Language" (Lucas, 2001:14). People who use SASL do not regard themselves as disabled but rather as a linguistic minority. South African Sign Language is not the home language of these children. Their home languages are Xhosa, Afrikaans or English.

The school offers weekly tuition in Sign Language for the parents of profoundly Deaf learners. The parent classes are poorly attended owing to the morning timeslot when parents are at work; if parents are not working they cannot afford the transport cost of getting to the school (informal discussion with educator).

Sign Language is learned through the eyes (visual perceptual receptors) while spoken language is conveyed through the ears (auditory receptors). The written language will be another language, usually English (DEAFSA, Bilingual Education, n.d.(a)). The multilingual challenges these children face are evident. The bilingual model of language learning is termed Bilingual Education. According to DEAFSA:

Only when the Deaf child has mastered Sign Language, and gained general knowledge through Sign Language, a model for teaching English/Afrikaans is introduced. First they are taught to read and write, thereby adding the possibility to obtain knowledge by themselves through printed material.

The previously mentioned approach to language learning complements the additive bilingualism which is advocated for all learners in Curriculum 2005, the official national school curriculum in South Africa.

Attention now turns to the educational context of the research. A number of political and educational aspects are dealt with in the following section.

4.7 The educational context

This research study straddled a number of fields and phases of education. It occurred within a changing policy and legislative context. At the time of the research, the Revised National Curriculum 2005 statement was about to come into effect. A South African Sign Language (Main Language) Draft Curriculum for Grade R-12 had also been produced. This draft curriculum was produced under the auspices of Deaf Federation of South Africa (DEAFSA) and implementation had begun. In 2001 White Paper 6 entitled *Building an Inclusive Education and Training System* (Department of National Education, 2001b) was released. The recommendations proposed in the White Paper 6 will impact on special needs schools.

The first field of study is that of early childhood development. Publications by the National Department of Education (RSA) refer to early childhood development as an umbrella term used to describe the holistic development of children aged 0-9 years (Department of

National Education, 2001a). The entrance grade of the foundation phase of education that this group of children are in, is termed the Grade R. Grade R is the first year of the Foundation Phase, known as the Reception Year. The Reception Year caters for learners in the age cohort of 5-6 years.

The research cohort is also affected by all policy pertaining to "Education for Learners with Special Education Needs" (ELSEN). White Paper 6 (Department of National Education, 2001b) is one of these policies. Aarons and Akach, however (2002:154), argue that:

... implementations of inclusion policy do not apply neatly and easily to this [Deaf] community.

They suggest that signed language medium of instruction schools be established (Aarons & Akach, 2002:156). These schools would be open to any child choosing to be instructed in the medium of Sign Language. DEAFSA argue that it is the schools for the Deaf that provide a collective base for the acquisition of Deaf culture (DEAFSA, Deaf Culture, n.d.(b)). They further state that it is at school where the child acquires:

... common beliefs, attitudes, customs, behaviours, social habits, values and technology (DEAFSA, Deaf Culture, n.d.(b)).

If the child is the only sign user in a mainstream school, it is "exclusive" rather than inclusive education (Aarons & Akach, 2002:161). They cite the response of the World Federation for the Deaf (1995):

The education of Deaf children should not be carried out by placing him/her alone in hearing schools if proper interpreting service is not available during all lessons. Deaf children have the right to

education in Sign Language and Deaf children have the right to be educated in their own schools (Aaron & Akach, 2002:161).

Within the Western Cape Education Department, the school where my research was located fell under the Directorate: Specialised Education Support Services. Under this directorate there were, in 2003, seven schools for deaf or hard of hearing children in the Western Cape. Four schools were in the Cape Metropole and three were in rural areas (Breede River/Overberg). The schools in the Cape Metropole were divided in their approach to language learning. There are historical and political reasons for the different approaches. One school taught Sign Language, two schools used total communication and the fourth school favoured oralism.

4.8 Describing the early childhood setting

The research site Grade R class is located in a small four-roomed house. The house is shared with the profoundly Deaf toddlers (aged two-and-a-half to four years).

The appropriate early childhood development environment created by the parental involvement and the small house is supportive of young learners. The homely environment creates a natural bridge from home to a relaxed first experience at school. Photographs of the research setting overleaf illustrate my claim.

Figure 4.4 The back view of the house

The house provides for some shared space with the younger children (two of the rooms) and a home base for each of the groups. The space that is shared is a domestic area that allows for imaginative



Figure 4.3 The front view of the house.



Figure 4.4 The back view of the house

The house provides for some shared space with the younger children (two of the rooms) and a home base for each of the groups. The space that is shared is a domestic area that allows for imaginative

and fantasy play. It is furnished with child-size domestic furniture and plenty of props and dressing-up clothes. The domestic area stimulates socialisation and communication among the children.

The second shared space is the room used for constructive play. The educational equipment comprises constructional-type games used for design and building. These include wooden blocks, farm animals, Lego, Duplo, cars and trucks. It is here where the computer is located. The choice to place the computer here seems to have been based on practicalities. These include electricity supply (plug points), security and an appropriate time in the daily programme. The time of day is when the educator and the children are all present in this room for self-selected constructive play. After providing a narrative report of the setting, I now introduce the staff at the school.

Vignettes of the educators

The ratio of staff to learners is 4:1. The staffing is made up of an audiologist who was also the educator. I met the first educator, Bernadette,⁸ at the computer training provided by my organisation. She was an enthusiastic trainee who seemed eager to explore the benefits of computer technology with her learners. Bernadette was a postgraduate student in hearing and speech therapy. She subsequently left the school to take up a new position in March 2003.

Leila was a young graduate who began teaching the Grade R class at the start of the second quarter. Her expertise was also in speech and hearing. She was the Grade 3 educator and took up the Grade R post when the previous teacher left. Initially my field notes record that she seemed hesitant of me but felt obliged to continue with the research process that was some three months old (field notes, 9 April

⁸ Not her real name. The rationale for the use of pseudonyms is explained in Chapter 3.

2003). Leila was supported in the teaching context by a Sign Language interpreter who was also an assistant teacher.

Lesley was a fluent Sign Language user although it is not her first language. She was also the young parent of a learner at the school. Lesley trained as a Sign Language interpreter as a result of wanting to communicate with her Deaf child. Although she did not complete her formal schooling, she has a natural ability when working with young children.

These three educators became central to the facilitation of the research process at the site. I describe the other members of staff as an explanation to contextualising Deafness in education.

There were three additional staff members, two of whom are Deaf and communicate using Sign Language. Two assistants work with the toddler group (one is a first language sign user) and received guidance from the Grade R educator. The other is a cleaner in the school. She is also a first language sign user. The inclusion of first language sign users on school staff is in accordance with recommendations made by DEAFSA. They provide role models for the children to identify with. Three of the staff members are also parents of children who attend the school. The use of Sign Language which is central to Deaf culture indicates that a micro Deaf culture is emerging within the school.

After describing the early childhood educators, I now explore early identification and intervention.

4.9 Early identification and intervention

In a demographic description of this group of learners the profoundly deaf represent only 1% of the population of South Africa. As a linguistic minority there are about 600 000 people

who use South African Sign Language. The Department of Education supports the development of expressive communication in all children. Expressive communication embraces spoken and signed language. A Consultative Paper on Special Education reports that:

The years of childhood development (0-9years) constitute a crucial phase for preventing learning and development problems and preparing the child to participate in an inclusive society. It is widely acknowledged that many children in this age group are 'at risk'. The Ministry recognises that some learners in this age group with disabilities will require intervention to enable them to develop basic receptive and expressive communication competencies which are necessary for independent learning and living ... a particular focus should be placed on those with disabilities such as learners who are deaf or blind and for learners with multiple disabilities (Department of National Education, 1999:21).

DEAFSA regards the issue of Sign Language within the realm of language and human rights, rather than within the health and welfare paradigm (DEAFSA, Sign Language, n.d.(c)). Clearly, DEAFSA argues for the language minority rights as opposed to the medical issues of Deafness.

It is significant to locate Sign Language in a human rights context within this study as there are links to my theoretical framework.

4.10 Sign Language as a human right

Sacks (1990:150) argues that internationally there are movements that concern themselves with the rights of the Deaf. These

movements are Deaf Pride and Deaf Power. Their concerns centre on access, language and policies for educating deaf children.

The Pan South African Language Board identified their vision in this regard during a strategic planning session on March 2002, as follows:

To achieve the equal status of all the official languages of South Africa as well as Khoe, Nama and San Languages and South African Sign Language (Anon.,2002:1).

The Board also called for respect for all languages in South Africa, equal treatment of all languages and non-discrimination on the basis of language. In the *Consultative Paper No.1 on Special Education: Building an Inclusive Education and Training System*, 30 August 1999, Chapter 4 refers to the medium of teaching and learning. It says that:

...the majority of members of the deaf community do not gain access to the curriculum at school and other institutions of learning through their first language, Sign Language ... International trends and developments in deaf education in our country support the achievement of bilingualism and bi-culturalism.

In this approach, Deaf learners are taught South African Sign Language (SASL) as a first language which is the basis for the acquisition of a second spoken or written language. Bilingualism is also seen as important for the promotion of equality and for the social inclusion of the Deaf in our society (Department of National Education, 1999: 45).

4.11 Language rights

Although Sign Language is referred to as the 12th official language of South Africa, it does not as yet enjoy the status of other official languages. Within the deaf community of South Africa there is a growing demand to be granted the rights entrenched in the Constitution. In Section 6(5) (a) (iii) of the Constitution recognition is made of Sign Language by stating its intention "To promote and create conditions for the development and use of Sign Language". These rights include the right to be educated in Sign Language. The Language in Education Policy of the Department of Education (1997) affirms this right. Muthukrishna (2001:157) cites the South African Schools Act (1996) regarding Sign Language in Clause 6(4):

A recognised Sign Language has the status of an official language for the purpose of learning at a public school.

The choice to use Sign Language means that a bilingual approach to teaching and learning will be adopted. The child will use Sign Language to communicate and a second language to develop literacy. The use of additive bilingualism is in line with the multilingual approach advocated in Curriculum 2005 (DEAFSA, Sign Language, n.d.(c)).

