COMPUTER ERGONOMICS: EXPERIENCES OF THE GRADE ONE LEARNERS IN A GAUTENG ONLINE COMPUTER LABORATORY

by

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ABSTRACT

The study aims at determining how the aspects of the computer hardware and the furniture affect the experiences of the Grade one learners in the computer laboratory in a Gauteng school. Qualitative data has been used, that is, data was collected through interviews, observation, measurements and literature review. The findings indicate that the learners' health is at risk as the computer workstations in the computer laboratory in a Gauteng school are not ergonomically designed to suit these learners, and the workstations too large. For learners not to be exposed to Musculo Skeletal Disorders (MSD), wrist pains, and vision problems, that may accumulate as a result of the strain they are subjected to when using a workstation not designed for their physique, the workstation in a Gauteng school will have to be adjusted accordingly. However, adjusting the hardware and furniture without the knowledge of using them safely is detrimental to their health. Learners and educators have to be taught ergonomics. Incorporating ergonomics as a theme in the curriculum would be the best option. A casual reminder by educators to the learners to enforce practicing ergonomics when working on the computers would gradually develop safe working practices and save the learner from upper limbs injuries

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CHAPTER ONE

1.1 BACKGROUND AND RATIONALE

Computers are used in many institutions all over the world (Steinmueller, 2001: [Online]). They are central in these organisations because of their ability to process information rapidly, thus enabling governments, institutions, companies and individuals to carry out an enormous amount of work that would be impossible otherwise (Drawbridge, Jaworski & Macmillan, 1990:4). Internationally, the use of computers also extends to schools and has proved to be effective as both administration and learning tools. Hence, governments in the developed countries responded positively to the challenges brought about by this technology and organised programmes to introduce computers into mainstream education (Tinstey & Van Weert, 1995:38). In South Africa, several new changes in education have brought about new challenges, for example, participation in the information society; impact of ICTs on access, cost effectiveness and quality of education and integration of ICT into learning and teaching (Department of Education, 2003:[Online]).

According to the Department of Education (DoE, 2003: [Online]), in South Africa, the government I s committed to providing quality education in order to foster economic growth and social development. Both the business sectors and the government joined hands to support the introduction of ICT in education. Programmes such as *Khanya* in the Western Cape were established to produce a pool of proficient youth who would be developed into engineers, programmers and software developers. In other parts of South Africa, *Schoolnet* in Kwazulu Natal, *Connectivity* in the Northern Cape and *GautengOnline* in Gauteng, embarked on programmes to introduce ICT into the education sector.

In the Gauteng Province, computers were first introduced in schools as managerial and administration tools (DoE, 2003: [Online]) and by the end of the year 2000, almost all the schools in the province had received at least two computers from the DoE or from private donors, (DoE GOL ICT Plan: 2000). These computers were

meant to alleviate both the managerial and administration tasks that were performed manually (cf. Forcier, 1990). Computers were also identified as the central tools to be used to improve the quality of teaching and learning (DoE, 2003: [Online]). In 2005, at the time when I started with this study, recent statistics were that, about 1100 computer laboratories had been installed in the Gauteng province. It was also indicated that each computer laboratory included twenty-five network computers, fifty chairs, a printer, air conditioning, server room, alarm system, security gate, power supply, a television set, a DVD and a video (GPG. Circular 7: 2004). At a launch of *GautengOnline* on the 1st of June 2004, the MEC for Education Gauteng Province, Angela Motshekga, stated that computers should be accessible to all learners. In the Gauteng Department of Education (GDE, Circular 13: 2005), it is further stated that all educators should use the computers with all the learners.

However, the implementation of computers is not without problems. It seems that little consideration has been given to the physical size of the equipment in the computer laboratories. The dimensions of the equipment that are installed in the laboratories are the same, regardless of the age and physical size of the users. It appears that the same hardware and infrastructure has been installed in the schools, regardless of whether these schools are primary schools or high schools. James and Steven (1988:78) state that computers and furniture used by adults are not suitable for young children. This raises a concern whether the computer laboratories are suitable for all learners of all ages.

The focus of my research is on the Grade One learners whose ages range from five to seven at a particular school in Gauteng. Most of them are from a low socio-economic background. They are a heterogeneous group, which comprises a larger number of learners who have never attended any pre-school. When they start school, these learners can neither read nor write. They still have to be taught to handle a pencil; they are to develop motor skills and eye-hand coordination. They have no typing skills and most of them experience the computer for the first time at school.

The aim of this research is to find out whether aspects of computer ergonomics do affect the experiences of the Grade One learners when working on computers in a Gauteng school. This will be accomplished by observation and interviews with their educators, and also from the literature.

1.2 RESEARCH QUESTION

It is evident from the previous discussion that the introduction of computers is not without problems. The research question that will guide this study is: **How do the aspects of computer ergonomics affect the experiences of the Grade One learners in a computer laboratory in a Gauteng school?**

1.3 AIM AND OBJECTIVES

The aim of this study is:

- To explore the way that the Grade One learners interact with computer equipment and the physical surrounding in the GautengOnline computer laboratory.

The objectives are to: -

- create a framework of reference for computer ergonomics by means of literature survey;
- determine how ergonomics affect users of computers;
- establish how a Grade One learner at the research site experience the computer ergonomics;
- recommend changes (in terms of computer ergonomics) that can be effected in a computer laboratory to accommodate even the Grade One learners.

1.4 RESEARCH DESIGN

The research is a case study based on collecting and analysing qualitative data. A case study seeks to explain a real life situation (compare Yin, 1984:23), and this

research will be conducted in a real setting, in a school computer laboratory where learners will be engaged in activities using computers. Qualitative research seeks to answer questions such as *why?* and *what?* (Henning, van Rensburg & Smit, 2004:40). Endeavours to find out *why* and *how* learners are affected by the aspects of the computer ergonomics will be made. Qualitative research involves using methods of qualitative data collection, such as interviews, observations and literature, to understand the phenomenon (Myers: 1997). Creswell (1994), states that in a qualitative research there should be a use of multiple sources rich in context. Literature will therefore be used to find out what others have gathered in relation to my research topic.

A one-to-one interview will be conducted with the Grade One educators and learners will be asked questions while working on the computers to determine how they experience computer ergonomics. As a tool for interviews I will use semi-structured questionnaires, which will comprise mainly open-ended questions, as these encourage the respondent to provide more information and also lead to other questions (Lecompte & Preissle, 1993:326). According to Patton (1986:320), probing an interviewee's response is likely to add richness to data collected. Probes will be used to make a follow-up on a question. Questions that require a *yes* or *no* will be kept to a minimum, and leading questions avoided. Questions and the responses for a focus group will be formulated in Zulu, as it is the mother tongue of the learners I intend interviewing, as they are not able to express themselves well in any other language. I will take notes during the interviews and with the respondents' permission use a tape recorder. The questions and the responses written in Zulu will later be translated into English. Questionnaires for the educators will be formulated in English.

In a case study, the researcher spends extended amount of time on site with the participants to present an in-depth description of the participants' experiences (Leedy, n.d: [Online]). I will observe the learners whilst working on the computers and record my observations. I will also use a video camera to capture all their movements. A document study is also undertaken to establish whether an official stance on this topic exists. This will include memos, circulars, books and policies.

To analyse data, I will make use of the qualitative analysis where data is broken down to ‘bits’ to reveal the characteristics elements (Henning et al, 2004). Data from audiotapes, videotapes, observations, and interviews will be transcribed into a readable document for data analysis. It will then be broken down into constituents to reveal the real characteristics elements and structure. Data will then be coded, concepts created and the connections between the concepts will be made so as to inform a new description.

1.5 ETHICAL STATEMENTS

My research will focus on a Grade One class and their educators. Participating educators will complete a consent form. Their anonymity is assured and they will participate in the research voluntarily. They will in no way be advantaged or disadvantaged by participating in this study. The learners’ ages range from five to seven and they are boys and girls. They are Zulus. With due consideration to the age, they will have to answer questions formulated in Isizulu. However, a formal interview with the learners will not take place as they are minors, but questions will be asked to determine the behaviour detected during the observation.

A letter requesting permission to conduct the research was submitted to the school concerned. After the permission had been granted, letters to the parents of the participants were written to obtain their permission to observe learners working on the computers. These letters were written throughout the research project. For instance, I needed the learners after school for about thirty minutes. Parents had to be notified of those days where I needed to observe the learners. I also asked from educators if they could remain after school for interviews.

A clear explanation of the purpose of this research was given. I explained that during interviews I may not be able to record everything and I will therefore need to use the video tape. I assured the respondents in the letter that their anonymity was guaranteed and the information given would not count against them but will be only used for the purpose of this research.

1.6 STRUCTURE OF THE RESEARCH

The chapters will be structured as follows: -

Chapter one is an introduction and an overview of the whole study. Through literature it identifies the context of a change of education in South Africa and highlights a need to solve a problem from the use of a computer laboratory that has not been designed to account for the age and physical size of the users. In this chapter an abbreviated overview highlighted the methods that would be used to collect and analyse data. Finally, the ethical considerations related to the study are highlighted.

In **Chapter two** literature is reviewed on the rationale for integration of computers into South African schools as a learning tool, justification of the use of computers in the primary school, e-Education policy, *GautengOnline* as the project involved in the rolling out of computers in the Gauteng Province and, finally, ergonomics defined with regard to the computer laboratory.

Chapter three gives a description of the research design and the methods used to collect and analyse data. The role of the researcher will be explored, trustworthiness of the study and ethical considerations to be followed during the study.

Chapter four analyses data collected and transferred to readable material, that is, data from video and audiotapes, interviews and recorded observations. It will then be coded classified and be compared with what is gathered through literature review.

Chapter five is the conclusion of the study, with recommendations and final contributions. Findings of the study, limitations, possible future studies and recommendation are discussed.

1.7 SUMMARY

This chapter has provided the background of the essay and the motivation for undertaking this study, the research problem, the aims and objectives, the research design, the structure of the research and ethical issues that will be adhered to during the study. The next chapter will be literature review on the rationale for integration of computers into South African schools as a learning tool, justification of the use of computers in the primary school, e- Education policy, *GautengOnline* as the project involved in the rolling out of computer in the Gauteng Province and, finally, ergonomics defined with regard to the computer laboratory.

CHAPTER TWO

A LITERATURE PERSPECTIVE ON RELEVANT THEMES TO THE RESEARCH PROBLEM

2.1 INTRODUCTION

In this chapter I will give a brief rationale for integration of Information Communication Technology (ICT) into South African schools. I shall examine the role played by the consortium *GautengOnline*, specifically with regard to my research site in Soweto. I shall also examine the justification of the use of computers by primary school children then review literature on the ergonomics of computer laboratories, so as to provide a framework through which to conduct my research into the problem faced by Grade One learners in the General Education and Training Band (GET) when using the computers.

2.2 THE RATIONALE FOR THE INTEGRATION OF ICT INTO SOUTH AFRICAN SCHOOLS

According to Jhurree (2005:467), “The health of the economy of any country, poor or rich, developed or developing depends substantially on the level and quality of education it provides its work force”. When the African National Congress (ANC) government took over in 1994, they had to meet people’s expectation to eradicate the policies and practices of apartheid. In order for them to be able to redress the imbalances of the past, they would have to first transform the DoE (Bengu, 1997b (i)). Kraak (2004:[Online]) states that one of the pillars of the new dispensation is to develop a single curriculum that would be compulsory and cater for all in the General Education and Training Band (GET), that is from Grade One to Grade nine. Curriculum 2005 (C2005) was developed in part to target the disadvantaged groups. Compulsory for all (Mafanga, 2002:26), C2005 was underpinned by the philosophy of Outcome Based Education (OBE) (Stevens, 2003:[Online]).

The DoE was also faced with a challenge to meet people’s expectations and improve the quality of teaching and learning (DoE, 2003: [online]). Although a new

curriculum would be developed, strategies would be necessary for it to be implemented. ICT was then identified as one of the strategies that could be used as a catalyst. It would therefore not be taught as an additional subject, but as the tool for learning, administration and pedagogy (DoE, 2003 [Online]). The DoE was advised by the Presidential National Commission on Information Society and Development (PNC on ISAD) to integrate ICT into the education sector, as it has the following benefits:

- It enables the schools to reflect the realities of society;
- It extends and enriches the educational experiences across curriculum, teaching and learning methodologies and philosophies of OBE;
- It improves the quality of teaching by reducing the time spent on the administrative work;
- It helps learners to achieve national curriculum goals which state that a learner should be able to solve problems using technology (Revised National Curriculum Statement {RNCS} 2005:14), and provides a broader enriched environment beyond the classrooms;
- It promotes understanding by incorporating contextual problems to solve;
- It creates interesting tasks and promotes the spirit of inquiry and inclusiveness (DoE, 2003 [Online]).

According to Hawkins [online], the classroom has to keep up with the dynamic nature of the world children live in. It was also indicated that this tool had not proved to be effective in social spheres and economical development only, but had also improved the quality of education and training in other spheres, hence the South African government could not miss the opportunity to introduce it (Asmal, 2003 [Online]). The DoE, overwhelmed with the potential benefits of ICT, was enthusiastic about introducing it into South African schools. However, as much attention was focused on the introduction of computers into the classroom, some hardware and furniture suppliers developed a “one-size-fits-all” type of furniture and hardware components, not considering that different Grades contained learners with widely varying physiques.