According to Muthukrishna, (2001:158):

The White Paper recommends that urgent attention be given to target groups including the very young (preschool) learners with disabilities. With respect to the Deaf, the Deaf community argues for a special focus on the deaf learner from the age 0-3 years born to hearing parents. The White Paper recommends that all Early Childhood Development (ECD) provisioning should, therefore, be multi-sectoral, community based and integrated, to enable young learners to benefit from

learning in an environment that acknowledges and appreciates diversity. The White Paper explains that the Deaf community argues for, in the case of Deaf learners (ECD), that stimulation should include Sign Language instruction and the training of parents in Sign Language to enhance parent-learner communication, relationships and education.

In this section I have marshalled evidence to support an understanding of the rights of Deaf children in a democratic society. In the next section I introduce the children.

4.12 The children's profiles

I turn now to recording the profiles of the participants in this study. On commencement of this scholarship there were six young learners in the Grade R class. There were three boys and three girls. Three weeks into the research a fourth boy returned to the group after an unsuccessful attempt to mainstream him in a state school. Information about the learners is summarised in the following table.

Name	Date of Birth	Age*	Religion	Home Language
Ornar	11.09.97	5.5 years	Islamic	English/Afrikaans
Sepele	21.06.97	5.8 years	Christian	Afrikaans
Andie	09.05.96	6.9 years	Christian	Afrikaans
Jeremi	20.03.97	5.17 years	Christian	English
Emandy	07.05.97	5.9 years	Christian	Afrikaans
Sophie	19.06.97	5.9 years	Christian	Afrikaans
Paula	05.01.97	6.1 years	Christian	Sign

*All children's ages were calculated as at 1 February 2003

Table 4.12 The children's profiles

Name	Date of Birth	Age*	Religion	Home Language	Language Medium	Parents' Occupation	Marital Status	Position in family
Omar	11.09.97	5.5 years	Islamic	English/Afrikaans	Sign	Father: Artisan Mother: Housewife	Married	1/2 He has a younger brother aged 1
Sipho	21.06.97	5.8 years	Christian	Xhosa	Sign	Father: Works at a gym Mother: Domestic worker/ Translator for Xhosa parents of deaf children.	Married	5/5 (Youngest)
Andile	08.05.96	6.9 years	Christian	Xhosa	Sign	Father :Unknown to mother Mother: Unemployed	Single	1/2 2 siblings died
Jenni	20.03.97	5.11 years	Christian	English	Sign	Father and Mother have their own business	Unmarried	1/1
Beauty	07.05.97	5.9 years	Christian	Xhosa	Sign	Father: Groom Mother: Part-time domestic worker	Single but presently living together	1/2
Sophie	19.05.97	5.9 years	Christian	Xhosa	Sign	Father: Deceased Mother: Cleaner (has TB)	Single	1/1
Pumi	05.01.97	6.1 years	Christian	Sign	Sign	Father: Factory worker Mother: Assistant at Deaf school	Married	3/3 Mother pregnant

*All children's ages were calculated as at 1 February 2003

Omar

The first boy I introduce is a very small boy called Omar. Despite being profoundly deaf he also suffers from athetoid cerebral palsy.⁹ Verville (1967:449) argues that "in cerebral palsied children body measurements are significantly below normal". He moves with difficulty as muscles contract and twist in wave-like motion. His body appears relaxed but his arms move and contract in waves of wriggling movements. Both his gross motor co-ordination as well as his balance are poor. According to Verville (1967:449), it is not uncommon for the cerebral palsied child to have multiple handicaps. As a baby Omar had a bout of jaundice. Jolly (1982:551) postulates that severe jaundice is the most common cause of atthosis. Jolly goes on to say that "jaundice damages the inner part of the ear so that athetoid children are often deaf". Omar is profoundly deaf and will not benefit from wearing hearing aids.

Despite his physical challenges Omar is a happy little boy with a delightful sense of humour. My observations of Omar are supported by Jolly (1982:551), who argues that:

... the athetoid child is seldom fat because of his [*sic*] great activity: he [*sic*] is often cheerful, with a great sense of humour.

Omar comes from a working-class background. His mother has been involved in his developmental progress (discussion with the educator).

Sipho

The next boy I introduce is a lively, animated young boy from a large family. Being the youngest member of a hearing family he is very sociable and has developed an ability to lip read. Sipho does not wear hearing aids as he has no residual hearing that can be enhanced

⁹ The condition is caused by damage to the basal ganglia of the brain.

by aids, yet he succeeds in speaking a few words with remarkable accuracy and appropriate intonation. His mother has attended Sign Language classes so she is able to communicate with him. He is well adjusted and the enthusiasm he demonstrated during computer sessions shows a readiness for learning. No reasons for his deafness could be given. no cause could be found.

Jenni

The first girl in the group that I introduce is a petite little girl who arrived alone from Johannesburg to live with her grandmother in January 2003. Her name is Jenni. The absence of her parents was very distressing for her and resulted in behavioural problems at school. The parents have subsequently relocated to Cape Town. Jenni has powerful hearing aids and is therefore the only child in the class that has the ability to acquire some speech. A secondary medical condition is that her eyes are squint and need frequent medical attention resulting in her being absent from school. Her deafness was caused by secondary exposure to German Measles. According to Jolly (1982:549):

Andi... an infection in the mother such as German Measles, can affect the developing brain ... damage to the brain can also affect the area controlling hearing, causing deafness ... Eye muscles can be among the muscles affected, resulting in a squint.

Beauty

Beauty is a cognitively skilled learner who responds to the school environment with alacrity (discussions with educator). She has hearing aids but wears them reluctantly because they are often broken or the batteries are not working. The maintenance of hearing aids is a burden for poor and uneducated parents. Her home circumstances are complex as parental relationships are unstable. At

the beginning of the year she lived alone with her father. No one communicates in Sign Language with her outside of the school programme. Being a very receptive learner she is always disappointed if activities stop or change (observations). Beauty then displays her emotions easily. Her deafness was only diagnosed at age 3 years and no cause could be found.

Sophie

The third little girl of this group presents as a sad and lonely child who seldom initiates activities. She is happy to be led. The tragedy of her home life weighs heavy on her since her father passed away. She is frequently absent from school to care for her sick mother who is suffering from tuberculosis. The long absences from learning are evident in her slow progress. Sophie is thin and often arrives at school without lunch and not having had any breakfast. The educators at school have implemented a supplementary feeding programme for her. The cause of her deafness is ascribed to a bout of meningitis at four months of age. Jolly (1982:556) argues that deafness is often a sequel to meningitis.

Andile

The third and oldest boy in the Grade R class is called Andile. His home circumstances are complex and economically disadvantaged (school records). Despite being a good candidate to wear hearing aids, his mother sold his hearing aids. She has not attended Sign Language classes and therefore is unable to communicate with him. Andile's scholastic progress has been slow and his sign language is limited. His language is made up of gesture and pointing. It is likely that he will remain in Grade R for a third year. Developmental assessments have been inconclusive and ranged from suspected foetal alcohol syndrome to visual spatial difficulties. These developmental delays could

clearly be a factor in his difficulty in the mastering of Sign Language. No cause for his deafness is given.

ANALYSIS OF DATA

Pumi

Pumi arrived at school three weeks into the research. He returned to the Deaf school after an unsuccessful attempt to mainstream him. He is an intelligent and keen member of the group. He is the only child in the group whose home language is Sign Language. Both parents and siblings are deaf. His deafness is hereditary. The grounding of a main language is evident in his readiness for conceptual learning. The reason for attempting to mainstream Pumi was given by the educator as his readiness for learning. He clearly is the most well adjusted member of the group.

Chapter 4 has explored the many intersecting themes embedded in the context of my research. It has attempted to portray the pilot study as the springboard to the enquiry.

4.13 Conclusion

In Chapter 4 I have provided background information on the pilot project and introduced the computer unit and the program chosen for my study. I have described the educational setting and introduced the research participants.

In the next chapter I begin the analysis of the data collected over the research period.

Chapter 5

ANALYSIS OF DATA

5.1 Introduction

Chapter 4 has located my research into the use of computers within the context of early childhood development and special needs education. It has provided a descriptive account of the research setting and has drawn detailed profiles of the participants involved in the study.

In Chapter 5 I will analyse the data that was gathered and present my findings. The analysis chapter is presented as a descriptive account. The descriptive analysis and interpretation will be presented together as a context to building a case study. I have favoured the approach of Wolcott who uses the term “transforming data” (Wolcott, 1994:1). He advises the qualitative researcher to use descriptive analysis when writing up the research findings. In his definition of descriptive analysis, Wolcott (1994:12) argues that qualitative inquiry asks the question “What is going on here?” This simple question has aided me in the interpretation of both observation and videotaped data. The question is not dissimilar in meaning to the question Vygotsky asked in his research, namely, “What are the children doing?”(1978:13). Vygotsky too, worked with young children and it is from a Vygotskian understanding that I have built a case for the cognitive and social influences of computer technology on profoundly Deaf young learners. It is Wolcott’s (1994) and Vygotsky’s (1978) previously mentioned key questions which framed the analysis of my data.

The descriptive analysis deals with the interpretation of the data gathered during the research period. The research question which framed my research was as follows:

Can computer technology add value to the education of profoundly Deaf young learners?

The question is discussed here in relation to three forms of “value-addedness”, namely the social influences of computer technology, language and communication, and the cognitive influences of computer technology.

5.2 The social influences of the computer

The children’s first encounter with the computer

As an illustrative example of the potential of the computer to mediate cognitive and social learning in Deaf children, I will describe the first encounter and analyse it within a Vygotskian framework.

On 12 February 2003 the computer was introduced for the first time to the five Grade R children present. The teacher, Bernadette, gave the computer program *Millie’s Maths House* a sign name. The character of the program is Millie the cow. So in consequence the teacher decided that the sign name for the program would be “cow”. It was signed as fingers curled on either side of the head to form horns. The inability of Deaf pre-school children to write does not allow for spelling of names in Sign Language in the beginning of the Grade R year. This means everything at this stage is given a proper name (noun) which has a related sign. The animal, cow, is familiar to the children in this cohort. In fact the video recording (12 February 2003) shows the children signing the word for cow before the educator provided the given sign name. The children were prompted by the visual clue of the cow provided by the computer.

The session was teacher-directed, as the educator, Bernadette, explained the rules of conduct for computer time. The social skills that were reinforced were “to walk around the computer unit and not to climb over it”. The children were also encouraged not to lean on the keyboard. Prosocial behaviour was reinforced as Bernadette gently nudged children’s elbows off the keyboard when they forgot the rules. It was the way in which the teacher mediated social learning within the context created by the computer that allowed the children to learn new social skills.

Towards the end of the session children were correcting the behaviour of others. Siphon was captured on the video pulling Andile back from jumping up to point to the screen (video, 12 February 2003). I observed the teacher encouraging the children to take turns and to share at the computer. It was this particular social learning created by the computer and mediated by the teacher that I noted. I had recorded that the children were very cooperative and well behaved.

The social learning embedded in this illustration provides evidence of how adults scaffold social learning for children. Vygotsky (1978:84) contends that:

...through imitating adults and through being instructed about how to act, children develop an entire repository of skills.

The educator had given the children appropriate expectations of socialising and behaving during the computer sessions. The internalisation of these skills was reflected in how children transferred the social learning to teaching their peers about appropriate behaviour. Drawing on the video data of Siphon correcting Andile on 12 February 2003, it was evident that the children’s social learning, influenced by the computer-mediated social learning, had begun.

5.2.1 The educators' view of the social influences of the computer

The interviews provide another source of data and here I draw on the evidence of the computer's ability to provide unique social opportunities that were observed by the educators when I was not present. These observations were recounted to me in the interviews with the educators.

The question in the interview protocol that refers to the social influences of computer technology is also the auxiliary question. It is as follows: Is there evidence of collaborative learning between Deaf children when they use the computer? The educators were asked if they had observed children collaborating with one another.

Bernadette described the empathy of Deaf children in wanting to help one another. The incident she reported was linked to children assisting with mouse control.

They are reassuring. Peer education is a powerful thing ... they were not nervous with a friend.

Leila, the second teacher, also made the link to empathy as she replied:

... most definitely (I observed) putting a weaker child with a stronger child and how willing they are to help each other. Pumi is very good, he doesn't take over doing everything, he will sit and he will say if Andile chooses the wrong thing, he suggests what about that one and he points out the difference.

The assistant educator, Lesley, had witnessed an improvement in sharing. The computer, she felt, had encouraged sharing and helping one another. She said:

They are more open to talking to each other, they like just wanted to do something by themselves before. When they sit at the computer you can actually watch them playing together.

The educators reported that during computer sessions Jenni had become more cooperative and willing to engage with other children. Her skill and experience with computers made her confident and this seemed to boost her self esteem. The unique instances of social behaviour she displayed were laughing, dancing in her seat to the music and hugging her partner.

The social influences of the computer described by Bernadette were those of waiting and turn taking. She said, "the computer provides a new context of turn taking". She also referred to the opportunity to "interact within a technologically advanced world". Her statement resonates the understanding of Berk and Winsler (1995:21) who argue that a technical tool can mediate human influence on environment.

The assistant teacher, Lesley, cited a number of occasions when she had observed that the children had become more socially involved as a result of the computer. Lesley said:

I think they are signing more to one another now.

The early evidence of collaborative computer tasks suggests that it had initially stimulated social learning. The observations of the educators resonate the argument presented by Vygotsky (1978:88):

Children can imitate a variety of actions that go well beyond the limits of their capabilities. Using imitation, children are capable of doing much more in collective activity or under the guidance of adults.

Clearly, the data gathered in the interviews shows that the computer has the potential to support social learning in Deaf children.

5.2.2 Vignettes of the social influence of computer technology

I have chosen to illustrate the evidence from the data gathered by providing sketches and portraits of the children's individual responses to the computer. The word vignette is used to interpret the meaning of the phrase, "a short description" (*Concise Oxford Dictionary of Current English*, 1979:1297).

A significant finding in this study was that the children's responses to the computer were very individual. There are, however, themes of commonality. It is therefore necessary that the vignettes are presented as individual studies in order to formulate my case study. In the following sections the most pronounced learning of each child is portrayed. For the purpose of the analysis, the descriptions of social learning, cognitive learning and language and communication are separated. However, as children do not learn in isolated episodes, the categories in reality merge into one another. Social learning normally progresses to cognitive learning or language development and communication is illustrative of a social process. The vignettes are therefore not mutually exclusive but may display the various aspects of learning being investigated here.

Social Sipho

In the case of the young boy called Sipho, significant evidence of social learning was observed. In this section, I will describe and analyse his social learning. His attendance at school was consistent, being present for all ten computer sessions. Like Beauty (whom I discuss later), his progress was gradual, steady and consistent. In my recordings he was the only child in the group that seemed able to pair compatibly with anyone of his peers (field notes, 7, 21 & 30 May). In fact he worked with each member of the group during the

research period. From the analysis of field notes, all other group members favoured partners of similar abilities. I have noted that Siphos response in one particular relationship with a little girl called Jenni was very nurturing. He would often hug her. He praised her in Sign Language when computer tasks were correct. He also acknowledged her with smiles and affirming nodding of the head (field notes, 21 May 2003). In collaborative situations he provided support by pointing to the appropriate answer and finger counting as his partner worked. His response to the computer was often humorous. On 16 April 2003 Siphos realised the humour of putting big shoes on the small man and of putting small shoes on the big man. My field notes record that he was laughing with enjoyment. He displayed a social nature as he would hold sign conversations with his partner as the computer provided content for the discussion. It was clear that social collaboration was transforming his cognitive abilities. The following cognitive vignettes describe Siphos progress.

An example of his interpersonal intelligence¹⁰ was observed on 21 May 2003. Siphos turned up the volume of the speaker on the computer when he saw Jenni dancing in her seat. His profound deafness does not allow him to hear, so how did Siphos know she wanted more volume to dance to? The cause and effect response of behaviour to music volume must have been learnt from his older siblings.

I analysed the childrens responses to the mathematics program in terms of the sequential structure that was presented on the computer. Through observations of Siphos work I noted his maths abilities. Mathematically he was only able to work with numbers up to eight. At times he would need two or three attempts at a problem before he

¹⁰ Interpersonal intelligence is the ability to perceive moods, intentions, motivations and the feelings of others. It is the ability to respond effectively to cues (Woods, 1997).

was successful. In these attempts he was positive and undeterred by the repeated efforts. Vygotsky (1978:73) posits that:

The growing complexity of children's behaviour is reflected in the changed means they use to fulfil new tasks and the corresponding reconstruction of their psychological processes.

In Siphó's case, practice assisted his performance. Faced with a new maths task he was able to adjust his response in order to meet the task requirements even if it was with repeated efforts. On 23 April 2003 I recorded in my field notes that Siphó was anxious about one particular maths task:

His body language is stiff after one incorrect response. The teacher guided his learning by signing the instructions again. He gets two responses correct in a row. The duck on the computer shows him a thumbs up sign and Siphó lies down on his seat and covers his face with pride.

This anecdote illustrates the position raised by Vygotsky of the "buds" of development today (Vygotsky, 1978:86). Siphó's maths learning was in a process of maturation. However, his positive attitude allowed him to work within his zone of proximal development at the computer. The computer stimulated his actual development and the level at which he was functioning, as he attempted new tasks. This in turn raised his threshold level as he strove for cognitive growth and improvement. Thus it is evident that he was motivated and undeterred by the maths challenges. This sketch showed the positive attitude he had to learning and the ability of technology to frame cognitive learning in innovative activities that stimulate development. Clearly, Siphó's learning demonstrated an interaction between the social and the cognitive influence of the computer.

Jenni's learning

Jenni had had previous computer experience at home. The adeptness of her motor control when using a mouse was observable. This skill enabled her to progress smoothly and sequentially through all seven mathematics activities in *Millie's Maths House*. In my field notes I have recorded that she spent approximately one-and-a-half sessions on each program. She was absent for two of the ten sessions observed.

On the second computer session I made a significant observation (17 February 2003). At this point the educator had placed the children in groups in an attempt to foster collaboration between the children. Jenni was in a group of three children with Omar and Beauty. Jenni was the second child to work at the computer in this group. Her prior computer experience resulted in a response of ten correct choices in a row.

The third child in this group to have her turn was Beauty. The teacher provided some support as Beauty struggled to control the mouse. However, at this stage Omar and Jenni were bored. They began measuring each other to see who was the tallest. A Sign Language discussion ensued and Omar can be seen on video footage raising himself out of the computer bench to reach his maximum height (video 17 February 2003). The concept of size on the computer program had prompted concrete practical applications of mathematics. This signals the embeddedness of mathematical understanding in the children which had been taught on the computer and explored by the children in a concrete and experimental way. Vygotsky allows us to understand the intellectual operations of young children. Sacks (1990:122) draws on his theory to explain that:

The new higher concepts [in turn] transform meaning of the lower...the child does not have to restructure all his[sic] earlier

concepts...Once a new structure has been incorporated into his[*sic*] thinking ... it gradually spreads to the older concepts as they are drawn into the intellectual operations of the higher type.

The children had measured themselves in activities done during the previous week's theme of size. They had also done full body tracings of themselves. These concrete experiences allowed the children to draw on earlier learning and incorporate the concept of size into the new computer applications.

Sacks (1990:122) says that the concrete and the abstract should not be seen as mutually exclusive. He argues that it is not a question:

... of the one being abandoned as one progresses to the other ... On the contrary, it is precisely the richness of the concrete that gives power to the abstract

Having mastered the abstract applications of size, Jenni and Omar returned to the concrete mode of learning by measuring each other.

Jenni becomes sociable

The computer also highlighted a secondary barrier to learning of Jenni's which had not previously deterred her scholastic competence. One task stands out as being particularly challenging for Jenni. *Bing and Boing* provides a visual pattern and asks the child to repeat the sequence. Jenni was unable to repeat more than two objects in a sequence. (Her peers managed four or five patterns.) Her squint was causing barriers to visual learning. According to Jolly (1982:520):

A squint causes double-vision, that is, the child sees two objects when only one exists.

In no other program was transference of objects across the screen called for, therefore this was not detected.

Because of her squint's needing frequent medical attention, Jenni was not always very sociable at school. Her routines at home were erratic. The educators reported that she was often sleep deprived owing to a poor home routine. This tended to make her grumpy and at times tearful. However, her competence and success at the computer made for good rapport with her peers. In my field notes, I noted her partnerships with four of the other six members in the group. Leila reported that Jenni experienced rivalry with Pumi. I noticed that she did not choose to work with him during the observations.