2.3 AN OVERVIEW OF THE INTEGRATION OF ICT INTO SA SCHOOLS

The DoE and different consortia, such as *Khanya* in the Western Cape, *SchoolNet* in Kwazulu Natal, *Connectivity* in the Northern Cape and *GautengOnline* in Gauteng, were involved with the integration of ICT into South African schools, although the levels of success differ from province to province (Asmal, 2003 [Online]). Computers were first introduced to schools as management and administration tools (GOL ICT Plan, 2000) and later as teaching and learning tools (DoE, 2003:4). The aim of the e-education policy is that by 2013 all the schools should be e-schools (Asmal, 2003 [Online]), that is "Every South African learner in the general and further education and training bands will be ICT capable, that is, use ICTs confidently and creatively to help develop the skills and knowledge they need to achieve personal goals and to be full participants in the global community by 2013." (DoE, 2003:17) Transforming schools to E- Schools learners would:

- Acquire skills that are necessary for the use of new information and communication technologies;
- Use approaches that allow networking among teachers and learners in order to solve problems co-operatively;
- Use any culture that supports the use of ICT for educational purposes, regardless of one's level of expertise.

A strategy was devised in order for that outcome to be achieved. It consists of three phases, discussed as follows; (DoE, 2003:10)

2.2.1 Phase 1 (from 2004 – 2007)

An education and training system is to be put in place. Teachers' and managers' confidence will be built by making computers available for them to acquire basic skills on the use of ICT. The Norms and Standards will be revised to include ICT use and integration. Teachers will have access to in- service training and ICT technical support, and every school will be provided with a computer for administration purposes. 50% of schools should have access to networked computers for teaching and learning, and schools will be using the educational

content according to norms and standards. Another aim is that they will have the means to communicate with provincial offices, with all schools having access to e-rate (50% subsidy), and communities support for ICT facilities (DoE, 2003:31).

2.2.2 Phase 2 (from 2007 -2010)

In this phase, 50% of educators should have been trained, 80% of administrators should be able to use ICT for administration, and 80% schools should have access to networked computer facility for teaching and learning. Schools should have access to digital libraries. Communities support ICT facilities. Schools should have means to communicate with provincial offices, (DoE, 2003:31).

2.2.3 Phase 3 (from 2010 –2013)

All departments should be using ICT seamlessly in planning, management, communication, monitoring and evaluation. All teachers integrate ICT into the curriculum, ICTs are integrated into teaching and learning in all schools, all schools use educational software of high quality in an outcome based way. All learners and educators should be ICT capable, interventions are informed by research and communities are integrally involved in e – schools, (DoE, 2003:33).

As mentioned above, the integration of ICT is taking place at different paces. For instance, the school in which my case study is based is still in the first phase of ICT integration. As they use computers for administration and have received the initial in-service training, they have access to internet and are aware of the standards set by the DoE for educators.

In the following discussion I will look closely at *GautengOnline* as a consortium involved in the introduction of ICT in Gauteng, the province in which my research site is situated.

2.4 *GAUTENGONLINE*

As noted above, *GautengOnline* (gpg.gov, 2004: [Online]) is a Gauteng Provincial Government initiative to impart ICT to the Gauteng schools. It was initiated in order to contribute towards the development of human capital. The Premier, Mbazima Shilowa's vision was to "invigorate the province economy by laying the foundation of e – governance". The Gauteng Department of Education (GDE) committed R500 million to kick-start the programme and secured additional funding from the private sector. They then appointed service providers to roll out GOL and deliver facilities and equipment which would be checked, acknowledged and signed for by the principals and the School Governing Bodies (SGBs). About 2000 schools would benefit from this project. According to Raynor, the GOL manager, each computer laboratory would cost R250, 000 (itweb 2004: [Online]. By the end of the year 2000, almost all schools in the Gauteng province had received at least two computers from the DoE or from private donors (DoE ICT Plan: 2000). These computers were meant to alleviate both the managerial and administrative tasks that were performed manually (Forcier, 1990).

At the time of this research, every school had been provided with a computer for administrative purposes, and more than 50% of schools had access to networked computers for teaching and learning. A special room in every school, to be referred to as an 'ICT laboratory' would be installed, and wired to suit the standards that would cater for connectivity and Local Area Network (LAN). The laboratories would have the following equipment: a teacher's workstation; printer; air conditioning; server room; power supply and networking; alarm system; smoke-detector; security gate; ceiling security; work benches and fifty chairs; blinds; internet connectivity; 25-networked computers, and a television set (Sahara, 2005: [Online]).

On 15 June 2001, Ikageng Primary School in Soweto was the first school to benefit from *GautengOnline* project. Mr Mbazima Shilowa, at a launch indicated that the project would benefit even those learners in the rural areas. Hence, the schools in the rural areas and township were prioritised. By 17 February 2004, 500 hundred

computers laboratories had been installed in the Gauteng schools (itweb, 2004: [online]).

2.4.1 *GautengOnline* Workstation

According to itweb: 2004: [online] *GautengOnline'*s own specifications each workstation consists of a working surface that is 70mm high, a plastic chair that is most suitable for an adult or of the same size as the office chair, a 15 inch monitor, a keyboard and a mouse that are put on the working surface and a central processing unit that is put on the floor. The computer laboratories that were installed in both primary and high schools have the same equipment, that is, the computer hardware and the furniture are of the same kind, height and size.

The relevance of this to the problem being researched in this paper relates to the effects these aspects of "one-size-fits-all" furniture and computer hardware may have effects on the younger users, in Grade One particularly. Here the learners' physique is generally diminutive in comparison to that of the users for whom the furniture and equipment were designed, but who are nevertheless compelled by the curriculum to use computers as the learning tools.

2.5 JUSTIFICATION OF THE USE OF COMPUTERS BY PRIMARY SCHOOL CHILDREN

One of the national specific outcomes for technology stipulates that, at least by the end of the second year in the foundation phase, which is Grade Two, learners should be able to use technology and related ethics to solve problems (NCS). This implies that at the end of the second grade, learners are expected to be able to use computers as a tool in solving problems and practice ergonomics, which are the healthy habits when working on the computer. At a launch of *GautengOnline* on 1 June 2004, the Member of the Executive Committee (MEC) for Education, Gauteng Province, Motshekga, also emphasized that computers should be accessible to all learners. In the template timetable suggested by the DoE, to Gauteng schools to ensure that every learner has access to computers, it is indicated that at least all learners should access computers for not less than two-

and-a-half hours a week (GoE, Circular13:2005). The Grade One learners are therefore included in those who should be using computers as learning tools. The following are the benefits of using a computer by primary school learners, (Osin & Lesgold (1996[Online]) : -

- Learners can use computers to enhance language skills and compose letters using the appropriate software.
- They can work as groups.
- Each learner can learn according to his cognitive level and at his pace
- Individual guidance is received with explanation tailored to perceived problem
- The time taken to achieve a learning outcome is less.
- Computers enhance children's self-concept.

According to the research conducted in North Central Regional Education Laboratory (NCREL, 2001: [Online]) in the United States of America (USA), in the report entitled Computer-Based Technology and Learning, it is suggested that using a computer for learning may have the following benefits and uses: -

- Make learning more interactive;
- Enhance the enjoyment of learning;
- Individualize and customise the curriculum to match learners' developmental needs
- Cater for personal interests;
- Capture and store data for informing data-driven decision making;
- Enhance avenues for collaboration among family members and the school community;
- Improve methods of accountability and reporting.

There are, however, alternative views of the use of computers by primary schools learners. Monke and Setzer (1989: [Online]) felt that integration of computers incur excessive expense, yet in those relatively early years the side effects thereof were

not considered. They also stated that computers were not critically looked at for the disadvantages their use might have, rather for the benefits they could bring.
A decade later, Hoffman (1998:60) stated that the computer is not appropriate for children under the age of three as the change movement and focus from time to time because they still cannot focus on the same activity for a long time. He then suggests that children from the age three to four could start using computers to learn. He also points out that children who use computers have greater development gain than those who have no access, as displayed in their intelligence, non-verbal skills, problem-solving, manual dexterity, verbal skills, and improved motor skills that enhance mathematical thinking. Papert (1998) in Haugland (2000: [Online]) emphasized that computers have a positive impact on the children when they provide concrete experiences for learners, children are able to work as a team, teachers use it to teach and learners access and control the learning experience.

Introduction of ICT into education sector is the government strategy to improve the quality of teaching and learning, management and administration. Integration of ICT provides resources beyond classroom through Internet.(DoE, 2003: [Online]) It is therefore imperative for educators to equip themselves with this new technology in order to be efficient as facilitators of ICT as all learners are expected to use computers as learning tools and not as an additional subject. There are different consortia that have joined hands with the government to integrate ICT in the SA schools (GoE, Circular 7:2005). Children at the primary schools are developmentally ready to use computers although there are alternate ideas about this matter. Learners should, therefore, be given equal opportunity to access computers in order to be ready to compete globally when they leave schools. However, the sizes of computer hardware and furniture that has been installed to all the schools, that is, in the primary and high school are the same. It seems that the different levels and sizes of learners that need to use these equipments were not considered. In the following discussion I will through literature, explore ergonomics, that is, whether the sizes of the computer hardware and furniture do affect the users, particularly the Grade One learners.

2.6 ERGONOMICS

2.6.1 Introduction

The word ergonomics was coined by Professor Hywel Murrel (Pleasant, 1996:4). The word *ergos* is derived from a Greek word which means work and *nomos* means the natural law. This word as suggested by Murrel may be applied on any human or purposeful activity (Pleasant, 1996:5). He therefore defines ergonomics as the scientific study of the interaction of man and his working environment, and that the working environment may include everything that one uses. For instance, the machines, the furniture, the material and the tools that one uses constitute this working environment. HFESA (2004: [Online]) describes ergonomics as human factors. Dul and Weerdmeester (1993:1) also state that ergonomics is the study of the workplace and how people utilize the equipment in the workplace with the aim of discovering whether the equipment causes any discomfort. Ergonomics in the computer laboratory would be the study of the interaction between the Grade One learners and the equipment in the workstation.

Murrell (1978:4) indicates that ergonomics is a multidisciplinary field of study as it encapsulates the physiological, psychological and the engineering study. He adds on to say that these areas are covered in order to maximize the operator's comfort or reduce fatigue of the operator in the working station. The operator's safety, efficiency and reliability are taken into consideration. Conducting ergonomics as a study in the computer laboratory is a strategy to determine whether the Grade One learners are safe and comfortable in their workstations. Murrell further states that ergonomics is also important in that it informs the future technology designs of the human needs in order to effect changes in the latest designs. When the operator is safe, he becomes comfortable, efficient and can be relied on because of the accuracy at which he does his work. A workstation or a product, which was designed with the safety of the operator in mind, is said to be ergonomically designed (cf. CDC (2000: [Online]) According to Janhager (2005: [Online]), as technology advances, both the complexity of products and the number of functions they comprise are steadily increasing. This leads to more opportunities for using the products. In the following discussion I will explore aspects to be considered

when developing an ergonomic product, characteristics an ergonomic designed product, creating a conducive environment in the work place, injuries associated with the use of computers, ergonomics in the office as a similar working station to the site of this research project, and effects thereof. I then explore an ideal workstation for learners in the computer laboratory.

2.6.2 Consideration when developing an ergonomic product

According to Pleasant, (1996:22-23), the design should be empirical, that is the needs of the user should be investigated and analysed so as to develop the product that will match the user's behaviour, experiences and physical and mental characteristics. After obtaining the empirical data, the product should be developed according to the need. It is also emphasized in CDC (2000: [Online]) that the equipment in the workplace should match the operator's anatomy and physiology. Pleasant (1996:22) indicates that it is necessary that the user participate during the design phase in order to have the product tried out. It would therefore, not be necessary for the user to adjust to the product's demands, as the product would be designed in such a way that it meets the user's needs. The product should also accommodate human diversity and allows the interaction between the product and the user to take place. Machines or tools that are not ergonomically designed result in a number of constraints experienced by users in the working place.

2.6.3 Characteristics of an ergonomically designed product

According to Pleasant (1996:9) the following are the characteristics of an ergonomically designed product:-

- It must have been tried out during its development.
- The conditions under which it will be used must be taken into consideration.
- It should be established if it will fit the body shape of the user.
- It should be determined whether it is user friendly
- It should be established if further improvements are possible.
- It should be determined if one still feel relaxed after he has used the product for a long time.

The developer of the product should adopt the user-centred approach so as to develop the product that will best suit the user. For one to develop an ergonomic product one has to take a number of factors into consideration. As Murrell (1996: [online]) states, ergonomics is the relationship between the user and the equipment in a working station, with the workstation having to be designed in such a way that the position of the operator is comfortable and conducive to work. The objective is to provide an environment in which one can work safely, efficiently and in comfort. This should be a separate, quiet space where there is no disruption from the rest of the building. The space should be well-lit (naturally or artificially), free from undue noise and have adequate ventilation and heating. The following are some of the aspects to be taken into consideration when creating a conducive working environment

2.6.3.1 Clearance

A human body should be allowed sufficient space at the workstation for efficient mobility. Murrell (1996: [online]) stipulates that there should be space for at least the following furniture and equipment, including some detailed dimensions:

- Desks 1600mm x 800mm and 1200mm x 800mm, preferably arranged in an L-shaped formation for ease of use.
- VDU, keyboard, printer and telephone (with answering machine where appropriate).
- Drawers for the storage of stationery (pens, paper, forms, etc.).
- A chair
- A wastepaper bin.

2.6.3.2 Reach

According to Dul and Weerdmeester (1993: 20), there should be sufficient unencumbered working surfaces, for example 1200mm x 800mm, to allow working with plans, documents and other material. Layout or organization of the work area which allows materials to be handled without excessive bending, twisting and stretching reduces injuries. They also state that the materials, tools or machines

that one is using, should be within reach. They indicate that a reach where a worker does not have to stretch is called optimal reach and a reach where one has to stretch is called maximum reach. They further state that the user of the machine should be able to reach the equipment he is using without straining any part of the body. The Occupational Safety Health Association (OSHA, 2001: [Online] indicates that a flat-panel display requires less desk space, and suggests that flat-panel display which is not as deep as a conventional monitor can be a better option in a computer workstation.