The educator, however, reported that she had placed them together and it had made a significant impact on their relationship. In the interview Lesley explained how she had put two children together at the computer who were rivals. After the first session, Lesley reported that they "actually started helping each other". The task demands of the computer had encouraged mutual cooperation. The computer had provided a scaffold for social and cooperative learning to occur.

The unique opportunity created by the computer for cooperative learning in Deaf children was observed by the educator in other learning areas. Thus, Leila referred to the same two children who "can now sit at a table and share a pack of crayons".

Leila explained the frustrations of Sign Language in that whatever children were doing they would have to stop in order to communicate. This applied to eating at snack time or painting during art. However in paired work at the computer, children managed to hold conversations as one manipulated the mouse and the other signed advice. Leila's statement is significant in the light of Vygotsky's ideas on "cognitive socialisation" (1978:88). His notion of cognitive socialisation implies that human learning has a specific social nature.

The educators reported that during computer sessions Jenni had become more cooperative and willing to engage with other children. Her skill and experience with computers made her confident and seemed to boost her self-esteem. The unique instances of social behaviour she displayed were laughing, dancing in her seat to the music and hugging her partner.

Jenni talks

On 23 April 2003 Jenni was observed attempting to talk. Jenni was working at the computer with the educator. They were working on the program, *Little, Middle and Big*. The educator had turned up the volume of the speakers and Jenni began pointing to her ears to indicate that she could hear. When she clicked on the cat it reshuffled the shoes in the cupboard and the cat miaowed. Jenni repeated the word/sound "miaow" after the cat and then next she said "middle". Vygotsky (1978:28) provides a framework for what I observed as he argues that:

Signs and words serve children first and foremost as a means of social contact with other people. The cognitive and communicative functions of language then become the basis of a new and superior form of activity in children.

Jenni used words for the purpose of making conversation with her teacher, Leila. It is also significant that Jenni spoke on the day when she was working at the computer with an educator who can hear and who uses oral language. Jenni was prompted by the computer to make social contact with the educator by using verbal language rather than Sign Language as a result of the computer's being an oral machine.

Both words that Jenni had spoken start with the same letter and have the same initial lip movement. The strength of Jenni's hearing aids, together with the stimulation of the computer, influenced her verbal

language as a social behaviour. Leila reported that Jenni was the only child in the group who would have benefited from a total communication approach to language learning. It was, unfortunately, too late by that stage for her to follow this route.

As the researcher, I also recorded that her collaboration with peers on the computer improved during the observation period. She began to seek reassurance from partners at the computer rather than from the teacher. Signed dialogue was observed more frequently. Omar especially wanted to discuss the peripheral and humorous objects on the screen. She responded well to his conversation. Jenni had also learned to trust the judgement of her partner. On the video footage Jenni is seen first looking at the educator with her query. Later she turns to her partner and obeys the instruction Omar gives her (videotape, 28 May 2003). The computer seemed to have fostered independent thought and less cognitive dependence on the educator.

Yelland (1994:2) in a case study on six children using the Logo computer program reports that she:

... noticed that the children in both classrooms were more likely to collaborate on computer tasks than on non-computer tasks. The collaboration was characterised by sustained co-operation on a project, seeking advice from each other and making random comments on each other's work.

Yelland (1994:2) postulates that the reasons given for improved co-operation on computer tasks are that there are more interesting tasks and more opportunities for interaction on the computer. This was evident in the paired work. Jenni's learning was appropriately social as her medical condition had interfered with her social development. The computer allowed Jenni to use her cognitive skills to return to social learning.

5.2.3 Social graces as a dimension of social development

The social graces of being polite, greeting, waiting your turn, saying please and thank you are constantly reinforced by the computer program. The social graces were observed being mediated both by the educators and the computer. Many of these signs are universal and the educators commented on the example of the "thumbs up sign" used by the computer characters as a means of visually reinforcing praise. Waving goodbye, pointing and winking were all gestures that the children understood. For children using Sign Language, the reinforced visual gestures provided a significant social learning opportunity. Clearly, social graces are not easily acquired by Deaf children. However, the computer provided a context within which the children could learn these universal signs.

Data which reinforced the children's understanding was observed in Beauty's humour at *Dorothy Duck's* wagging tail and winking eye for correct responses (30 May 2003). According to Leila, the teacher, the visual reinforcement of a task well done proved to be a motivator for the children. It 'spoke' to the children and encouraged their achievements. A framework for understanding the meaning and significance of gesture is provided by Vygotsky in his notion of the history of written language. Vygotsky (1978:107) argues that:

Gestures, it has been correctly said, are writing in the air, and written signs frequently are simply gestures that have been fixed.

The learning of social graces through gesture as mediated by the computer provided a significant social learning opportunity for these children which conventional teaching had not been able to convey.

5.3 The influence of the computer on language and communication

The educator introduces new computer terminology

On 12 February 2003 the teacher explained the terms “computer” and “mouse” to the children. The introduction of the two new words in sign language increased the children’s developing Sign Language vocabulary. She then began mediating the conceptual learning that the program offered (namely size). First she asked the children who was the biggest in the class and who was the smallest. It was appropriate to refer to the children’s sizes as a frame of reference for them. The concrete comparison initiated some Sign Language discussion among the children. When they had decided that Beauty was the biggest and Jenni was the smallest, Bernadette turned their attention to the men on the computer. She asked the children to find big shoes for the big man and small shoes for the small man.

The learning outcome of size in this activity had been the topic/theme in the Grade R class for this week. In training provided by the NGO in September 2002, teachers had been encouraged to integrate computer learning into their daily curriculum planning. The training is in line with the guiding principles provided by the National Association for the Education of Young Children (NAEYC) in their position statement on *Technology and Young Children*. NAEYC (1996:12) argues that:

Appropriate technology is integrated into the regular learning environment and used as one of many options to support children’s learning.

The educator explained to me that small and big are fairly easy concepts of size to teach using sign language (12 February 2003). In sign language the word “big” is an exaggerated and dramatic use of the hand above the head and “small” is two hands cupped close together. Visually the differentiation of size in Sign Language is

graphic and explanatory. Bernadette had never introduced middle in size vocabulary. The computer asked for shoes for the medium-sized man and the children did not hesitate to choose the middle-size shoes. The visual clues allowed children to differentiate between the three sizes on the computer. In providing Sign Language instructions, the teacher guided the learning of the computer and was the "voice" of the computer. Clearly, the data provides evidence that the computer was able to scaffold the new learning concept of middle. In the following section, I begin to marshal evidence of the relationship between language and cognition as it occurred with computer technology.

The benefits of children's learning at that point were in language development and in differentiating the mathematical concepts of size. These findings are supported by Clements (2002) who researched Computers in Early Childhood Mathematics. He argues that:

[computers] foster deeper conceptual thinking ... [They] can help young children develop competence in such skills as counting and sorting (2002:162).

The computer program had required the children to sort shoes according to the concept of size. The educator had provided the integrated teaching within the curriculum in order to support the learning required for the computer task. Clements (2002:162) makes the point that:

Children might best work with such programs once they have understood the concepts: then practice may be of real benefit.

The computer was reflecting personal inclinations and learning styles of the children. The educators supported the notion that the computer had fostered language and communication opportunities for the children.

5.3.1 The educators' view of the influence of computers on language and communication

The question of what contribution the computer had made to the cognitive development of the profoundly Deaf child has strong links to language. Bernadette expressed the limitations of Sign Language and how the visual clues on the computer overcame these. She gave the example of middle which is difficult to differentiate in terms of size. The computer program, she said, overcame this by presenting size so graphically. Bernadette saw the computer as an extra experience and activity in which communication could be fostered.

The assistant teacher, Lesley, was most positive regarding the computer's ability to mediate learning when she described how children had become more cognitively flexible. Previously, concepts taught in the classroom were not transferred to other areas. She used the activity of counting as an example. Children were now counting everything they saw. She said:

They go outside and pick up acorns, they pick up cards and ask how many? They make like they are actually playing on a computer ... it's quite amazing to see.

Leila too, saw strong links between the computer and language. Leila said:

It's given them more opportunity to learn. Language is reinforced on the computer and I use it as a reference.

To illustrate her point of using the computer as a reference for understanding difficult words, Leila gave the following example. She explained that the use of different movement vocabulary is difficult in Sign Language. In ball games you can ask children to throw, catch or roll a ball. She was grappling with the word bounce.

When she linked it to the computer program of *Bing and Boing* (the bouncing friends) “they all went bouncing along”. The children were immediately able to make the connection between the word meaning and the movement.

Although, there was evidence of language and communication in each participant, in the discussion that follows I have chosen to single out only two children as their language learning was most engaging. I present the vignettes of Sophie’s and Andile’s language learning.

5.3.2 Vignettes of language and communication

Language has been a central theme in the study of the profoundly Deaf learners of this cohort. Language and communication are the bridge between the social and the cognitive influences of computer technology on learners. Communication, it is argued by Vygotsky, has social origins and communication is linked to significant people in the child’s environment. The understanding of language as an aid to mental functions is argued by Vygotsky (1978:89) as he says:

The acquisition of language can provide a paradigm for the entire problem of the relationship between learning and development.

It was the influence of technology on language development in this study that I sought as evidence. The data gathered from observing the children was interpreted from South African Sign Language to use as descriptions. The obvious follow-up to the social influence of the computer was to seek evidence of improved communication, by means of signing, between the children. Sacks (1990:62) argues as he draws on Vygotsky that:

Vygotsky never forgets that language is always, and at once, both social and intellectual in function, nor does he forget for a moment the relationship of intellect and affect, of how all communication,

all thought, is also emotional, reflecting the personal needs and interests, the inclinations and impulses of the individual.

The following vignettes mirror evidence of the social nature of language and its influence on the learning within the Grade R class. In the interviews with the educators of the Grade R class, they described the significance of language for the Deaf. For both educators, language learning was central to their roles.

The third interviewee was the assistant teacher. Lesley described her responsibility as an interpreter: "I interpret for the teacher in the class. It means helping out the kids signing." The supportive role played by the interpreter is in line with the call by DEAFSA for the services of SASL interpreters to be provided in all communicative situations.

As explained in the contextual chapter, none of the educators are trained in the foundation phase of education. Their expertise is in speech and hearing therapy.

Sophie's choice

Sophie's progress on the computer was the slowest in the group. This was due to a number of reasons, the most significant being her poor attendance at school. I was only able to observe her on six of the ten observation weeks. On a chart measuring her level of involvement in the *Millie's Maths House* program, she only worked on the first three programs. Sophie's emotional vulnerability, which has been discussed in Chapter 4, had created anxiety and a loss of self-esteem which in turn influenced her progress. The educators reported a negative change in her behaviour since returning from her father's funeral in the Eastern Cape. She seemed comfortable to always start the computer session at the very beginning. After each absence from school she returned to the first program, *Little, Middle and Big*. Her zone of proximal development appeared "fixed".

She seemed rooted in "actual development". Vygotsky (1978:85) argues that:

A well known and empirically established fact is that learning should be matched in some manner with the child's developmental level....if we wish to discover the relations of the developmental process to learning capabilities. We must determine at least two developmental levels. The first level can be called the actual developmental level, that is the level of development of a child's mental functions that has been established as a result of certain already *completed* developmental cycles.

Sophie found solace in knowing what she could do. She had achieved that "cycle of development" so she returned to the known rather than venturing into the unknown. She was allowed to have a choice in what to do and with whom to work. She began choosing Andile, the lowest functioning member of the group, as a partner. It is significant that Sophie did not want to deal with pressure or competition. There were some days when she would rock gently as Andile worked. They did not sign to each other but pointed or gestured. Vygotsky (1978:56) claims that:

It becomes a true gesture only after it objectively manifests all the functions of pointing for others and is understood by others as such a gesture. Its meaning and functions are created at first by an objective situation and then by people who surround the child.

A possible reason for this behaviour was that the abstract nature of the mathematics tasks may have prompted them to revert to symbolic play. Vygotsky provides an understanding of their behaviour when he argues that:

... children's symbolic play can be understood as a very complex system of "speech" through gestures that communicate and indicate the meaning of playthings. It is only on the basis of these

indicatory gestures that playthings themselves gradually acquire meaning ... (1978:108).

Andile's level of language development made it appropriate for him to revert to gesture and Sophie in her desire to please him responded accordingly.

Sophie had chosen a path of learner-paced and learner-based education. Vygotsky allowed me to understand her style of learning as he posits an activity theory (Engestrom, 2001:134). The cultural-historical activity theory of expansive learning looks at the why, what and how of learning (Engestrom, 2001:133). It reviews the notion of directionality in learning and development. Educators are inclined to view all good learning as vertical in nature. Engestrom (2001:153) argues that a case can be made for horizontal or sideways learning. Sophie's sideways learning was the best kind of learning that her emotional health would allow after the death of her father. (Who could provide grief counselling for a young child using Sign Language?) She was progressing to the best of her ability that circumstances would allow.

The only collaboration witnessed came from her choice of partner, which was very morale-boosting for Andile. She was also very comfortable counting for him as he worked. A warm and mutually dependent relationship had developed.

An interesting observation of Sophie's number concept was her choice of the number six (her age) no matter what number the computer asked for. I observed that she was having difficulty moving away from the egocentric state she was in. Her level of potential development was shifted with guidance from Andile only on the last observation session. In the case of Sophie, the computer had provided a context for language and communication. Although her grief had created avoidance of social engagement, the computer

facilitated an opportunity to work collaboratively with a peer at a cognitive task.

Andile's anxiety

Andile was present for nine of the ten computer observation sessions. On 17 February 2003, I observed how deafness influences cognitive learning. Andile was working at the computer with Siphso. They were in the program of size. Andile began with the question and answer mode where the spider talks to the children as it asks for shoes on behalf of the men. Andile kept choosing the small shoes, regardless of the size of the men. He was focused on the spider as a new character in the program. He had assumed that the spider was a new character in the game who also wanted shoes. The educator realised he wanted small shoes for the spider. Andile did not realise the spider was asking the questions and was not part of the game. Clearly, he did not understand the question mode on the computer. Sacks provides an understanding of this barrier to learning in the Deaf when he cites Rapin (1990:57):

Asking questions of [deaf] children about what they had just read made me aware that many have a remarkable linguistic deficiency. They do not possess the linguistic device provided by the question forms. It is not that they do not know the answer to the question, it is that they do not understand the question.

The teacher asked Andile which shoes he wanted and he again made the sign for baby (folded arms in rocking motion). Bernadette encouraged him to return to the explore-and-discover mode of the computer.

Later Siphso, his partner, was getting bored and began to correct the behaviour of Andile. He had reverted to the social learning of norms and expectations. Muma and Teller (2001:33) argue that:

From a Vygotskian perspective [it is] indicated that learning in general begins on a social level and then shifts to a cognitive level. This finding is crucial because it means that the way in which an individual is socially and culturally situated are defining issues for subsequent learning. Thus it behoves educators of the Deaf to expand and vary an individual's experiential world towards establishing Level 1 (what he/she knows of the world) of the cognitive social bases of language.

My research echoes what Muma and Teller (2001) provide as evidence to support the notion that computers are able to scaffold learning for the Deaf. Siphon had demonstrated what he knows about the world on a social level.

During the research period Andile spent the first five observation sessions on the first program, *Little, Middle and Big*. Leila, the teacher, felt it would be beneficial for him to work with her. He worked with the educator for the first six sessions and he showed no progress in terms of moving forward to more challenging tasks. He was very nervous and would scratch on the back of the plastic seat throughout the session. The educator indicated that his anxiety of adults and their criticism seemed to stem from being rejected at home (discussion with educator, 13 August 2003).

In session six he was paired with Sophie. They had chosen to work together. There was a notable change in his body language. He appeared more comfortable with a peer. He was relaxed and there was no evidence of the scratching or tension in his body. They chose the *Number Machine*. After three attempts to match the number he finally got it correct. Sophie sat quietly but trustingly beside him making no attempt to intervene. Remarkably he followed with four correct responses in a row. It was evident that Andile had understood and internalised the task response.

Vygotsky (1978:57) provides a framework for the understanding of the transformation of the process of internalisation and argues that:

An interpersonal process is transformed into an intrapersonal one. Every function in the child's development appears twice: first, on the social level, and later, on the individual level. This applies equally to voluntary attention, to logical memory, and to the formation of concepts. All higher functions originate as actual relations between human individuals.

The unspoken social acceptance that I observed in Sophie had provided a scaffold for Andile's cognitive learning. He was beginning to grasp the mathematical concepts. A lack of social acceptance and delayed language appears to have hampered his cognitive development. In the next session where Andile was paired with Sophie they began to communicate (field notes, 30 May 2003). A sign "discussion" took place. It was an improvement on the "pointing and labelling" previously observed. He told her what to do on the computer task. This was the first time he had facilitated anyone's learning at school. The newly-found confidence and shared cognition allowed him to get six correct responses to the *Number Machine* activities. For Andile the social acceptance of a peer led to task responsiveness and success.

Singling out the young boy, Andile, I observed that he seemed unable to use the conceptual sign word for small but answered with the sign word for baby (folded arms rocking). Very young children are known to use the diminutive form of a word, e.g., baby shoes for small shoes. He was, however, the oldest child in Grade R and was reverting to early learning as young children are known to do. An explanation of his behaviour came from Vygotsky's analysis of word meaning in young children. Vygotsky (1978:50) provides a framework to understand the analysis of word meaning when he presents the following argument:

Investigations in this area show that the connections underlying words are fundamentally different in the young child and in the adult. Children's concepts relate to a series of examples and are constructed in a manner similar to the way we represent family names. To name words for them is not so much to indicate familiar concepts as to name familiar families or whole groups of visual things connected by visual ties. In this way the experiences of the child and the "unmediated" influence of the child's experiences are documented in his [*sic*] memory and directly determine the entire structure of the young child's thought.

The visual clue of smallness in size had prompted Andile to name the shoes as "baby" shoes. As Vygotsky suggests, Andile connects the whole group of "small" to the one word he calls "baby". The visual/graphic nature of the computer highlighted an aspect of his development not previously known. He has delayed abilities to analyse word meanings. This is a challenge faced by deaf children who have not had adults to model language for them. In Vygotsky's (1962:75) experimental study of concept formation he argues that:

Much can be learned about complex thinking from the speech of deaf-mute [*sic*] children, in whose case the main stimulus to the formation of pseudo-concepts is absent. Deprived of verbal intercourse with adults and left to determine for themselves what objects to group under a common name, they form their complexes freely, and the special characteristics of complex thinking appear in pure, clear-cut form.

Andile clearly had made his own conclusion about concepts of size and his response reflects the findings of Vygotsky's study. In a discussion with Leila, she expressed concern about Andile's progress and had sought specialist guidance for his future placement "as he is not ready for formal learning" (journal, 26 August 2003). Sacks provides some possible clues to Andile's difficulties. Sacks (1990:64) argues that deaf children have to be:

5.4 coaxed from a perceptual world to a conceptual world. It is not just language, but thought, that must be introduced. Otherwise the child will remain helplessly trapped in a concrete and perceptual world

....
A compounding issue was that Andile's mother was unable to communicate with him. She had not attended the Sign Language classes offered at school and was therefore unable to sign to him. Sacks (1990:66) cites the argument of Schlesinger who says mothers create the cognitive worlds of children and children imitate these worlds. Sacks also contends that "poor dialogue leads to intellectual constriction" (Sacks, 1990:67). He places the responsibility of the formation of a conceptual world in young children with the mother or primary caregiver. He signals that:

They not only describe the perceptual world but help their children reorganise it and to reason about its multiple possibilities (1990:67).

The late stage at which Andile acquired language and the limited exposure to language (approximately 25 school hours per week) are compounding issues in his delayed development. Sacks (1990:66) argues:

... there may be major communicative and cognitive difficulties, even in preschool days, unless language is introduced as early as possible; there must be some communication with parents, with other people, some understanding of the world in general, that is cut off.

Andile's silent home background may also be reflected in his preferential choice of solitary play.

5.4 The cognitive influences of the computer

The computer was a tool that allowed children to exploit their
In all seven children of this cohort, new concepts linked to the mathematics programme were acquired. It was clear from the data that the study yielded that the children learned to sort and differentiate according to size, to recognise and read numerals and to understand that numbers represent certain quantities, regardless of the object. The educators found that this ability of transferring learning across the curriculum was not previously done by profoundly deaf learners in the Grade R class. Therefore, evidence suggests that the computer was able to mediate cognitive learning for profoundly deaf learners.