2.6.3.3 Posture

According to OSHA (2001: [Online]), maintaining good posture is often difficult when working on the computer, because of alignment of components and the user. The website describes good posture as keeping the wrist straight, elbows close to the body and head straight. Pleasant (1996) defines posture that one adopts when one performs a task as the relationship between the dimension of one's body and the dimension of the item in one's workplace. He also states that a working surface that is too high or too low for the operator of the machine may affect posture, for instance having to hold the upper limbs in a raised position. He further states that when one is working on the computer, the back must always be supported. If the working position is too low, the head, neck and the trunk will be inclined forward, which will cause stress to the spine. CUergo (2004: [Online]) also indicates that maintaining good posture includes making sure that the user sits back in the chair and has good back support. In addition, the feet can be placed flat on the floor or on a footrest. According to Rasicot (2000: [online]) it has been reported that the percentage of young children who are complaining of back pain is also escalating

2.6.3.4 Temperature

The temperature in a working environment in turn affects one's body temperature. If, for instance, the temperature is too high or too cold, one may experience discomfort which thus affects one's performance.

2.6.3.5 Lighting

According to CDC (2000: [Online]) the degree of lighting in the computer laboratory is the cause of vision problems. If the light is too bright and shines directly to the eyes it causes direct glare and indirect glare if it is reflected from the screen. It is therefore advisable that lights that are hidden in the ceiling or blinds on the windows be used to avoid glare.

2.6.3.6 Ventilation

Emmons and Wilkinson (2001: [Online]) state that the air conditioners and the ventilators should be at a reasonable distance from the computer users. According to OHCOW (1998: [0nline]), poor air quality may result in eye, nose and throat irritations, headache, dry mucous membranes, dry skin, mental fatigue, trouble concentrating, nausea and dizziness, and Increased incidence of respiratory infections.

2.7 INJURIES ASSOCIATED WITH THE USE OF COMPUTERS

According to Pleasant (1996:78), an ergonomic injury is the one that occurs as a result of the direct or indirect consequence of the nature of demand in the work place. They may be discrete at the time and be realised over a long period of time as a result of over-exhaustion. Esnouf and Porter (1998:140) state that computer users usually suffer from back pain, hand and wrist strains ad eye problems

2.7.1 Back Pain

The working surface that is too high or too low for the operator of the machine may affect the posture. The upper limbs may be held up in a raised position and back must always be supported. If the working position is too low, the head, neck and the trunk will be inclined forward, which will cause stress to the spine (Working Well organisation, 2004: [Online]).

2.7.2 Vision problems

Visual work that is performed exceedingly close to the eye causes fatigue to the eyes. For instance, viewing the monitor screen from a short distance may cause convergence to the eyes while viewing from a distance may cause the user to recline and assume an awkward posture. It is therefore recommended (Pleasant, 1996:78) that for young people, a distance of 80 to 120mm and 350 to 400mm for older people from the point of focus.Common vision problems are blurring of eyes, headaches, burning or gravely sensation around the eyes. According to Infin, (2001: [online]) starring at the screen decreases the blink level and causes the eyes to dry up. OSHA (2001: [Online] indicates that a computer monitor attracts electromagnetic dust and distorts images, thus causing a strain to the eyes. It is therefore suggested that a monitor screen be cleaned to avoid accumulated dust on the screen. To ease common problems associated with vision OSHA (2001: [Online] suggest that:-

- *a computer user should rest eyes periodically by focusing on something else*: If it in the computer laboratory an educator may design an activity in such a way that after twenty minutes a different activity is given that will make learners to focus elsewhere other than on the screen;
- *users should learn to blink at regular intervals*: They may be trained to look away and blink to moisten their eyes;
- *for a few minutes focusing on a different object*: Learners may be also taught to frequently focus on something else in the room to rest their eyes;
- *glare should be avoided on the screen*: Blinds may be used to avoid direct light from outside and monitors may be positioned in such a way that light does not shine on the screen.

2.7.3 Hand/wrist problems

The problems that are usually experienced include Musculoskeletal Disorders (MSDs). These have been discovered in both adults and children. However, it is not known whether the percentage of children experiencing it will escalate, since there are a great number of children starting to use computers as learning tools

now. There may be discomfort and tenderness, inflammation and weakening of tendons (Infinite Innovations, 2001: [online]).

2.7.4 Neck strains

This problem of neck strain results from the forward inclination of the neck and the head, and usually puts the neck muscles under a lot of strain since the weight of the head rests on the neck and cause a discomfort. Pleasant (1996) states that muscle tissue responds badly to prolonged static mechanical loading. The static effort restricts blood flow to the muscles.

2.8 ERGONOMICS IN THE OFFICE AND COMPUTER WORKSTATION

The hardware and the furniture that the user interacts the most with are the working surface, the chair, the monitor, the keyboard and the mouse. Before I can discuss the ergonomics in the computer laboratory, I will explore a similar working place, that is, an office where a computer is used as the main tool. The basic workstation consists of the table, on which a computer is commonly placed, and the chair. The user of the computer in an office usually has the physical contact with the working surface, the chair, the floor, the keyboard and the mouse. Research, in Ergonomics shows that a well designed learning environment impacts on students and teachers emotionally, physically and psychologically. It also contributes to a high degree of learning and handling of information (Bowers & Burkett, 1989). On the other hand, an improperly designed classroom can impede learning by causing fatigue, discomfort, irritation and distraction. Poorly designed workstations affect both the health and the productivity (Bergvist, Wolgast, Nilsson and Voss, 1995).

As indicated in Chapter One of this study, children use computers throughout education all over the world. Large sums of money have been spent on buying computers and providing internet access to learners all over the country in South. So much attention has been focused on buying computers and little or no attention has been paid to the effects of the use of this machine from an earlier age. Computer laboratories were first installed before training was provided to either

educators or learners. (Bergvist et al., 1995) have observed young learners working on the computers and compared them to the children on sports and musical instruments. They are unlikely to report when they experience discomfort. Ergonomics further state that, from their observations on the young learners working on the computer, they are at risk. The concern has led to the formation of the International Ergonomics Technical Committee, initially made up of twelve members representing twelve different countries. The aim of this committee was to establish effects and develop guidelines and standards on the efficient and the safe way of using the computer.

Bleecker in Rasicot (2000: [online]) cited that a number of computer students have come to him complaining of wrist or back pains. According to Cornell University study (1999), the primary areas that are usually affected are neck shoulders, back, wrists, and eyes. According to the survey conducted in the University of Rochester in New York, it is imperative that ergonomics programmes be put in place for people who use computers as working tools. In education, these programmes can be incorporated as an in-service training for teachers and be implemented immediately to benefit both educators and pupils (Williams et al., 2000).

2.8.1 The office desk/table/ working surface

According to Yale (1998: [Online]), the working surface or the table should have enough space to can accommodate the monitor, keyboard, mouse, speakers and all other accessories, at a reasonable reach. He adds that the table should have enough space for the legs to move or stretch and a tray for the keyboard, should there be a need. CDC (2000: [Online]) states that an adjustable work surface may be desirable where people of different height share the workstation. Yale (1998: [online]) also suggests that an adjustable working surface is ideal when both adults and children are to share the working surface. They add that although adjustable tables are expensive, they are flexible, as they cater for different workstation users. He also indicated that work surfaces are designed to be of standard height, although the users are not of the standard height. On the other hand, Yale (1998: [online]) emphasises that the working surface has to be stable and indicates that a

working surface has to be large enough to accommodate all the material to be used. It must be large enough to put the screen at a viewable position.

2.8.2 The chair

By 1996, a number of offices in the United Kingdom were already using adjustable office chairs, especially where the work is screen-based (Stevens & Taylor, 1996). These chairs have arm rests, their height is adjustable, they swing from left to right and they have supportive backrest .The armrests allow the user to rest his/her arms and support them when standing or sitting on the chair. The left to right swinging of the chair allows the user to move to both directions without straining the body, while the adjustable height of a chair allows any user, either tall or short, to adjust the height and work comfortably. Some chairs also have backrests that adjust to the user's direction.

If the keyboard or mouse can be adjustable, choose the chair that will allow both feet to be fully supported by the floor. The knees should not be higher than the hip joints, as this causes strain on the back tissues. If the height of the mouse or the keyboard cannot be adjusted, the user should be placed in such a way that the arms are relaxed and the buttons are right under the fingers. If the latter is impossible, the footrest should be used to support the feet, or alternatively the computer must be put on a lower surface. An office chair that is ergonomically designed should possess the following features:-

The height should be easily adjustable from the sitting position. The height range will depend on the kind of table that it is to be used with, that is it will depend whether the table is fixed or adjustable. Typists' chairs traditionally have a low backrest, whereas the executive office chairs have medium height level or high-level backrests. The angle of the backrest should be adjustable in order to give the user a variety of working positions. To accommodate all users, one must be able to disable the tilting devices if one does not need them. The backrest should be countered to the form of the lumbar of the spine CUErgo (2004: [Online]),

The best armrest allows the user to rest the part of the arm that lies between the wrist and the elbow, without compressing any part of it. It reduce postural strain and muscle load in the upper arms, shoulder; and neck. It alleviates loads on the spine by distributing the weight of the upper body. It reduces arm extortion and key forces while typing.

CDC (2000: [Online]) states that although most people think that sitting is relaxing, sitting for a long time also causes stress to the intervetelebral discs. It also affects the feet and the legs as blood is pulled down and the circulation is slowed down. It is therefore recommended that one alternate between standing and sitting, sit upright with lower back against the back rest and choose the chair that has adjustable and removable arm rests CDC (2000: [Online]). Barrero and Hedge (2000: [online]) state that when a chair is chosen for learners it should be a chair that will allow them to sit with their feet fully supported by the floor. It is also suggested that if the chair is very high and the learners' feet are not supported by the floor, foot support should be devised. It is further stated that the learner's sitting position should be such that the elbows bend to ninety degrees the upper arms are relaxed closed to the body and the knees are not higher than the hip joint, as this increases stress on the back tissues. According to CUErgo (2004: [Online]), the height of the chair can be fixed if only one person is using it. When the chair is high, some users tend to perch on the front of the chair and that deprives them of support from the backrest. For a very short person, adjusting the chair to reach the level of the table may be very uncomfortable for the user to work, since the feet may dangle and not be supported by the floor. If one lowers the chair one may have to work with shoulders hunched and elbows raised sideways.

2.8.3 The monitor

According to (Bennet, 1998:24), a monitor is an output device that displays data that has been typed on the keyboard and the instructions before data is processed in the central processing unit (CPU). The information displayed is usually referred to as a 'soft copy'. The monitor is usually place on the working surface. CDC (2000: [online]), indicates that once the working surface and the chair height are properly positioned, then a monitor can be put at a viewable position. According to

OSHA, (2004: [Online]) the monitor should be put perpendicular to the windows to avoid glare. It is also stated that it should be put at a reasonable distance where a user can be able to read text without straining the eyes and be positioned in straight line with the keyboard and the chair. It is further indicated that working too close to the monitor causes strain to the eyes as it makes the eyes to 'converge'. Viewing the monitor from a long distance can be detrimental to the user as it causes one to assume an awkward posture by leaning forward. Rasicot, 2000: [Online] indicates that the monitor can affect the user's eye sight if it is not put on the recommended height. She therefore recommends that the monitor be put at or a little lower than the user's eye level. If it is place higher or lower than that a user will be forced to look up and down and that causes eye and neck strain. To avoid distorted images on the screen, the monitor should always be dusted to avoid electromagnetic dust on the screen.

2.8.4 The keyboard

Madaan (2000:8) describes a keyboard as a chief input device. It should be placed at the optimal reach, be positioned inline with the monitor and should be next to the body at elbow-level, with the elbow at ninety degrees (OHCOW, 1998: [Online]. Most keyboards that are on the market are split keyboards. The recommended keyboard has an adjustable slope. The home row of the keyboard should be at the elbow's sitting position. The keyboards that are used recently and said to be ergonomic are split keyboards. Its alphanumeric keys are split at an angle. These keyboards are reported to be more comfortable than the traditional ones. However, it is not indicated whether these keyboard offer any postural benefit. They are categorized into the following types:

The modified standard layout, which looks like the standard keyboard, but its keys are angled to avoid ulnar deviation when typing CUErgo (2004: [Online]),

Fixed angle split keyboards (.Microsoft, 2006: [Online]) includes alphanumeric keys split at a fixed angle and slightly tent the keyboard. This design works better for broader, larger and pregnant people, as they are larger than the traditional

ones. This affects the positioning of the mouse, as it has to be further. These are exorbitant but comfortable to work with for people who do touch-typing. An adjustable angle split keyboard allows the user to change the angle according to his needs. They are not easy for ‘haunt and peck’ typists (CUErgo, 2004: [Online]). On completely split keyboards the left hand and the right hand are completely split apart. In some design the keys are in a design scooped. This allows the hands to be in a neutral posture for typing (CUErgo, 2004: [Online]).

Vertically split keyboards are a special design that is similar to an accordion, with two sets of keys. The keys cannot be easily seen and the hands face each other when typing. This is comfortable to use an ulna deviation and wrist extension does not occur (CUErgo, 2004: [Online]).

Chordic keyboards have a smaller number of keys and letters. Digits are generated by a combination of keys and chords. They are used by people with special needs, such as blind and people who suffer from acute arthritic hands. They are also expensive since they are specialized (CUErgo, 2004: [Online]), they are not generally available to the general public, but are designed for people with specific needs. These may be expensive. (www.datahand.com), and include one-handed keyboards, an alternative for people who are using one hand or who have to be using the other hand for something else (aboutonehandtyping, n.d.: [Online]). According to Healthy Computing (2001: [Online]), **little Princess keyboard** is ideal for user with small hands. It is just like the adults keyboard but it is smaller and has cute colours and design.