5.4.1 The educators' view of the cognitive influences of the computer

know about the keyboard and if the letters of his name could be shown to him. On another occasion he asked what was in
Drawing on the analysis of interview data, it is clear that the educators also saw the computer as a springboard for new learning. Bernadette saw the computer as an extra experience and activity in which communication could be fostered. Exciting new activities stimulated communication as children wanted to share their experiences. Leila echoed these findings. She said:

It's given them something to talk about. Something common ... as they finish on the computer they go and talk about what they did. They see it as a personal achievement.

The children, she felt, had developed a personal confidence which enabled them to ask questions. She referred to two of the children. They were Omar and Beauty.

By Since Omar has been getting assistance he is streaking ahead, he gets impatient if I'm too slow. On the other hand, Beauty will take her time to make sure everything is right.

The computer was a tool that allowed children to exploit their individual learning styles. In Omar's case he wanted to go faster but Beauty on the other hand was working at her own pace.

5.4.2 Vignettes of the cognitive influence of computer technology

In the next category of data analysis, I describe the unique way in which computers influenced the children's cognitive development.

Curious Omar

I observed a distinct curiosity in Omar that was stimulated by computer technology. He wanted answers to many of the peripheral graphics on the screen (field notes, 17 February). On the first day he wanted to know about the keyboard and if the letters of his name could be shown to him. On another occasion he asked what was in the box in a corner of the screen. The researcher had no idea and allowed him to click on the box. It was a jack-in-the-box. Omar's discovery learning was of a social nature as he engaged the educator by asking questions. He proceeded to share this learning with the children he was later paired with (field notes, 7 May & 4 June). The argument presented by Vygotsky (1978:25) allows us to understand what Omar was doing by "talking" about his experiences. Vygotsky explains that:

...the child begins to master his [*sic*] surroundings with the help of speech. This produces new relations with the environment in addition to the new organisation of behaviour itself. The creation of these uniquely human forms of behaviour later produce intellect and become the basis of productive work ... (1978:25).

By asking questions Omar was making meaning of his environment. The evidence of his enquiry and his desire to share his knowledge suggest he had altered his relationship with computer technology.

Therefore the change in his behaviour indicated that this incident had “produced intellect” (Vygotsky, 1978:25). On three subsequent occasions I recorded this pattern of learning by Omar in my field notes. After a very challenging number program at which he was most successful, he went to fetch a group of children and asked if he could show them how the program worked. He asked, he learnt and applied his learning to the computer and then he transferred his knowledge to his peers (23 April, 7 May & 4 June). He was modelling what Vygotsky (1978:24) terms collectively as “social interaction and the transformation of practical activity”.

A unique response that Omar displayed was to vibration. He was observed on 30 May 2003 putting his hand on the speaker. He then asked Leila to repeat the sound by clicking the mouse and pointing to the object. He appeared very definite in the request for the objects on the screen. He chose objects that could be matched to the sensation he was experiencing. The drum and the trumpet were his objects of preference. Both provided deep and resonating sounds. Leila explained that low frequency sounds provide the strongest vibrations. Sacks (1990:7) contends that:

Those with the profoundest deafness may hear noise of various sorts and may be highly sensitive to vibrations of all kinds. This sensitivity to vibration can become a sort of accessory sense.

Apart from being an accessory sense, vibration perception is part of sensory perception. Vygotsky (1978:31) contends that:

... speech affects several psychological functions, in particular perception, sensory-motor operations, attention, each of which is part of a dynamic system of behaviour.

The computer had created an avenue into the discovery of an accessory sense that could aid Omar’s conceptual connections. The

connection was that of identifying and linking objects to noise. The sensation provided by the computer was linked to his existing knowledge of the objects. His prior knowledge would have been about the physical properties of a trumpet or a drum. The new knowledge scaffolded by the computer was about sensing what the sound produced by the object felt like. The discovery of vibrations as an accessory sense for Omar clearly indicates that computers can add value to learning in the profoundly deaf young learner. The conceptual connection to the vibration aided Omar's cognitive learning.

His collaboration with other children was limited as a result of the physical challenges he faced at the computer. Omar's mind was racing ahead of what his body was able to do. Being born with athetoid cerebral palsy, his physical limitation masked his cognitive abilities. By the third session the teacher decided to work one to one with him. She sat on the small bench and placed him in a standing position between her legs. The support that she provided restrained his waving involuntary movements. Omar pointed and signed instructions as she manipulated the mouse. Initially he was tense and jerky but after a few minutes at the computer he became very calm, displaying intense concentration and very quick thinking. I observed and recorded the calming influence it had on Omar as he concentrated on the task at hand (field notes, 23 April 2003). The sensitive support provided by the educator allowed the computer to draw on his strengths and scaffold his learning.

He was the only child in the group who displayed boredom at the pattern-making program of *Bing and Boing*. The program mentioned is regarded as a "drill program". It does not allow the freedom to be creative. He wanted to create his own program. The other interesting request Omar made was to seek an explanation of the menu page. Clearly, he wanted to know how the machine worked.

The concrete evidence of a higher level of cognitive functioning came on the last day of observation. A physical scaffold had been provided as he worked with the teacher. Leila provided support for his physical barriers to learning by allowing him to point as she controlled the mouse. She had also placed him in a position which restrained his involuntary movements. At this point it was decided to reintegrate him into the group. The discovery that Jenni was very adept at mouse control and could nearly match his cognitive abilities seemed to indicate a good partnership. The peer tutoring was attempted again.

On the last day they were busy in the *Cookie Factory*. The horse was asking for jellybeans (sweets) to be put on his cookie. With repeated success the computer increases the number. Jenni and Omar had reached the number 15. In Grade R the teacher seldom works with numbers greater than ten. Therefore within the Grade R curriculum requirements, the children's number concepts were less developed than what the computer was expecting of them. Omar began instructing Jenni with finger counting, using one to one correspondence on the screen. He placed his fingers on the computer screen. He matched each finger to a jellybean as Jenni dispensed them from a machine onto the cookie. Each hand of five fingers was matched to five jellybeans. Clearly, he was working in sets of five. Omar then made the connection that he had grouped five jellybeans three times. He used multiplication as he demonstrated 3 times 5 in order to reach the total of 15. The number 15 is also very graphic in Sign Language as a set of five fingers is moved downwards three times.

Finger counting is significant in Sign Language as well as from a Vygotskian perspective. Vygotsky views it as a tool to assist humans in their problem solving. I observed finger counting as a cognitive tool for the Deaf. It is from this conceptual understanding that I was

able to observe the numeracy development of the cohort. Vygotsky (1978:127) argues that:

Counting fingers was once an important cultural triumph of humankind. It served as a bridge between immediate quantitative perception and counting ... In early counting systems, we may observe that in developed and active form the same process that is present in rudimentary form during the development of a child's arithmetical reasoning.

In my observations of the computer mathematics program the children's encounters with counting were aided by finger counting. It was a natural tool that assisted their cognitive functioning in a concrete way. The children in this cohort were encouraged to use finger counting and were often seen matching quantities on the computer screen to their fingers. Pumi provided a model for the children he paired with. On 30 May 2003 he was observed finger counting and pointing as Beauty worked. The computer stimulated counting in a relevant context for these children which was not previously observed in classroom situations. On 4 June 2003 my field notes record how the children were counting jellybeans as they placed them on cookies. My field notes read as follows:

Pumi helps Andile to count. He tells him when to stop and reassuringly says, "This is difficult". When Andile gets the answer correct, he says, "Well done". Pumi has facilitated the teaching completely.

The scaffold that Pumi provided for Andile's learning was evident. Pumi provided a supportive and sensitive approach to a challenging task. He collaboratively worked with his peer, Andile, to ensure successful task completion.

The Beauty of computers

Beauty was present for all ten observation sessions. Her steady progress as a result of that continuity was very visible. The computer scaffolded her learning as she mastered one program and moved to the next level in a sequential fashion. In a profile drawn up of her progress on the computer program, Beauty spent two weeks on the first program, two weeks on the second program and an average of one week on all subsequent programs. I noted an interesting observation on 16 April 2003. After the school vacation, she chose to return to the very first program of *Little, Middle and Big*. Vygotsky (1978:69) allows us to understand Beauty's response when he describes how children gain task experience. In his study of children's choice reactions, Vygotsky found that:

In the first stage of responding to arbitrarily related stimuli, the child has insufficient experience with the task to organise his [*sic*] behaviour effectively. He uses experience naïvely. But in the course of the experiment, he, [*sic*] gains experience necessary for restructuring his [*sic*] behaviour. Just as naïve physical knowledge is acquired as the child strives to carry out the choice reaction task. As he [*sic*] attempts to recall which stimuli are linked to which responses, the child begins to learn what remembering in this situation consists of and begins to use one or another of the auxiliary stimuli effectively.

The break from school for the holiday appeared to cause a memory lapse for Beauty of how to proceed on the computer. Beauty had chosen to return to a program that had provided a memory clue for her of prior computer operations. She was making use of past experience to restructure her response to future learning. I was able to understand the change in Beauty's behaviour from a Vygotskian perspective of children's adaptive responses. Vygotsky (1978:73) argues that:

The growing complexity of children's behaviour is reflected in the changed means they use to fulfil new tasks and the corresponding reconstruction of their psychological processes.

The problem solving she applied to her own learning was evident.

A unique and unexpected influence of the computer was observed in Beauty from the first observation on 12 February 2003. She displayed emotional attachment to the computer as she would cry at the end of a session or walk away with slumped shoulders and head bowed. The educators reported that she constantly asked for time on the computer. She had found a tutor in the computer. The rapid progress that Beauty had made in language learning (she only started Sign Language learning after her third birthday) was a stimulant to want more. Her quest for knowledge was not being met by educators who faced so many diverse challenges within the group. Beauty realised that the computer could mediate knowledge and that she could control her path of learning where humans had failed. Sacks echoes my findings in a boy he calls Joseph who first learns Sign Language:

This, manifestly, gave him great joy; he wanted to stay at school all day, all night, all weekend, all the time. His distress at leaving school was painful to see, for going home meant, for him, return to the silence, return to a hopeless communicational vacuum, where he could have no converse, no commerce, with parents, neighbors, friends: it meant being overlooked, becoming a non person again (1990:39).