2.8.5 The mouse

According to Bennet (1998:26) the mouse is an input device that is worked by a finger to move the cursor to any desired direction and it is also used to move or drag the graphics. It is said that a mouse used in the offices is too large for young learners. If the users vary in size, it is necessary that there be a provision for a variety of sizes to choose from (Healthy Computing (2001: [Online]. The monitor as the device that is used frequently in the computer workstation should be placed at the optimal reach and not at the maximum reach (Dul & Weerdmeester, 1993:18).

Like the keyboard, the mouse should be next to the body at elbow-level, with the elbow at ninety degrees (OHCOW, 1998: [Online]).

2.8.6 Computer workstation accessories

According to Williiams (I998: [online]), not everyone needs the same accessory in order to maintain good posture. The following are some of the accessories that individuals, according to their needs, may use to maintain good posture and maximize comfort when working on the computer:-

The wrist rest supports the forearm during typing. A broad flat surface design wrist rest is said to work best. Some keyboards have an attached wrist rests. The soft plastic ones, which are filled with gel, should be avoided. The wrist should be allowed to glide over the broad flat surface during typing.

Back pillows may be used when the pan of the chair is too big for the user, and one tends to sit towards the front. The backrest of the chair is then not able to provide support; a back pillow can be used to provide support.

Booster seats can be a pillow that is used to sit on in a case where the chair has a big pan for the user.

Document holders are used in order to make the document to be at the reading level as the monitor to avoid unnecessary muscular strains in the neck.

A **foot rest** is useful when working on the computer as the feet need to be supported by the floor. If the user is too short and the chair is not adjustable the use of a footrest may be necessary to avoid the feet from dangling. Books as a shift make or a box can be helpful.

Keyboard and mouse trays. According to CUergo (1999: [Online]), a mouse tray allows one to use the mouse with upper arms relaxed and as close to the body as possible, allowing the wrist to be in a comfortable and neutral position. A keyboard tray is adjustable and allows the user to tilt it away to allow good posture. (cf. Ergo in Demand, (2006: [Online]).

Children use computers throughout education all over the world (Subrahmanyam, Kraut, Greenfield and Gross, 2000: [Online]). He also adds that large sums of money have been spent on buying computers and providing internet access to learners all over the country in South Africa. So much attention has been focused on buying computers and little or no attention has been paid on the effects of the use of this machine from an earlier age (Hawkins, 1998: [Online]).

2.9 AN IDEAL COMPUTER WORKSTATION

An ideal workstation for learners is one which accommodates different learners' physique to work comfortably without being exposed to any injuries. It therefore should accommodate all levels and sizes of learners and should have the following features (OHCOW, 1998: [Online]):-

- Adjustable chairs and table tops which have adjustable devices that are user – friendly to all users;
- Stable working surface that does not wobble;
- The footrest should be available where the user's feet are not fully supported by the floor and foot rests that are well constructed, with a stable, non-skid platform which tilts forward and back to allow ankle movement should be .selected;
- The sizes and position of the keyboard and the mice should be such that users do not have to stretch any part of the body in order to reach them;
- The screen of the monitor should be positioned in such a way that a glare is avoided;
- There should be enough space to allow the user to move freely;

The user may have the ergonomically designed equipment but still assume awkward posture if s/he is not aware of safe practices.

2.10 GUIDE LINES FOR HEALTHY COMPUTING

It is necessary to ensure that there is a sufficiently large working surface. The equipment is placed so that the user can easily reach them without strain on the body. It is advisable to vary tasks and take periodical breaks. To ensure good posture when working on the computer CUErgo (1999: [Online]) suggests that one has to ensure that: -

- one can reach the keyboard keys with one' wrists as flat as possible (not bent up or down) and straight (not bent left or right).
- one's elbow angle (the angle between the inner surface of the upper arm and the forearm) is at or greater than 90 degrees to avoid nerve compression at the elbow.
- the upper arm and elbow are as close to the body and as relaxed as possible for mouse use - avoid overreaching. Also make sure that the wrist is as straight as possible when the mouse is being used.
- one sits back in the chair and has good back support. Also check that the feet can be placed flat on the floor or on a footrest.
- the head and neck are as straight as possible.
- the posture feels relaxed for the user.

2.11 CONCLUSION

Considering aspects of an ergonomic product, it is clear that there should be a need analysis before a product is even designed. After it has been designed, the presence of the user is of utmost importance so as to have the product tried out to determine whether it is with accordance with the user's needs. To develop an ergonomic workstation for learners, the first step should be determining the need analysis and learners should try the designed workstation as this is one of the characteristics of an ergonomically designed product. According to the survey conducted in the University of Rochester in New York, it is imperative that ergonomics programmes be put in place for people who use computers as working

tools to ensure that they are safe from injuries that they may develop from awkward posture when working on the computers. In education, these programmes can be incorporated as an in - service training for teachers and be implemented immediately to benefit both educators and pupils (Williams et al, 2000: [Online]).

This chapter has looked at the integration of computers into SA Schools, the rationale and justification of the use of computers by primary school learners. I have also examined through literature the ergonomics in the computer workstation, possible injuries, and aspects to be considered for creating a conducive, environment and risk that computer users are susceptible to. I discussed the characteristics of an ideal workstation in terms of the research question ‘How the aspects of computer hardware and the furniture affect the experiences of the Grade One learners in a Gauteng school’. In the next chapter I will discuss the methodology I am to use to collect data for this study.

CHAPTER THREE

RESEARCH DESIGN

3.1 INTRODUCTION

In this chapter, I give a description of the nature of study, how data was collected, the methods and the techniques used throughout and the processing of data. I also discuss the trustworthiness of the study and ethical considerations followed.

3.2 RESEARCH APPROACH

Krueger (1994: 245) states that qualitative research is one of the main research methods in education. It provides a quest for an “in-depth explanation and understanding of a phenomenon” (Merriam, 1999:19). Qualitative research also uses multiple methods in enquiring data and the main methods are interviews, observations and literature review (Henning, van Rensburg & Smit, 2004:35) I decided to use this approach in my study in order to gain an in-depth explanation of how aspects of the computers affect learners’ experiences in the computer laboratory in a Gauteng school. Two Grade One educators were interviewed, learners were observed while interacting with the keyboard, the mouse and the monitor and the furniture, that is, the chair and the working surface in the workstation.

Although this is a qualitative study, I decided to incorporate numerical data into my study in order to establish whether the sizes of the workstation and the sizes of the Grade One learners are proportional. I measured the heights of learners and the sizes of the workstation equipment in the computer laboratory. The measurements of the furniture and hardware components include their height and length.

According to Merriam (1998:7-8), my study qualifies to be a qualitative research because it has the following characteristics:-

- Qualitative research is interested in the people's experiences (Merriam, 1998:7):- In my study I aim to in find out how the Grade One learner's experience the aspects of computer hardware and furniture in the computer laboratory in a Gauteng school.
- The researcher is the primary instrument for data:- I have collected data alone and I will also process it alone.
- Qualitative data usually involves field work:- The researcher has to physically go to the setting. I had to go to the computer laboratory and observe learners interacting with the furniture and hardware components in a Gauteng school.
- It primarily uses inductive approach:- I have not followed a theory or tried to prove a hypothesis, but I conducted the study with an aim of establishing how learners experience are in the computer laboratory.
- It also focuses on the process of meaning and understanding:- Words and pictures are used to convey knowledge. I have given in-depth description of the situation and I have also compiled pictures that display certain aspects in the computer laboratory.

3.3 RESEARCH DESIGN

My study is a case study as it focuses on a bounded setting (Henning et al., 2004:40), which is the computer laboratory in a Gauteng school. Yin (1984:23) states that a case study seeks to explain reality by exploring a real life situation. The study seeks to find out what the learners' experiences are in relation to the computer hardware and furniture in the workstation in a computer laboratory in terms of ergonomics issues. Henning et al. (2004:41) point out that a case study, as a method of research, endeavors to answer questions such as *why*, *where*, *when* and *what*. They further describe a case study as a strategy that provides an in-depth understanding of the situation as a process rather than the outcome. It provides intensive description and analysis of a unit and focuses on the phenomenon that has identifiable boundaries. Denzin and Lincoln (1994:2) define a case study as a type of research method with a multi-perspective approach to social interaction aimed at describing and interpreting the interaction. Henning et

al. (2004:41) also state that this type of research involves qualitative data tools, such as interviews, observations and literature, to gather data in order to understand the phenomenon. In line with this, I reviewed the literature to develop a framework before using mmultiple methods, such as interviews and observations, to capture data and in addition, measurements of the computer hardware and the furniture, the working space and the average height of the learners to be observed were taken.

3.4 METHODS OF DATA COLLECTION

Qualitative research involves the qualitative data such as interviews, observations and literature to understand the phenomenon (Myers:1997).

3.4.1 Interviews

According to Babbie and Mouton, (2001:289), the individual key informant interview is conducted with an in-depth, knowledgeable, informed subject who may assist the researcher to gain a deeper understanding of particular issues that are of interest. Merriam (1988:74) states that an interview is a conversation with a purpose. I conducted interviews with the Grade One educators as they were involved with the learners and observe their interactions on daily basis. A one-to-one interview was conducted with Grade One educators with the aim of establishing the educators' interpretation of learners' interactions with the furniture and the computer hardware. Henning et al. (2004:53) state that interviews are used as the mechanism to yield information that represents reality through the participant's response, but the content may vary from deep emotions and lived experience to narratives of an individual or group of people or opinion and facts. Informal interviews were held with the learners to find out the reason for certain behaviour while interacting with the computer hardware components and furniture. Henning et al. (2004:53) also state that as the information is usually regarded and believable, the interviewer is therefore advised to guide the interview and avoid leading questions. An interviewee should not be forced to be in a confessional mode. I therefore avoided questions that needed a yes or no answer as much as

possible, or questions that may have been perceived by the interviewees as being too interrogatory.

Structured interviews were conducted as I drafted questions for the interview before each one. Henning et al. (2000: 53) suggest that the use of standardised interview provides guidance without interference. As a tool for interviews, I used standardised questionnaires which comprised mainly open-ended questions, which encourage the respondent to provide more information and also lead to other questions (Lecompte & Preissle, 1993:326). According to Patton (1986:320), probing an interviewee's response is likely to add richness to data collected. Probes were kept to a minimum and leading questions avoided. Questions and the responses for learners were formulated in Zulu, as it is the mother tongue of the learners I observed, and they are not yet able to express themselves well in any other language. I took notes during the interviews and with the respondents' permission used a video tape recorder. The learners' questions and the responses were written in Zulu and were later translated into English. Questionnaires for the educators were formulated in English, although they were mixing English and Zulu in their response.

3.4.2 Observations

In a case study, the researcher spends extended amount of time on site with the participants to observe them in their natural setting to present an in-depth description of the participants' experiences (Leedy, [Online]). Merriam (1988:88) also notes that observation, as a qualitative data collection method is a research tool that serves a research purpose, formulated and planned deliberately, recorded systematically, and is subjected to checks and controls on validity and reliability.

According to Henning (2000:90), a standardized observation form may not yield rich information, but organizes the researcher's work in a sense that one does not loose focus on what to look for. As suggested, to use these observation schedules as supplementary tools, I developed a schedule before the observation. On the day of observation, I recorded the actions and conversation in line with the

research question as field notes. According to Le Compte and Preissle (1993:224), field notes are a written account made during the observation, on the spot or as soon as possible after the event, that represent the interaction and activities of the researcher and the people studied. I also used a video to capture all the learners' movements, which I assisted me in reviewing and recording the moments I had missed during observation at the site. Patton (1987:72-73) states that learners experience observation as less threatening than a test; that when problems and misunderstanding arise, they can be spotted and attended to immediately; that progress can be monitored by means of regular observation; and that observation provides the researcher with supplementary data that could not be acquired in any other way. I informally interviewed some learners during the observations to establish the purpose of observed behaviour whilst working on the computers. I observed how the learners occupied the chairs, their posture in relation to the chair, monitor, and keyboard. I also observed whether their feet were fully supported by the floor and whether there were any hindrances. I attempted to detect whether there was any level of discomfort whilst learners were using the computer centre.

3.4.3 Literature Review

Merriam (1988:61) states that the literature review interprets and synthesises what has (already) been researched and published in the area of interest. Leedy (1997:71) adds, "When you know what others have done, you are better prepared to investigate the chosen problem with deeper insight and knowledge that is more complete". A document study was undertaken to establish whether an official policy documents regarding ergonomics in school laboratories existed on this topic. This included memos, circulars, books and policies. I had to first give the background of my study where I discussed the integration of computers into South African schools, the rationale, *GautengOnline* and the justification of the use of computers by the primary school children. I then discussed ergonomics, where I gave the definition; considerations when developing an ergonomic product; characteristics of an ergonomic designed product; creating a conducive environment in the work place; injuries associated with the use of computers and an ideal workstation for learners in the computer laboratory.

3.4.4 Physical Measurement

Measurements were taken of the computer hardware and the furniture, the working space and the average height of the learners to be observed. The purpose was to compare the sizes and heights of the furniture to the physique of the Grade One learners. Measurements were also used to establish whether the working space is adequate for learners to work freely without them being hampered. A tape measure was used as a measuring instrument.

3.5 DATA ANALYSIS

It is the final stage of listening to hear the meaning of what is said (Rubin & Rubin, 1995:25). According to McMillan (1992:221) the aim of data analysis and interpretation of qualitative data is to discover patterns, ideas, explanations and understandings. Qualitative data analysis is a search, in their opinion, for a general statement about relationships among the categories of data, which are grouped in units.