The discovery of the computer had provided a cognitive awakening for Beauty. Beauty had only been diagnosed as deaf at the age of three. The delay in language acquisition had not adversely affected her cognitively as she made remarkable progress. The educators

reported that she had an ability to analyse language that was not evident in the other children of this cohort.

When the computer asked for a semi-circle she wanted to know the name of a semi-circle in sign language. Later in the year, the new teacher, Leila, called it a circle. Beauty was indignant and insisted that the first teacher had given it a name. (In Sign Language, it is circle cut in half.) Beauty displayed confidence in wanting logical explanations for language. She was the child who told the teacher she lied that a computer mouse can be the same as mouse (animal) in Sign Language. On enquiry the teacher learnt that the hand shape of the word is the same with the addition of a twitching/clicking index finger. Vygotsky argues in favour of the social origins of memory. This allows us to understand Beauty's behaviour as the recall of a previous learning experience. Memory arises as a result of the influence of external stimulation on people (Vygotsky, 1978:39). Clearly, significant people and the mediation of the computer had impacted on Beauty's memory. Her memory was what Vygotsky termed "a product of specific conditions of social development" (1978:39). Social conditions, together with computer learning, had facilitated the memory recall process for her.

The argument Vygotsky presents concerning the development of speech was observed in Beauty's progress at the computer. Vygotsky (1962:47) refers to this stage when children count on their fingers and use aids for their thinking. Egocentric speech is characteristic of this development. From mid-April Beauty was observed signing under the computer desk. She was "talking" to herself as she attempted to solve her problems. In problem-solving situations Vygotsky (1962:47) signals the significance of speech when he argues that:

[i]n speech development this is the final stage of inner, soundless speech. There remains a constant interaction between outer and

inner operations, one form effortlessly and frequently changing into the other and back again.

The cognitive tasks of the computer had scaffolded Beauty's language learning to the next level. By the end of April she was fingerspelling words rather than using only emergent Sign Language. Emergent literacy was being fostered by the computer experiences. These experiences were taking her into a literate and bilingual environment. Sacks (1990:72) in his definitive work about the Deaf resonates these findings after he met a young deaf girl called Charlotte :

She would exclaim excitedly in Sign over all the shapes and colors, but then attend and pause to ask, How?, and Why?, and What if? Clearly it was not isolated facts that she wanted, but connections, understanding, a world with sense and meaning. Nothing showed me more clearly the passage from a perceptual world to a conceptual world, a passage impossible without complex dialogue - a dialogue that first occurs with (adults) but then is internalised as "talking to oneself", as thought.

Dialogue launches language, the mind, but once it is launched we develop a new power, "inner speech" and it is this that is indispensable for our further development, our thinking.

Beauty's progress has remarkable parallels with that of Charlotte in relation to her questioning and the development of perceptual understanding growing into conceptual cognition. The development of inner language had launched her into a quest for knowledge. The computer experience had created an awareness and questioning. She was seeking answers and finally making sense of her world. In both instances they mirror the universals of language development. Beauty's threads of thinking were a prerequisite for literacy learning.

A clue to children's transference of knowledge was very evident in Beauty's learning. At the beginning of the year just after the introduction of *The Mouse House*, which teaches geometric shapes, Beauty went into an art activity and began tracing shape templates to do a picture. The educator referred to the "rigidity" of learning in deaf children and that they seldom apply the learning elsewhere. The educator had clearly not anticipated that the computer would scaffold the transference of knowledge into the curriculum.

Leila explained in this regard that:

they can [now] actually make forms from the shapes, they actually make drawings, which is excellent.

The data of this interview (24 July 2003) provides evidence to suggest that children are able to use the learning on the computer across the curriculum in a way that was previously not possible. Beauty provided evidence of this when she transferred her learning at the computer into a drawing. An understanding of her behaviour is explained as Vygotsky argues that young children do not see the symbolism of their drawings. It is only at age seven that they become more masterful (1978:112). He goes on to say that "we should regard such drawings as a particular kind of speech" (Vygotsky, 1978:112).

Beauty had attempted to communicate her computer experiences pictorially. A copy of Beauty's picture is inserted overleaf.



Figure 5.1 Beauty's House

Discovering zero

The last little boy in this cohort was Pumi. He arrived three weeks into the commencement of the study. The delay in beginning to work on the computer did not deter him in any way. Pumi was present at all seven subsequent sessions. He displayed a steady progress, moving from dependence on the teacher's guidance to independence, usually in the facilitator's role. Pumi spent exactly one week on each activity in *Millie's Maths House*. That is, seven weeks to complete the seven activities in *Millie's Maths House*.

The inter-connectedness between hearing and learning was observed in Pumi on two occasions. On 23 April 2003 Leila turned the volume of the speaker up without him seeing her hand movement. He immediately turned to her with a huge grin. The sound was very pleasing to him. He began to make the ringing noise each time he clicked on the phone. On 21 May 2003 I noticed and recorded in my field notes that he was agitated and performing poorly at the computer. Then his hearing aids began to crackle in response to the frequency of the sounds on the computer. On examination, Leila

discovered his ear moulds were missing causing poor fitting of the hearing aid. The discomfort and distraction of crackling noises affected his learning negatively. The contrast between the behaviour on the first occasion when the sound was pleasing and second occasion when the sound was annoying was marked. From a Vygotskian (1978:26) perspective, learning is seen as multi-modal. When all the senses are not in harmony it is clear that learning is interfered with. The notion that children learn holistically and that several factors need to be in harmony for successful learning to take place became evident.

Vygotsky (1978:29) signals that children's problem-solving abilities involve a "unique mixture of processes". In his observation of children, Vygotsky alluded to the multi-modality approach to tasks used by children (Vygotsky, 1978:26):

Children solve practical tasks with the help of their speech, as well as their eyes [ears] and hands.

In Pumi's case the aggravation of sensory input by the computer impacted on his ability to perform at his best. Clearly adverse conditions affecting these modalities interfere with learning.

Pumi's superior Sign Language abilities allowed him to scaffold language learning for his peers. A particularly amusing example was observed 30 May 2003. Pumi was working collaboratively with Beauty. They were working in a program that asked the children to match a number to a quantity of objects. *Dorothy Duck* asked Beauty to put zero objects on the screen. He signed "don't do it" and taught her the sign for nought (puffing air from pursed lips and hitting it away with the hand). They both emitted huge belly laughs.

According to Sacks (1990:61):

It is impossible to acquire language without some essential innate ability, but this ability is only activated by another person who already possesses linguistic power and competence.

Pumi demonstrated the social nature of language. He knew the meaning of a new word "zero". Beauty was confronting a new concept and Pumi as a collaborating partner at the computer had the knowledge to share with her. The computer had provided the springboard for the content. The nature of the content had facilitated new learning for Beauty as she discovered the concept of zero.

5.4 Conclusions

Wolcott (1994:11) addresses the interpretation of data by posing the question "What is to be made of it all?" Through "thick description" (Denzin, 1989:93) I have marshalled the evidence of both primary data sources as well as secondary sources to support the conclusion that computer technology has cognitive and social influences on the profoundly Deaf young learner.

Chapter 5 has presented a descriptive analysis of the data. The following three findings have emerged. The findings have a direct relationship to the research question which sought three forms of "value-addedness". Firstly, the computer provides unique opportunities for social and collaborative workings with peers. Secondly, from a Vygotskian understanding of thought and language, I have observed that SASL has a significant bearing on young Deaf children and their computer applications. Lastly, scaffolding by educators/peers is crucial to the cognitive influences of computer technology. Clements (2002:172) argues that:

... scaffolding leads children to reflect on their own thinking behaviours and brings higher-order thinking processes to the fore.

The barriers to learning faced by Omar did not allow for independent computer operations. However, the scaffold created to facilitate his learning supported the findings that the computer was able to mediate cognitive mathematical tasks when barriers to his learning were removed.

6.1 Introduction

In the final chapter, I will summarise the findings and make suggestions for further research.

In the final chapter, I will summarise the findings of my research study in this chapter. Gaps and limitations to my research study will be briefly outlined and recommendations will be made.

In the twenty-first century, it is difficult to imagine education without access to computer technology. In South Africa, not being able to use a computer is, however, the reality for a vast majority of learners. For this small cohort of learners a door to the future has been opened. They have successfully engaged with technology to develop unique learning strengths through varied and personalised applications.

6.2 A summary of the findings

I have marshalled evidence to support the claim that computers influence cognitive and social learning in the cohort. My findings support Haugland's (2000:18) argument that:

computers empower young children.

Chapter 6

CONCLUDING THOUGHTS

There is always one moment in a childhood when the door opens and lets the future in (Greene, 1940:7).

6.1 Introduction

After presenting vignettes as descriptive analysis in the previous chapter, I will summarise the findings of my research study in this chapter. Gaps and limitations to my research study will be briefly outlined and recommendations will be made.

In the twenty-first century, it is difficult to imagine education without access to computer technology. In South Africa, not being able to use a computer is, however, the reality for a vast majority of learners. For this small cohort of learners a door to the future has been opened. They have successfully engaged with technology to develop unique learning strengths through varied and personalised applications.

6.2 A summary of the findings

I have marshalled evidence to support the claim that computers influence cognitive and social learning in the cohort. My findings echo Haugland's (2000:18) argument that:

computers empower young children.

She also claims that computers enable children to become immersed in the joys of learning.

This particular evidence has become apparent for profoundly Deaf learners. The data collected, showing Beauty's insistence on using the computer and her ability to share these skills with others, reflects an empowered young learner. The sheer pleasure displayed by Jenni as she worked on the computer is proof of her joy of learning.

Fischer and Gillespie (2003:90) found evidence that:

the strongest points of computer technology include support for social interaction.

Social interaction has been central to this investigation. The computer stimulated cooperative behaviour as children worked in pairs and collaborated to realise learning outcomes. For Andile, the computer was able to scaffold his role as a facilitator as he assisted a less competent peer.

The understanding of Vygotsky's sociocultural theory allowed the use of Sign Language as a cultural tool to mediate the learning that took place on the computer. Learning was also mediated by the educator as a facilitator of Deaf culture. Bruner (1986:74) refers to social cognition as a mode of learning that occurs by means of a tutored process called scaffolding. Social graces were scaffolded by the computer and used more frequently by the children after computer sessions.