3.5.1 The Researcher's role in analysis

This study is undertaken by a single researcher, and no other people were involved in collecting data. The researcher as such acts independently and, in relation to this study, is not working for any person or organization According to Denzin (1989:12), it is inevitable for one not to be influenced by one's believes concerning the topic chosen. One either agrees with or has arguments against the topic chosen. Scheurich (1994: [Online]) states that one's race, gender, historical position and class influences one's processing of knowledge and limit and restrict the production of knowledge. I may have an influence on the processing of data in this study since I am a technical teacher at a school and most of the aspects in my study I personally experience them when working on the computer as a Computer Based student at University of Johannesburg. This means that I will have to try and

distance myself from the data rather than to influence it so as not to limit or and restrict knowledge.

Atkinson and Coffey (1996) state that data analysis is a process of putting data together and endeavour to transform the myriad of data that stands before the investigator into something useful. Marshall and Rossman (1989:112) also define qualitative analysis as a process that brings order, structure and meaning to the mass of collected data. It enables the researcher to discover themes that emerged from the gathered data. Roth (2001:34) cites that a researcher is part of the interpretation as his frame of reference influences the interpretation.

3.5.2 Preparing for qualitative data analysis

Data was collected using interviews, observation, taking physical measurements. The qualitative data gathered was transcribed into a readable material in preparation for analysis. The method that I will use in this study will be content analysis. According to Pope, Ziebland and Mays (2000: [online]}, analyzing data begins during data collection, that is, as one collects data, it is shaped in the researcher's mind and it influences the "ongoing data collection". They also state that the "interim analysis", which is the analysis during data collection, has an advantage as a researcher is able to refine the questions to be used during the interviews. They further state that qualitative analysis is either inductive or deductive. Inductive analysis is when categories emerge gradually from data where as deductive analysis is when a "framework approach" is used.

3.5.3 Developing a framework for data analysis

Pope, Ziebland and Mays (2000: [online]} state that "the framework approach was developed in Britain for applied or policy relevant qualitative research." They also state that this approach is short and starts with preset aims and objectives. It is therefore structured as it is influenced by prior data. According to Natcen (2006:[Online]), themes are developed from "documents that are read over and over" and are used to generate questions for the interviews. As mentioned above,

analysis starts as data is collected. My opinions on the ergonomics were greatly influenced by the data that I gathered and I used information from literature to formulate questions for the interviews. I also decided to develop a schedule using the information from literature to use for observations. The framework that I developed is illustrated in table in picture 3.1: -

Table 3.1 The framework used to collect data

Research questions	Equipment	Literature	Interview	Observation	Measurements
			Data obtained from field		
Do learners sit back or lean forward when working on the computers? Are their feet fully supported by the floor? What did learners say about	Chair	Posture, size, positioning, reach, temperature,	Data related to chair size and shape (4.2) (Appendix A, line 2)		
Is the space in the working surface/ tabletops enough for learners to move comfortably?	Working surface	Posture, size, positioning, reach, temperature,	Data related to working surface (4.3)		
Do learners keep their arms close to the body or away from the body whilst working on the computers?	Keyboard	Posture, size, positioning, reach, temperature,	Data related to keyboard use		

:

I therefore will use the framework approach to analyze data. The following are the five steps to follow when using framework approach (Pope, Ziebland and Mays (2000: [online]) :

Familiarization with the raw data: - A researcher has to ensure that data is familiar by reading documents that are pertaining to the phenomenon under study. Most literature that I read was attesting to the same facts concerning the furniture and hardware aspects in the computer work station.

Identification of thematic framework: - When the data has been read over and over it is then easier for the researcher to be able to identify themes that can be used to further search or collect data. Through the constant discovery of the same data I was able to identify similar aspects such as the size, clearance, posture and reach when working in a computer workstation.

Indexing: - The themes can there after be systematically arranged

Charting*:* - ***Identified: -*** themes are further arranged accordingly, that is, those that relate they are put together,

Mapping and interpretation: - After association between themes is established, interpretation of the data can take place.

3.5 TRUSTWORTHINESS

Lincoln and Guba (1985:299) state that the criteria for trustworthiness include: credibility, transferability, dependability and confirmability, which are parallel to validity and reliability. Dependability refers to whether the findings of the research would be consistent if the study were repeated with the similar subjects in a similar situation (Krefting, 1991:216).

3.5.1 Credibility

Credibility refers to the extent to which data is believable and on the analytical abilities of the researcher (Lincoln & Guba, 1985:296). It can also be enhanced through triangulation, which is the use of multiple sources in order to validate the findings. The multiple data sources that I used will be made available for the credibility of this research project. Lincoln and Guba (1985:296) suggest that credibility can be obtained by referential adequacy. I used the videotape to capture movements and pictures and archive together to support my findings. The ongoing check of the researcher‘s interpretation adds value to the research report as well as the repeated observations, peer examination and clarification of the researcher’s bias (Creswell, 2003:204).

3.5.2 Transferability

It is said that the findings are transferable when they fit into a similar context outside the project (De Vos, 1998:349). This method is used to determine whether the findings apply to similar situations. In the case of my study, which is based on the computer laboratory in a school for all grades, the techniques that I have used can be repeated in a similar situation where Grade One learners are to work on a computer work station of the same dimensions as in a school in Gauteng.

3.5.3 Dependability

Dependability also refers to whether the findings of the research would be consistent if the study were repeated with the similar subjects in a similar context (De Vos, 1998:350). Lincoln and Guba (1985:296) suggest that there cannot be credibility without dependability. They also propose the inquiry audit as one measure that can be used to enhance dependability of the research findings. The same documentation used for determining credibility will be used for this purpose. We say that research findings are transferable when they fit into contexts outside the study situation. The degree of transferability is determined by the degree of

similarity or “goodness of fit” between the two contexts (De Vos, 1998:349). The ongoing check of the researcher‘s interpretation adds value to the research report.

3.5.4 Confirmability

Confirmability is the degree at which other researchers can confirm the research findings. Marshall and Rossman (1994:146) suggest that a researcher must be able to confirm his findings by keeping all collected data and documents in an organised and retrievable order to be able to make them available when the research findings are challenged. I will keep all the documents and the recordings I have gathered.

3.6 ETHICAL CONSIDERATIONS

According to Bryman and Burgess (1994:4), it is the responsibility of the researcher to ensure that during the research project, the rights and the integrity of the participants as human beings are preserved. Ethics are therefore defined here as principled behaviour when a researcher is sensitive to the rights of others. Creswell (2003:64-65) suggests that participants should not be put at any risk. This includes making the participants vulnerable because of age. If minors are to participate in a study, there has to be a consent form that is signed after the agreement to engage in the project by a participant or a guardian where a participant is a minor. Creswell recommends the following detailed to be filled in the concert form:

- Indicating that the participants have the right to withdraw from the project at any time.
- Giving a clear explanation of the purpose of the project
- Giving the layout of all the procedures to be followed during the data collecting so as to enable the participants to anticipate what will be happening,

- Making participants aware that they have the right to ask questions concerning the research project and also to have access to the results of the research.
- Explaining the benefit of the project
- Appending the signature of the participants to the consent form after the agreement has been reached.

In this project ethical issues were addressed as I first wrote a letter to the principal of the school concerned. In the letter I explained the purpose of my research. When the request was accepted and I then set a date to meet the principal and the educators so as to discuss all the procedures. I assured them of the anonymity and confidentiality of the school when participating and that the information gathered would only be used for the purpose of this research and not for any other endeavours. I also promised to let them know of the findings made during interviews and observations for them to verify their contribution. This would be done by giving participants transcripts, before the information volunteered is used. Merriam (1998:199) defines this as building confidence in the investigation conducted and the results the investigation yields. I explained that a letter to the learners' parents would have to be written through the school. We then, together with the school principal, wrote the letters to the learners' parents. I attached a consent form to those letters for the parents to sign allowing learners to participate. Henning et al (2000:73) states that before the interviewees take part in the project, they have to sign letters of consent. I also drafted a consent form on which the educators signed to indicate that they were not obliged to be part of my research project. I explained that I would be using a recorder during interviews to ensure that I do not leave out any information that I might not be able to record during interviews and a video camera to help me with the information that I may not be able to see during my observations.

3.7 SUMMARY

In this chapter I have discussed the research approach and design as a qualitative case study; interviews. Literature review, observation, and taking measurement as

the methods used to collect data, the role of the researcher; trustworthiness of the study; how data will be analyzed and ethical considerations to be followed during this study. In the next chapter I will provide a data analysis of the study.

CHAPTER FOUR

FINDINGS: GRADE ONE LEARNERS' INTERACTION WITH THE PHYSICAL COMPUTER ROOM ENVIRONMENT

4.1 INTRODUCTION

In chapter three I provided an explanation of the research design and approach, and the ways in which I collected data. I provided a detailed description of how I would analyze data and included an example of a framework table to be used. The purpose of this chapter is to present and analyze data by comparing data collected in the computer laboratory through interviews, measurements and observations to the literature. The aim of this chapter is to establish how the educators', the learners' and the researcher's experience those issues related to ergonomics in the computer laboratory in the Gauteng school that was the research site for this study.

The findings that are reported here are presented after interviews with two educators at the selected school, observation of the learners that were using the school computers and conversations with some of the learners.

4.2 EVIDENCE MAP

Table 4.1 indicates in tabular format what data were collected for the purposes of this study, and where supporting evidence can be found in the appendices that are attached to this report.

Table 4.1 mapping the evidence

Research questions	Equipment/Injuries	Literature	Interview	Observation	Measurements
			Data obtained from field		
Do learners cope with the size of the chairs in the computer laboratory? Do learners sit back or lean forward when working on the computers? Are their feet fully supported by the floor?	chair	CUErgo (2004: [online]) Barrero and Hedge (2000, [online]) Stephen (1996:9) OHCOW (1998: [Online])	Data related to chair size and shape		
			(Appendix A, line 24) Appendix A, line26) (Appendix A, line 45) (Appendix B, line 28) (Appendix B, line 30) (Appendix B, line 50)	(Appendix C, paragraph 1, line I – 6) (Appendix D picture. B & E) (Appendix D picture. G).	45cmx 37cm(seat pan)
Is the space in the working surface/ tabletops enough for learners to move comfortably? Is the height of the working surface compatible to that of the learners?	Working surface	CDC:[online], Coohs [Online]) Murrell , 1978	Data related to working surface		
			(Appendix A, line 13) (Appendix A, line 17) (Appendix A line 47) (Appendix B, line 17) Appendix B, line 21) (Appendix B, line 53)	(Appendix C, paragraph 2, line 1 – 4)	70cm x 70cm
Do learners keep their arms close to the body or away from the body whilst working on the computers? How do learners cope with the size of the keyboard?	Keyboard	OHCOW, 1998: [Online]., Dul and Weerdmeester (1993: 20),	Data related to keyboard use		
			(Appendix A, line 31) (Appendix A, line 51) (Appendix B, line 24) (appendix B, line 58) (Appendix B, line 66) (Appendix B, line 75)	(Appendix C, paragraph 3, line 1 – 9) (Appendix D, picture A).	45cm x 14cm
Do learners keep their arms close to the body or away from the body whilst working on the computers? Is the mouse easy to reach and work with?	Mouse	OHCOW, 1998: [Online].	Data related to mouse		
			(Appendix A, line 45) (Appendix A, line49) (Appendix A, line 56) (Appendix B, line 55)	(Appendix C, paragraph 4, line 1-4) (Appendix D picture. F) Appendix D picture. C),	regular

Research questions	Equipment /Injuries	Literature	Interview	Observation	Measurements
			Data obtained from the field		
How do learners cope with the positioning of the screen? Do learners have to look up on the screen (monitor) or the monitor is at their eye level. Do learners draw nearer to the monitor or leave a distance of about 30mm?	Monitor	Emmons and Wilkinson (2001: [Online]) OSHA: [online] CDC,2000[online]	Data related to the monitor		
			(Appendix A, line 53) (Appendix B, line 63) (Appendix B, line 86 & line 89))	(Appendix C, paragraph 5, line 1 – 3) (Appendix D, picture. D)	37,5cm
How is the ambience in the computer laboratory? What can be improved in the computer laboratory to make it conducive for grade one learners?	Environment	(Emmons and Wilkinson 2001: [Online]) (Rasicot, 2000:[online]) (OSHA, 2004:[online])	Data about the environment		
			(Appendix A, line 58) (Appendix A, line 60) (Appendix A line 63) (Appendix A, line 65) (Appendix B, line 68) Appendix B, line 70 (Appendix B, line 77) (Appendix B, line79)	(Appendix C, paragraph 7, line 1 – 3)	
Have you observed any signs that indicate that some learners' eyes are strained when they work on the computers? Have learners ever complained of a headache after working on the computers? Have learners ever complained Carpal Tunnel Syndrome (CTS)?, Eye strain, MSD's,	Injuries	ATIC, 2005: [online] Pleasant (1996)	Data about Strains or injuries associated with the use of computers		
			(Appendix A, line 31) (Appendix A, line 35) (Appendix A line,40) (Appendix B, line 35) (Appendix B, line 36), (Appendix B, line 43) (Appendix B, line 50)	(Appendix C, paragraph 8, line 1 – 8)	
Added category	CPU	OSHA (1998: [online])	Data about the CPU		
				(Appendix C, paragraph 6, lime 1 & 2)	

4.3 HOW GRADE ONE LEARNERS COPE WITH THE TYPE, SIZE AND SHAPE OF THE CHAIRS IN THE COMPUTER LABORATORY

According to the measurements of chairs that I took in the computer laboratory in the selected Gauteng school, the seat pan of the chair is 45cm high and 37cm wide. It was apparent to me that the chairs are too big for Grade One learners, as these learners only occupy a small area of the chair pan. See Appendix D (picture. B & E) According to CUErgo (2004: [online]) a large chair does not allow a user to be fully supported by the backrest, and its seat pan catches behind the knees. When they recline, they cannot reach the mouse or the keyboard, and when they attempt to do so they lean forward to such an extent that their backs are not supported by the backrest. Pleasant (1996), maintains the when working on the computer, the back must always be supported by the backrest.

In addition, these plastic chairs are too high for Grade One learners, as their feet do not touch the floor but dangle in the air. For the learners' feet to touch the floor, they have to stand up or perch towards the front part of the chair. OHCOW (1998: [Online]) state that in a computer laboratory, awkward posture may include perching on the edge of the chair or leaning forward. Barrero and Hedge (2000: [online]) state that when chairs are chosen for learners, they should allow them to sit with their feet fully supported by the floor. These four-legged chairs are not adjustable to different heights to allow users of different heights to use them comfortably, as they do not have adjusting devices. Nor do they have armrests required as support when using the keyboard. According to CUErgo (2004: [Online]), the height of the chair can be fixed if only one person is using it. Stephen (1996:9) states that an ergonomically designed chair would be tried out to establish whether it will fit the shape of the user. It is also suggested that if the chair is very high and the learners' feet are not supported by the floor, foot support should be devised. It is further stated that the learners' sitting position should be such that the elbows bend to ninety degrees, with the upper arms relaxed, close to the body, and the knees no higher than the hip joint, to avoid stress on the back tissues. It is further stated that the chair should have a good backrest in order to provide lumbar support, and that "the best seated position" is when the body is in a reclined

posture of about 100-110 degrees, as sitting is not relaxed sitting. CUergo (2004:[Online]) also indicate that maintaining good posture includes making sure that the user sits back in the chair and has good back support. In addition, the feet can be placed flat on the floor or on a footrest.

In addition to the personal observations that were made, interviews and conversations with teachers and learners confirmed that the chairs were indeed not of a suitable size and height for these Grade One learners. In relation to how learners cope with the size of the chairs, the educators Indicated that they are too large for Grade One learners, and responded by saying: ”**the size of the chairs is too big and not meant for these learners”**(Appendix A, line 46), and ”**The size of the chairs is too big and not meant for these learners” (**Appendix B, line 50). “**Their feet are dangling in the air and some even prefer to stand up when working on the computer** (Appendix A, line 27) and **“Their feet are dangling in the air”** (Appendix B, line 31), also see Appendix D (picture G).

4.4 HOW LEARNERS COPE WITH THE AMOUNT OF SPACE AND THE HEIGHT OF THE TABLE/WORKING SURFACE

I noticed that the space on the working surface is not enough for them to work without disturbing each other. For instance, when they move the mouse they disturb each other**.** The amount of space on the working surface cannot accommodate additional accessories, such as a document holder for the learners, so they strain their necks when trying to read a document. CDC (2000 [Online]) state that the working surface has to be large enough to accommodate all the material to be used. The length of each workstation in the computer laboratory in a Gauteng school is about 70cm, but, according to Emmons and Wilkinson (2001: [Online]), the average working area should be about 90cm. They further state that an ideal workstation should possess furniture that is adjustable to all learners of different sizes, not “a one size fits all.” According to Murrell (1996), a human body should be allowed sufficient space at the workstation for efficient mobility, desks should be 1600mm x 800mm for children and 1200mm x 800mm for adults. The perception of the educators I interviewed was that the size of the working surface

is not enough. This is reflected in their response, which states that: "**I do not think that the working surface is enough especially that they Grade One learners are still learning to move the mouse" (**Appendix A, line 13). The other educator responded by saying: **"I think it is congested for them**" (Appendix B, line 18). I also realized that the working surface in the computer laboratory is too high for the Grade One learners, as most of their shoulders are little above the height of the working surface. The users cannot bend their arms when working on the keyboard or mouse, instead their whole arm is stretched and they appear to be uncomfortable. According to OSHA, (1998: [online]), properly designed workstations will help to prevent awkward posture, so users will not stretch to reach the equipment in the working surface. Dul and Weerdmeester (1993: 20), states that the materials, tools or machines that one is using should be within reach to avoid straining any part of the body. With regard to the height of the working surface, the educators both responded by saying that: **"The working surface is too high"** (Appendix A, line17) and (Appendix B, line 53).

4.5 COPING WITH THE SIZE AND THE POSITION OF THE KEYBOARD IN THE WORKSTATION

I have noticed during my observation that the keyboard seemed very large for the Grade One learners as they work on the keyboard with their arms kept away from their bodies. The perception of the educators is that the keyboards used in the computer laboratory are too large for the Grade One learners: "**They are big for these learners"** and **"It is big for these learners and I think they should use a smaller keyboard which has the small letters since the Grade One learners are not conversant with use of big letters**" (Appendix A, line 52) **and** (Appendix B, line 58 – 61). Dul and Weerdmeester (1993: 20), states that the materials, tools or machines that one is using, should be within reach to avoid straining any part of the body.I also realized that learners lift their shoulder in order to be able to use the keyboard. They seem to struggle to locate letters on the keyboard and also bend their heads onto the keyboard, especially when they have to write in lower case. Educators also witnessed that and responded by: "**They draw too near to the keyboard, it seems that the alphabets are not big enough for them to see and**

a smaller keyboard which has the small letters since the Grade One learners are not conversant with use of big letter" (Appendix B, line 58 – 61). They use one hand and the pointing finger to type and therefore they twist the body to press some keys on the keyboard, see Appendix D (picture A). At this level it still not easy for them to recall that when one presses a key marked with an upper case letter, if one has not also pressed the shift key or "caps lock" key, only lower case letters will appear on the monitor. I saw them turn their necks from left to right very often and asked them what they were looking for, only to discover that they were looking amongst the keys for lower case letters. It is stated that awkward posture also includes twisting of the neck and side-to-side movements (OHCOW, 1998:[Online]). I further noticed that the most learners' arms were stretched when working on the keyboards, that is, a desired angle of ninety degrees between the upper and lower arm was not formed whilst some drew very near and bent over onto the keyboards. Regarding the positioning of the keyboards educators' response was: **"Some of them reach it with ease some stretch their arms to reach it**." However, they also indicated that: "**They do not behave the same way as some draw too near to the keyboard whilst others stretch their arms to reach the mouse" (**Appendix B, line 24).

In physical terms, the keyboard used in the computer laboratory is a split keyboard, and its height is adjustable. However, since the desk is already too high for them to reach, any adjustment to the keyboard height is relatively insignificant. Occupational Health Clinics for Ontario Workers Inc, 1998: [Online] recommend that when keyboarding, the keyboard be at elbow-level. Putting the keyboard on an adjustable slope prevents the wrists from being stressed.

4.6 HOW LEARNERS COPE WITH THE SIZE AND THE POSITION OF MOUSE

I have realised that some learners find it difficult to use the mouse, as their hands are smaller than the mouse. According to Healthy computing [Online] the mouse that is used in an office is rather too large for young learners. It is also stated that If the users vary in size it is necessary that there be a provision for a variety of sizes

from which to choose. The educators did not have the same opinion. One said: "**It is okay**" (appendix A, line 50), whilst the other said: "**The size of the mouse is big for some of the learners as they have small hands**" (Appendix B, line 55 See Appendix D, picture. F). It also seems that the mouse is not within reasonable reach, as the learners stretch too far to reach it. Their bodies follow the direction of the mouse when they bend their bodies to the left hand side, to reach the mouse. See (Appendix D picture. C). Educators indicated that the position of the mouse seems to be far, and both participants agreed that learners stretch too far to reach it**: "They stretch their arms too far to reach the mouse and even bend to the direction of the mouse"** (Appendix B, line 55). However, the other participant also indicated that learners do not behave the same: **"They do not behave the same way as some draw near to the keyboard whilst others stretch their arms to reach the mouse**" (Appendix B, line 66 &67). Like the keyboard, the mouse should be next to the body at elbow-level, with the elbow at ninety degrees (OHCOW, 1998: [Online].

4.7 THE VIEWING POSITION, HEIGHT, DISTANCE AND ANGLE OF THE MONITOR

Monitors in the computer laboratory are placed at an appropriate position, as they are placed in a straight line with the keyboard and the chair. Concerning the position of the monitor the first educator's opinion was that it is at the reasonable position: "**It is okay"** (Appendix A, line 53) I made a follow-up to that response to establish what the meaning was. An explanation was given that: **"The learners draw closer to the monitor with an intention to reach the keyboard, but the monitor is at a reasonable position" (**Appendix A, line 56 & Appendix B, line 62). The other educator said**: "It is okay when learners are working with enlarged letters but not with the normal font."** (Appendix B, line 91) I also realised that learners draw very near to the monitor when working on the computers. I enquired and a learner told me he needed to find letters on the keyboard: "**I draw near because I am trying to locate letters on the keyboard."** See (Appendix D, picture. D). I also noticed learned that although the monitors are not perpendicular to the windows but were facing away, there was no glare on the screens.

According to OSHA, (2004: [online]), the monitor should be put perpendicular to the windows to avoid glare. However, also noticed that some learners were scratching their eyes, and on asking what the problem was, I learned that: **“the eyes are sore.”** See, appendix D (picture.H). OSHA (2004: [online]) also stated that the monitor should be put at a reasonable distance where a user can be able to read text without straining the eyes. It is further indicated that working too close to or too far from, the monitor can be detrimental to the health of the eyes. **.”** CDC (2000: [online]) indicates that once the working surface and the chair height is properly positioned, then a monitor can be put at a viewable position.

I also realised that the monitor‘s level is very high and learners have to look up. The learners were obviously looking up and down to view the screen and the top of the screen was far above the learners’ eye level. . In response to whether the monitor is at a appropriate height and whether learners have to look up on the monitor when working on the computer, both respondents indicated that the level is too high: ”**The monitor is at a very high level for these learners as the height of the working surface is**” (Appendix A line 76) and**: “No, the monitor is not at their eye level they have to look up.** (Appendix B, line 86) According to Emmons and Wilkinson 2001:[online]), the top of the monitor screen, should be position at or slightly below the eye level. With regard to whether learners keep a safe distance both educators indicated that learners do not keep a reasonable distance between them and the monitor**: “As the learners draw closer to the keyboard to view letters, they also draw too close to the monitor”** (Appendix B, line 89). Pleasant (1996) recommends that for young people a distance of 80 to 120mm and 350 to 400mm for older people from the point of focus. He also states that the position of the object should be focused such that there is no necessity for the neck and the head to incline forward, if this happens the weight of the head will put strain on the muscles of the neck. Pleasant adds that the vision comfort and satisfactory posture depends on the on the display being located on the suitable distance from the eye.

4.8 COPING WITH THE SPACE, SIZE, LIGHTING, VENTILATION

The size of the computer laboratory in a school where I conducted the study is double a normal school classroom. Computers are installed on the other half of the

room whilst the sever room and the educator' workstation only occupy a small portion of the other half. I noticed that learners put their books on the floor. There is no shelf or cabinet where learners can put their books. The laboratory is kept clean and neat. When electricity was installed safety was considered as the wires are put away, that is they are tucked into a metal casing that runs along the wall. There is also a fire extinguisher and it is nearer the door. The door is legible but in case where there is fire and there is smoke one may not be able to locate the exit point as it is not marked. The colour of the walls is light grey and soft to the eye, it is not reflective. The material of the floor finishing and the working surface is also not reflective. The door is made of wood to dampen the level of the noise from outside the room.

The workstations in the computer laboratory in the Gauteng school are meant to be shared by two learners. The space in each work station seems not to be enough for one learner especially that Grade One learners are still learning to use the mouse. The educators felt that the space in between the workstations is not enough for learners to move freely without disturbing each other: **"Still, I feel that it is not enough"** (Appendix A, line 17). The other participant also stated that the space around each work station is not enough**: "still not enough learners can disturb each other"** (Appendix B, line 21)**.** However the space between desks is enough for educators to move freely without disturbing learners. The lighting in the computer laboratory is adequate and does not cause direct or indirect glare, that is, the light does not shine directly into the user's eyes and is nor reflected from the screens and there are blinds that hinder direct light from shining into the room. OSHA (1998: [Online]) state that the blinds should be used to cover windows to avoid glare.

The air conditioners are working properly, but I think that their position is inadequate. Although they are positioned higher on the wall, the air is directly transmitted to the computer users. With regard to the ventilation and the lights, the educators indicated that the lights and the air conditioner were in a good working condition: "**It is fine"** (Appendix A, line 59). **"I am happy that the ventilators are in a good condition and the lights are in working condition** (Appendix B, line 69&71). Emmons and Wilkinson (2001: [Online]) state that the air conditioners and

the ventilators should be at a reasonable distance from the computer users. According to OHCOW (1998: [0nline] poor air quality may result to Eye, nose and throat irritations Headache, dry mucous membranes, dry skin, mental fatigue, trouble concentrating, Nausea and dizziness and Increased incidence of respiratory infections.

However, they also indicated that the environment in the computer laboratory is not inviting for the Grade One learner: **"the atmosphere is not conducive to the Grade One learners**" (Appendix A, line 64 & 66). **"The furniture has to be made to suit not only the senior and inter - mediate phase but also the foundation phase**" (Appendix A, line 74 & 75). Emmons and Wilkinson (2001: [Online) state that a classroom that is poorly designed impacts negatively on learning "Students learn better in a well-designed classroom." The position of the CPU hinders the free movement of the learners' feet. OSHA (1998: [online]) states that there should be no hindrances under the working surface, as these restrict the movement of the user and result to inability to change posture and fatigue.

In addition one of the participants added that the language used to teach learners in Grade One is not suitable since they are not conversant with English, it being their second language: "**The language used to teach computers is also not adequate for the Grade One learners. I think that a special programme can be developed for the Grade One learners** (Appendix B. line 76 – 78).