Another dominant pattern emerging from the data is that of the cognitive influences of computer technology on the profoundly Deaf learners.

The computer provided a lens to view children's potential that was not obvious in the activities of the daily programme. The educators were unaware of Omar's remarkable potential. In computer-based tasks he was challenged to perform at levels not covered in the Grade R curriculum.

The Vygotskian framework allowed me to understand the process of conceptual learning in profoundly Deaf children. The computer scaffolded the development of mathematical strengths in learners that conventional education could not. The achievements of the young boy, Omar, on numerical activities, provides evidence of the benefits of computer technology.

In all seven children of this cohort, new concepts linked to the mathematics programme were acquired. Data yielded by this study indicated how the children learned to sort and differentiate according to size, recognise and read numerals, and to understand that numbers represent certain quantities regardless of the object.

The educators found that this ability of transferring learning across the curriculum was not previously done by Deaf learners in the Grade R class. Therefore, the evidence suggests that the computer was able to mediate learning for the profoundly Deaf learners. Vygotsky's use of a zone of proximal development was also applied in my study. As a tool of teaching computer technology, ZPD had a significant cognitive influence on the learners.

Clements (2002:166) cites the research done by Griffen and Case on equity issues:

[They] found that children from low-income homes often lack important quantitative concepts. For example they could not count

beyond very small set sizes, and even when they count, they often could not compare numerical magnitudes More important, the researchers discovered they could remediate this knowledge gap in about twenty 10-minute sessions, most of which were conducted in game format. Indeed after these experiences the children from low-income families scored the same as children from higher-income homes.

The computer games and activities in *Millie's Maths House* scaffolded children's understanding and progress in numerical tasks. These findings are significant for children facing compounding issues of disadvantage such as race, disability and a digital divide in a post-apartheid South Africa.

6.3 Gaps and limitations

My research has focused on the use of the computer as a tool for learning in the profoundly Deaf young child. In good traditional practice of early childhood development, the research would have embraced the holistic development of the young child. However, I have elected to research only social and cognitive development as they are the salient features in my choice of a theoretical framework.

The physical development of the children may have been referred to as it impacts on their sensory perception (hearing) or motor control of the computer mouse. Brief descriptions of emotional responses have also been given in relation to the children's spontaneous reaction to the computer.

Links with the early childhood development curriculum have been made in relation to integrated learning or learning across the curriculum as it applies to computer technology. The socio-economic context of the

learners has not been researched in this study despite all the learners being from socially disadvantaged backgrounds. It has, however, been considered in the explanation of the social context in which these learners found themselves.

The use of a small cohort, despite its being the whole class of Deaf Grade R learners, may be considered a limitation to the study. This study was aimed at researching the influence of computers on Grade R learners and primarily involved only the learners and the educators. In Head Start programmes involving low-income homes in the USA, schools have made use of parent volunteers as a way of empowering unemployed parents. Any further research should be cognisant of this fact and seek to take the parents' views into consideration.

6.4 Recommendations

6.4.1 Training needs of educators and learners

After reviewing the findings of this study, I wish to make some recommendations with regard to further training. Firstly, it is recommended that the replacement educator and the assistant teacher be afforded the opportunity to train on the appropriate use and integration of the computer program. This recommendation should be made to the funders who sponsor the programme.

Secondly, it is recommended that the learners would benefit if they were provided with further technology learning in Grade 1.

6.4.2 Recommendations in terms of further research

The following recommendations are made in terms of further research:

- An investigation be undertaken on the influence of computer technology on whole child development.
- An exploration be conducted on the development of effective computer programs for deaf learners.
- Conducting a longitudinal study on the progress of this cohort and their technology learning.
- An investigation of the mathematical and numerical abilities of deaf Grade 1 learners after computer intervention in Grade R.

6.5 Possible implications for policy

In the National Curriculum Statements for the learning area of technology there are three learning outcomes for Grade R. Neither the learning outcomes nor the assessment standards make any mention of computer technology for Grade R learners. In the light of international trends towards computers this is somewhat short-sighted. Leung (2003:13) illustrates this position. She explains that after a nine-year review of the use of technology in schools, the Hong Kong Commission (1999) decided that:

Information technology is a way of life today. It is foreseen that a wider use of information technology would become a regular feature in our schools to improve effectiveness of teaching and learning. It will become a part of our school system, although teachers in no way can be replaced.

In the light of the findings illustrated by Leung (2003), South Africa

ought to be cognisant of educational trends in computer technology.

In defining inclusive education, the White Paper 6 acknowledges that learning also occurs in the community (Department of National Education, 2001b:6). DEAFSA itself argues the importance of education within the Deaf community, with access to members of Deaf culture (DEAFSA, Deaf Culture, n.d.(b)). Muthukrishna (2001:157) suggests that:

There is, therefore, a need for special education for Deaf learners, catering for their unique language needs with adult role models, Deaf peers, a signing environment and free access to Deaf culture in school.

The attempt to include Pumi into mainstream education was unsuccessful. The medium of instruction (oralism) did not address his special language needs. Being the only first language sign user within this cohort, he was the best possible candidate for inclusive education. However, as Aarons and Akach (2002) have suggested, Pumi experienced exclusion rather than inclusion. Aarons and Akach (2002:156) suggest that:

... neither the existing situation, nor a mindless implementation of inclusion will lead to true inclusion and equal access for Deaf children.

Clearly, more creative approaches need to be sought.

6.6 The last word

If indeed a door to the future, a technological future, has been opened for the children of this study, then educators need to be concerned

about that future. Dewey (1938:32) argued that teachers need to be concerned about “what direction an experience is heading”.

This research study has attempted to make a case for a new mode of teaching profoundly Deaf children. It did not seek to throw out the old, but rather to complement, inform and assist educators of the 21st century. I have argued for the computer to be an additional activity in the early childhood curriculum.

Haugland (1999:30) posits that:

[In the twenty-first century] we probably should make our peace with the fact that computers will be in early childhood classrooms and learn to use them wisely.

It is the wisdom to use computer technology in a developmentally appropriate way for Grade R learners which is called for. The social application of the computer in paired work has unlocked the cognitive potential of these profoundly Deaf learners to mathematical learning.

In the final analysis, it is perhaps the profound words of Bernadette transcribed from the interview on 24 July 2003 that encapsulate the findings of this study. She said:

... it [the computer] makes deaf people equal.

Her words resonate the call quoted and made by Judge (2001:1) in Chapter 1 that computers “serve as an equaliser for a child with disabilities ...”

This research study has provided “a rare opportunity ... to focus on children as they explore a new medium” (Wright & Shade, 1993:3). The key concern of assessing the abilities of profoundly Deaf learners to

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learn cognitively and socially from computer technology has been responded to. Computer technology was found to be a suitable intervention that can ameliorate learning challenges faced by the profoundly Deaf child.

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APPENDIX A

23 January 2003

23 Januwari 2003

Dear Parents

Dear Bazali

Ndingumfundi onqwenela ukuvavanya iimpembelelo kulwazi nobugcisa kwibakala elandulela isiqalo esikolweni (u Grade R) sabangevayo kunya ka 2003.

Ndiyakusebenzisana neliqela qho ngeveki, ndinganalo nodliwano-ndlebe nani ndibe nento ebhaliweyo ngenikufumene kolu phando lwam.

Le ncwadi isebenza njengemvume yenu yokusebenzisana nabantwana benu, iniqinisekise ukuba enikufumeneyo kuyakubuhlonipha ubomi obubobenu, ukungaziwa nokugcina ihlebo.

Enkosi

Owenu ngenene

Linda Arnott

Nceda ubuyise le fomu.

Mna(igama) ndivuma ukuba yinxalenye yoluphando lubalulwe ngasentla.

Sayina:

Umhla:

APPENDIX A

23 January 2003

Dear Parents

I am a student who wishes to evaluate the influence of technology on the Grade R class at the School for the Deaf during 2003.

I will be observing and interacting with the group on a weekly basis.

This letter serves to seek your consent to work with your child and assures you that the findings of my research will respect your privacy, anonymity and will remain confidential.

Thank you.

Yours sincerely

Linda Arnott

PLEASE RETURN THIS FORM.

I (NAME) agree to be involved in the above-mentioned research/project.

SIGNATURE:

DATE:

APPENDIX B

SEMI-STRUCTURED OBSERVATION SCHEDULE

Name (Participant's Name)

Age (of Interview)

Gender (What is your role as an educator of profoundly Deaf young children?)

Programme's Name

Cognitive (How has the use of the computer changed what you see as your role? If yes, please explain.)

1. How does the teacher move the child to the next level of performance? Is this assisted performance/scaffolding?

2. How do you feel about having computer technology as part of your Grade R curriculum?

3. Is there evidence of a higher level of cognitive functioning?

Social (Has the computer had any social influences on the children? If yes, can you describe these?)

1. Could the child talk/communicate about their experiences on the computer?

2. Do you feel that it has added to the communication between the children? How and when?

3. How does the young child respond to computer technology?

4. In your opinion, what contribution has the computer made to the

5. Is there evidence of collaboration between the children with regard to computer technology?

6.1. Did you observe children assisting or collaborating with one another?

6.2. Do you think this collaboration supported the learning of the child using the computer?

7. Are you able to relate observed incidents (both positive and negative) directly linked to the computer and why it has to do with

8. Is there anything else you wish to add?

APPENDIX C

SEMI-STRUCTURED INTERVIEW SCHEDULE

Participant's Name

Date of Interview

1. Describe your role as an educator of profoundly Deaf young children?
2. Has the use of the computer changed what you see as your role? If yes, please explain.
3. How do you feel about having computer technology as part of your Grade R curriculum?
4. Has the computer had any social influences on the children? If yes, can you describe these?
5. Do you feel that it has added to the communication between the children? How and when?
6. In your opinion, what contribution has the computer made to the cognitive development of this group of profoundly Deaf children?
- 7.1. Did you observe children assisting or collaborating with one another?
- 7.2. Do you think this collaboration supported the learning of the child using the computer?
8. Are you able to relate observed incidents (both positive and negative) directly linked to the computer and what it has to offer?
9. Is there anything else you wish to add?