4.9 DATA ABOUT STRAINS OR INJURIES ASSOCIATED WITH THE USE OF THE COMPUTERS

Learners in a Gauteng school where I conducted interviews and observed learners working on the computers were kept for an hour. I noticed two learners scratching their eyes, so made a follow-up on what the reason could be. I learned that the learners complained of sore eyes, see appendix D (picture H) and the other one indicated that looking for letters of alphabet in the keyboard is making his eyes sore. Regarding the question of whether they indicated signs of experiencing eye strain, the first respondent indicated that she did not notice any signs:"**Not really**"

(Appendix A, line 36 & line 39), whilst the other one indicated that there may be an eye strain: **“they draw nearer to the keyboard and it seems that the letters are not big enough”** (Appendix B, line 35). According to Infinite Innovations (2001: [online]) starring at the screen decreases the blink level and causes the eyes to dry up. Pleasant (1996:78) also indicates that visual work that is performed exceedingly close to the eye causes fatigue to the eyes. He further state that common problems are blurring of eyes, headaches, burning or gravely sensation around the eyes.

Signs of fatigue were also noticed, such as stretching ones back and legs, lifting the arms, standing up from the chair from time-to-time. I tried to make a follow-up but learners would not account for these actions. See appendix D (Picture B) In answering whether learners do complain of Muscoloskeletal Disorders (MSDs) and stress injuries (STI), the educators indicated that learners are not kept for a long period in the computer laboratory, therefore they did not notice anything. They responded by saying**: “No, because they are not kept in the computer laboratory for a long time”** (Appendix A, line 39 -40). They both indicated that they have not noticed anything and learners have not complained of any problems.

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According to ATIC (2005: [online]), Computer related injuries are divided into three main categories, that is, back pain, Repetitive strain injuries (RSI), eye strain and discomfort. RSI, also known as Musculo Skeletal disorder (MSD) or Cumulative Trauma Disorder (CTD), can result from an activity that is repeated frequently over a long period. They do not happen as a result of a single incident but accumulate as the same activity is repeated over a long period: “They most commonly affect the hands, wrists, elbows, arms, shoulders, back, or neck” (ATIC, 2005: [online]). Back pain results from an awkward posture over a long period of time and is usually caused by “ongoing posture of flexion”. This imply that when the Grade One learners can continue to work on the computer laboratory where they assume awkward posture to reach the hardware components, they may be exposed to CTDs. Coohs [Online] indicates that the materials, tools or machines that one is using, should be within reach as this causes the user to assume an awkward position and if that last for some time it result to a strain. I realized that educators

have not started instilling good working habit in learners when working on the computers, instead they are concentrating on teaching them computer skills.

4.10 CONCLUSION

According to the findings gathered though interviews, observation, measurements and literature in this study the computer laboratory in the Gauteng school is not ergonomically appropriate for Grade One learners. According to Stephen (1996:9) for a product to be ergonomic it should posses the following characteristics:-

- *The furniture and the hardware components must have been tried out to suit the user's anatomy*: - The **chairs** in the computer laboratory are too high for Grade One learners as these learners work with their feet dangling. The seat pan of the chair is too big for Grade One learners and they all perch towards the edge of the chair which result to them working without the support of the back rest. The material used for making the chairs used in the computer laboratories is plastic, they are easy to clean but the material does not allow breathing and that causes discomfort. The **working surface** is very high as a result the learner's arms do not bend their arms when working on the keyboard or mouse but stretch to reach them. This condition of high and big furniture causes strains that when the same activities are repeated would result to injuries. The **CPU** is on the floor under the working surface and hinders the free movement of the learners' feet. It is therefore evident that these learner's needs were not considered when furniture for the computer laboratory was designed developed.
- *The furniture must be adjustable to suit all height levels of the users:-* The **chair and working surfaces** do not have the adjusting devices to accommodate different users in the computer laboratory
- *The furniture and hardware components of the computer are not user friendly:* - Learners do not sit comfortably on the chair with their feet dangling hence the often stand up to relieve themselves from strain caused by not being supported by the floor or foot – rests. The sizes of the **keyboards** are also big for Grade One learners hence they work with their

upper arms stretched away from their bodies. The sizes of the keyboards affect the positioning of the mouse and make it not to be within a reasonable reach hence the Grade One learners bent towards its direction to reach it. The size of the **mouse** is big for some of the Grade One learners. The height at which the **monitor** is causes strain in the neck as learners always have to look up to the screen. The **air conditioners** in the computer laboratory transmit the air directly to the users.

- *The equipment and furniture should allow future improvements*:- The plastic chair, the working surface, the keyboards in the computer laboratories cannot be improved into ergonomic products but they may have to be replaced if guide lines for an ergonomic laboratory are followed.

4.11 SUMMARY

In answering how the aspects of the computer components and the furniture affect the experiences of the Grade One learners in the computer laboratory in a Gauteng school, I have compared the opinion of the participants, what I gathered through observation and the measurement I took in the computer laboratory with literature. I focused on the sizes and the positioning of hardware components and furniture. I also looked at the ambience of the computer laboratory and analysed other aspects of the laboratory such as the lighting, ventilation, air conditioners, the material and the colours used in the computer laboratory in a Gauteng school. In the following chapter an overview of the study, summary of findings and recommendations will be given.

CHAPTER FIVE

FINDINGS, RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

The aim of this study was to establish how aspects of the ergonomics in a computer laboratory affected the experiences of the Grade One learners in a Gauteng school which has a *GautengOnline* computer laboratory. The study created a frame of reference whereby computer ergonomics could be assessed at the research site and how it affected Grade One learners at the school. The framework was preceded by a literature review on computer ergonomics. After observation and interviews, the study recommends changes (in terms of computer ergonomics) that can be effected in the computer laboratory to accommodate even the Grade One learners.

5.2 OVERVIEW OF THE STUDY

In Chapter one, an introduction to the study and an overview of the study identified relevant aspects to this study. This included the context of change in education in general in South Africa, the expanding use of computers in South African schools, and culminated in a discussion of the E-Education policy and the *GautengOnline* project. Subsequently, a research question was constructed. The study identified a need to solve a problem that emanates from the use of a computer laboratory that has been designed not taking into account the age and the physical size of the users. In this chapter an abbreviated overview highlighted the methods that would be used to collect and analyse data. Finally, the ethical considerations related to the study were highlighted.

In Chapter two, firstly, literature was reviewed on the rationale for the integration of computers into education, and specifically South African education. Particular attention was given to the E-education policy, which is the primary driver of computer integration in public education.. Then, the *GautengOnline project was described. Some insights on the use and,* justification of computers by primary

school learners were given. Finally, the concept ‘ergonomics’ were explored as it relates to use in computer laboratories.

Chapter three presented the research design, with an explanation of the methods that would be used to collect and analyse data. It was indicated that the study is a qualitative case study and tools such as interviews, observations, and a literature review would be used. A description of how data were analysed was provided and how the trustworthiness of the study would be determined.

Chapter four documented the analysis of the data. Following collection, data were transcribed into readable material, that is, data from video, interviews and recorded observations. Data that belonged together was then colour coded and data from the field compared with that gathered through literature.

5.3 DISCUSSION OF FINDINGS

Drawing on the analysis of data in the previous chapter, a number of findings were made.

5.3.1 How Grade One learners cope with the type, size and shape of the chairs in a computer laboratory

The size of the chairs is too large and not meant for these learners, as their feet were dangling in the air when seated. They were made of plastic, a material that does not allow the skin to perspire effectively; rather sweat develops under the thighs and causes discomfort to the user. In addition, the chairs were not adjustable to suit the different heights of the learners. The backrest did not support the learners’ backs when working on the computer and the seat pan was big, hence the learners perched on the edge. Finally, the chairs did not have armrests to support the users’ lower arms while using the keyboard.

5.3.2 How learners cope with the amount of space and the level of the table/working surface

The size of the working surface was not sufficient for one learner, yet the workstation was meant to be used by two learners. As a result the working surface was congested and other accessories, such as document holders, could not be accommodated. To make matters worse, the table was too high for Grade One learners.

5.3.3 Coping with the size and the position of the keyboard in the workstation

The keyboards were too large for these learners, hence not all of them were able to work on it with ease as they worked with their hands further away from their bodies. It was also at a high level, causing them to lift their shoulders when keyboarding. The learners find it difficult to locate letters on the keyboard, and they had to turn their heads frequently from left to right to locate them. It seems that the letters on the keyboard were not legible enough for the Grade One learners, because they drew their eyes very close and bent their heads onto the keyboard to view letters.

5.3.4 How learners cope with the size and the position of mouse

The mouse was too large for some of the learners, as their hands were small and unable to comfortably move it and click. Also it was not within reasonable reach, so when they moved it around they had to bend with their upper body to follow its movement.

5.3.5 The viewing position, level, distance and angle of the monitor

The monitor was in a reasonable horizontal position but at a very high vertical level, meaning that, combined with the low chair height, and diminutive stature of

the user, the top part of the screen was not at the learners' eye level and so they had to draw too close to it. Not only did this make computing difficult, it also strained their necks and might be potentially harmful to their eyesight.

5.3.6 Coping with the space, size, lighting, ventilation

The space between the workstations was not enough, so learners tended to be cramped and unable to work comfortably. In terms of the environment, ventilators and air conditioners were in good working condition but not positioned in the right place, so that the air was transmitted directly to some of the computer users rather than being spread evenly around the room. This condition could be detrimental in both cold and warm conditions. The position of the CPU under the working surface hindered the free movement of the learners' feet. The learners pile their books on the floor as there are no shelves or cabinets to put them. In terms of safety, there was no legible exit mark for learners to be able to identify the door in the eventuality of fire. A fire extinguisher was present and clearly marked.

5.3.7 Indicators of strain or injury associated with the use of computers

A number of indicators pointed to use that could potentially cause strain or injury to the users:

5.3.7.1 *Vision:* Learners indicated that they might be experiencing eye problems by scratching their eyes and drawing closer to the monitor;

5.3.7.2 *Fatigue and discomfort:* There were signs of tiredness and discomfort as the learners were stretching limbs and legs; lifting their arms; standing up from time-to-time. Teachers did not seem to encourage good working habits related to computer use like stretching, flexing and resting the eyes.

5.3.7.3 *Back pain:* Learners stopped working at some stage, leaned back and stretched their backs as though they were feeling strained.

5.4 LIMITATIONS OF THE STUDY

The limitations of this study pertain to two issues. Firstly, the study is a case study. Secondly, the primary objects of the investigation are Grade One learners, who may not have the language skills to articulate their experiences. These two limitations are now discussed.

Although the results of my study may not be generalized to suit a similar situation because of it's nature as a case study, (a particular computer laboratory in a Gauteng school), the findings may hold true for all the *GautengOnline* computer laboratories since they are installed by the same consortiums and the specifications are the same. The study was conducted in one school and the interviews were conducted with only two educators. I could not conduct interviews with the Grade One learners because of their ages, and it would have been difficult for them to articulate their experiences. There were instances where I observed certain behaviours and when I made a follow up, the learners were not able to account for them. Although I had met them the day before the observation took place and tried to familiarize them with me, I felt that my presence made them a little tense, and hence they were not free enough to tell how they were experiencing aspects of the computer hardware and furniture. The learners were not yet conversant with the use of computers.

5.5 OPPORTUNITIES FOR FURTHER STUDY

Based on this study, a number of areas provide opportunities for further study:

- In terms of the working environment, research into the language used as a medium of instruction for the Grade One learners in the computer laboratory is important. Such factors as the alphabet and vocabulary within different languages, and their relation to placing on the keyboard may be significant.
- With regard to inclusion in the computer laboratory, research may be done into facilities for learners with impaired sight, for example with the use of Braille keyboards.
- Teaching typing skills to curb the strains associated with so-called "hunt 'n peck" typing, as the learners' hands are too small to "touch type".

- Sustenance and maintenance of the computer laboratory when a technical teacher is not available to oversee it.

5.6 RECOMMENDATIONS

Arising from my study is a number of recommendations that are identified below.

For Grade One learners to be comfortable on the chairs in the computer laboratory, footrests can be developed by the school, to give full support to the learners' feet. Cushions can also be made to be used as either a support for the back or for sitting on, to boost the learners' height and enable them to work comfortably at the height of the working surface in the computer laboratory. Since the chairs are made of plastic, the cushions may be made of a material that would allow adequate epidermal respiration. Alternatively, adjustable chairs which have countered backrests and armrests that are detachable and made of material that allows the skin to 'breathe' would be adaptable for all users. Adjusting to the chair's height will enable learners to be comfortable with the working surface height.

The amount of space in the working surface can be maximized by replacing the current monitors with the new flat screen monitors that have recently been provided by *GautengOnline* to some schools in Gauteng for administration purposes.

Each workstation can be allocated two keyboards of different sizes, that is, the smaller keyboard for smaller users and the standard size one. Two contrasting colours, other than black and white or grey and white for letters on the smaller keyboards, can be used to help the learners to be able to locate the letters with ease. The provision of a smaller keyboard can not only allow the user's hands to spread over the keys, but will also enable the mouse to be within reasonable reach. Each workstation can be allocated a smaller mouse and a standard size one to accommodate users of different physical dimensions.

The furniture has to be made to suit not only the senior and intermediate phase learners, but also the foundation phase learners. Air conditioners must be

positioned in such a way that air is not directly transmitted to the computer users. The CPU must be removed from the floor. A metal casing that can lift a “tower” CPU from the floor can be used to allow more space under the working surface. A school can also make shelves that can be used as the learners’ book shelves in order to avoid the pilling of books on the floor. There should be a legible mark on the door to clearly indicate the exit, as is required by safety standards.

The educators, learners and all the computer users should be aware of computer ergonomics. Finally, computer Ergonomics can be incorporated into the curriculum as a theme to inculcate safe working behaviours that would not result in strains and injuries.

5.7 FINAL WORD

According to the findings of this study, the *GautengOnline* computer laboratory is not conducive to use by the Grade One learners. In particular, it poses a risk to the Grade One learners’ health. Emmons and Wilkinson (2001: [Online]) state that “learners learn better in a well designed classroom.” The hardware components and the furniture that is not compatible to the Grade One learners do not only threaten their health but also impact negatively on their learning. However, all the learners and educators should be aware of computer ergonomics, whether through its inclusion on the curriculum or through education programmes aimed at all computer users. Dockrell (2003 [Online]) points out that ergonomics is a critical component of the learning process. Parents, learners, educators and the computer industry itself should be aware of the risks associated with the use and potential misuse of computers, so as to improvise and come up with the devices that can supplement what the *GautengOnline* has provided already.

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APPENDIX A: Interview with educator A

Key Question: How do the Grade One learners experience the aspects of the computer hardware and the furniture in the computer laboratory in a Gauteng school?

8. INTERVIEWER: How would you describe the learners' motivation towards the
9 use of computers?

10. RESPONDENT: They are very much happy

11. INTERVIEWER: Is the space in the working surface/ tabletops enough for
12. learners to move comfortably?

13. RESPONDENT: I do not think it is enough especially that they are still learning
14.. to move the mouse.

15. INTERVIEWER: Is there adequate space between each workstation for
16. learners to move around comfortably

17. RESPONDENT: Still, I feel that it is not enough.

18. INTERVIEWER: Would you say that the learners are able to reach the
19. keyboard and mouse with ease?

20.RESPONDENT: They do not sit comfortably and some prefer to stand up in
21. order to reach the mouse and the keyboard with ease.
22. INTERVIEWER: Do learners sit back or lean forward when working on the
23. computers?
24. RESPONDENT: They lean forward.

25. INTERVIEWER: Does the floor support the learner's feet when they are sitting
21. on the chairs? If not what do you think could be the reason?

26. RESPONDENT: Their feet are dangling in the air and some even prefer to
27. stand when working on the computer.

28. INTERVIEWER: Have you observed any signs that indicate that some learners'
29. eyes are strained when they work on the computers? / Have you ever noticed
30. them scratching their eyes whilst working on the computer or afterwards?

31. RESPONDENT: They draw to near to the keyboard , it seems that the
32. alphabets are not big enough for them to see.

33. INTERVIEWER: Have learners ever complained of a headache after working
34. on the computers?

35. RESPONDENT: Not really.

36. INTERVIEWER: Have learners ever complained Carpal Tunnel Syndrome
37. (CTS)?

38. RESPONDENT: I have not noticed anything.

39. INTERVIEWER: Have learners ever complained of Musculoskeletal Disorders
40. (MSDs) or repetitive Stress Injuries (STI)?

41. RESPONDENT: No.

42. INTERVIEWER: How do learners cope with the following aspects in the
43. working station:

44. The size of the chairs

45. RESPONDENT: The size of the chairs is not meant for these learners
.
46. The height of the working surface

47. RESPONDENT: The working surface is too high.

48. The size of the mouse

49. RESPONDENT: It is okay

50. The size of the keyboard

51. RESPONDENT: It is big for these learners.

52. The position of the screen

53. RESPONDENT: It is okay.

54. INTERVIEWER: Do learners keep their arms close to the body or away from
55. the body whilst working on the computers?

56. RESPONDENT: They stretch their arms too far to reach the mouse.

57. INTERVIEWER: How would you describe ventilation in the computer
laboratory?

58. RESPONDENT: It is fine.

59. INTERVIEWER: Is the light in the computer laboratory sufficient?

60. RESPONDENT: It is adequate

61. INTERVIEWER: Are there any other problems that you identified? If so, what
62. have you done about them?

63. RESPONDENT: The atmosphere is not conducive for the Grade Ones

64. INTERVIEWER: How would you describe ambience in the computer
65. laboratory?

66. RESPONDENT: The atmosphere is not condusive for the Grade Ones.

67. INTERVIEWER: The last time I asked you about the position of the screen you
68. said it is okay, I just need to establish exactly what you meant by that.

69. RESPONDENT: The learners draw closer to the monitor with an intention to
70. reach the keyboard, but the monitor is at a reasonable position.

71. INTERVIEWER: What do you think can be improved in the computer laboratory
72. to make it conducive for Grade One learners?

73. RESPONDENT: The furniture has to be made to suit not only the senior and
74. inter - mediate but also the foundation phase.

75. INTERVIEWER: Do learners have to look up on the screen (monitor) or the
76. monitor is at their eye level.

77. RESPONDENT: The monitor is at a very high level for these learners as the
78. height of the working surface is.

79. INTERVIEWER: Do learners have to look up on the screen (monitor) or the
80. monitor is at their eye level.

81. RESPONDENT: The monitor is at a very high level for these learners as the
82.height of the working surface is.

APPENDIX B: **Interview with educator B**

Key Question: How do the Grade One learners experience the aspects of the computer hardware and the furniture in the computer laboratory in a Gauteng school?

10. INTERVIEWER: How would you describe the learners' motivation towards the
11. use of computers?

12. RESPONDENT: What do you mean?

13. INTERVIEWER: Are they interested in coming to work on the computers?

14. RESPONDENT: Yes they are

15. INTERVIEWER: Is the space in the working surface/ tabletops enough for
16. learners to move comfortably?

17. RESPONDENT: I think it is congested for them.

18.INTERVIEWER: Is there adequate space between each workstation for
19. learners to move around comfortably?

20. RESPONDENT: Still, I feel that it is not enough learners can disturb each
21. other.

22. INTERVIEWER: Would you say that the learners are able to reach the
23. keyboard and mouse with ease?

24. RESPONDENT: Yes, but they do not behave the same, some of them reach it
25. with ease some stretch their arms to reach it.
26. INTERVIEWER: Do learners sit back or lean forward when working on the
27. computers?

28. RESPONDENT: They lean forward.

29. INTERVIEWER: Does the floor support the learner's feet when they are sitting
30. on the chairs? If not what do you think could be the reason?

31. RESPONDENT: Their feet are dangling in the air.

32. INTERVIEWER: Have you observed any signs that indicate that some learners'
33. eyes are strained when they work on the computers? / Have you ever noticed
34. them scratching their eyes whilst working on the computer or afterwards?

35. RESPONDENT: They draw to near to the keyboard; it seems that the
36. alphabets are not big enough for them to see.

37. INTERVIEWER: Have learners ever complained of a headache after working
38. on the computers

39. RESPONDENT: No, because they are not kept in the computer laboratory for a
40. long time.

41. INTERVIEWER: Have learners ever complained Carpal Tunnel Syndrome
42. (CTS)?

43. RESPONDENT: I have not noticed anything.

44. INTERVIEWER: Have learners ever complained of Musculoskeletal Disorders
45. (MSDs) or repetitive Stress Injuries (STI)?

46. RESPONDENT: No.

47. INTERVIEWER: How do learners cope with the following aspects in the
48. working station?
49. The size of the chairs

50. RESPONDENT: The size of the chairs is too big and not meant for these
51. learners.

52. The height of the working surface

53. RESPONDENT: The working surface is too high.

54. The size of the mouse

55. RESPONDENT: The size of the mouse is big for some of the learners as they
56. have small hands.

57. The size of the keyboard

58 RESPONDENT: It is big for these learners and I think they should use a
59. smaller keyboard which has the small letters since the Grade One learners are
60. not conversant with use of big letter.

61. The position of the screen

62. RESPONDENT: It is okay when learners are working with enlarged letters but
63. not with the normal font.

64. INTERVIEWER: Do learners keep their arms close to the body or away from
65. the body whilst working on the computers?

66. RESPONDENT: They do not behave the same way as some draw near to the
67. keyboard whilst others stretch their arms to reach the mouse.

68. INTERVIEWER: How would you describe ventilation in the computer

69. laboratory?
70. RESPONDENT: I am happy that the ventilators are in a good condition.

71. INTERVIEWER: Is the light in the computer laboratory sufficient?

72. RESPONDENT: It is adequate

73. INTERVIEWER: Are there any other problems that you identified? If so, what
74. have you done about them?

75. RESPONDENT: I feel that there can be computers that can be designed for
76.these learners, which have keyboards that have big and small letters. The
77. language used to teach computers is also not adequate for the Grade One
78. learners. I think that if a special programme can be for the developed Grade
79. Ones

80. INTERVIEWER: How would you describe ambience in the computer
81. laboratory?

82. RESPONDENT: The atmosphere is not conducive for the Grade Ones

83. INTERVIEWER: The last time we spoke about the position of the monitor
84. (screen) you indicated that it is okay. Do you think that it is at a reasonable
85. height for the Grade One learners to view it at an eye level?

86. RESPONDENT: No, the monitor is not at their eye level they have to look up.

87. INTERVIEWER: Do learners keep a safe or a reasonable distance between
88. them and the monitor (screen)?

89. RESPONDENT: As the learners draw closer to the keyboard to view letters,
90. they also draw too close to the monitor

APPENDIX C: Observation data

- **Chairs**:-They are plastic chairs and they seem very big and high for Grade One learners as the learners do not occupy the whole space, when learners try to sit properly, they have to stretch arms to reach the mouse or the keyboard. The learners' feet do not even touch the floor when seated, for their feet to touch the floor they have to stand up or perch towards the front part of the chair.

- **Table/Working surface:-**The working surface in the computer laboratory is very high for the Grade One learners as most of their shoulders are at the same level with the working surface. They can not even bend their arms when working on the keyboard or mouse, instead their whole arm is stretched.

- **Keyboard**:-It is also at a high position as the working surface is high. They also seem big for these learners as they work on the keyboard with their arms kept away from their bodies. They seem to struggle to locate letters on the keyboard and they also draw very near the keyboard especially when they have to write in small letters. At this level it still not easy for them to recall that when you press this capital letter on the keyboard small letters will be typed. I saw them turn their necks from left to right .I asked them what they were looking for and discovered that they were looking for the small letters.

- **Mouse**:-Some learners find it difficult to use it as their hands are smaller than the mouse. They also stretch to far to reach it as their bodies follow the direction of the mouse, that is, they bend their bodies to the left hand side where the mouse is.

- **Monitor**:-Learners draw very near to the monitor. I was told that they draw near because they try to locate letters on the keyboard, The monitor‘s position is obviously very high and learners have to look up.

- **CPU**: - I noticed that the CPU in the computer laboratory is obstructing learners ‘ movements on the floor.

- **Environment**:-From my observation the environment is not inviting, Grade One learners in a computer laboratory seem like miniatures in the office desks. The space between the workstations was not enough, so learners tended to be cramped and unable to work comfortably. In terms of the environment, ventilators and air conditioners were in good working condition but not positioned in the right place, so that the air was transmitted directly to some of the computer users rather than being spread evenly around the room. This condition could be detrimental in both cold and warm conditions. The position of the CPU under the working surface hindered the free movement of the learners’ feet. The learners pile their books on the floor as there are no shelves or cabinets to put them. In terms of safety, there was no legible exit mark for learners to be able to identify the door in the eventuality of fire. A fire extinguisher was present and clearly marked.

- **Strains and injuries**: - I noticed two learners scratching their eyes. I then made a follow up on what the reason could be and the learners complained of sore eyes. Signs of fatigue were also noticed, such as stretching ones back and lifting the arms. I tried to make a follow up but learners would not account for these actions. Learners work with their hand stretched far from their bodies.

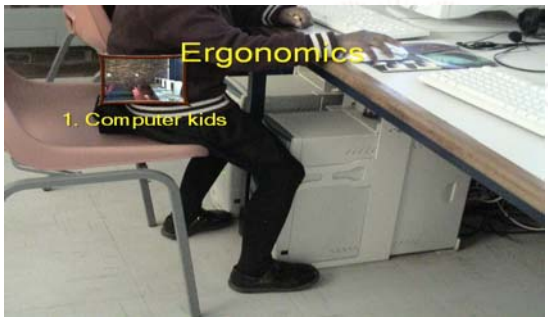
APPENDIX D: Pictures that display certain aspects in the computer laboratory.

Picture A: Use one hand to type

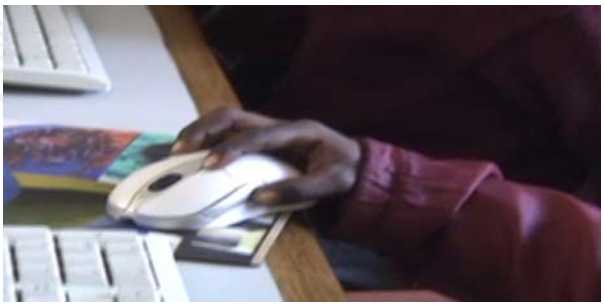
Picture B: stands up from time to time

Picture C: stretches to reach the mouse

Picture D: draws near the keyboard

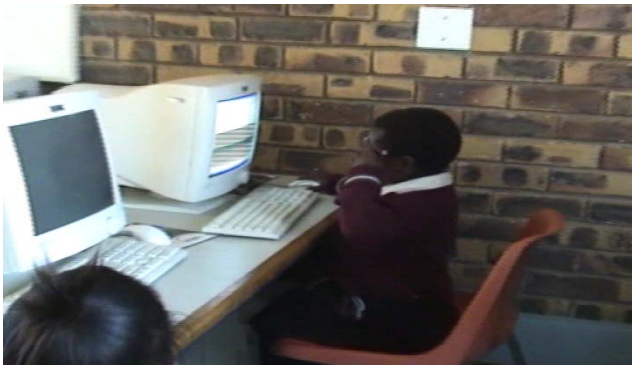


Picture E: the feet are destructed by the CPU



Picture F: The hand is small

Picture G: the legs are dangling in the air.



Picture H: scratches the eyes from time to time

APPENDIX E: Consent letter and receipt

18 August 2005

The Principal

Dear Madam

RE: PERMISSION TO CONDUCT RESEARCH AT YOUR SCHOOL FOR THE MASTERS DEGREE MINI - DESSIRTATION.

I am embarking upon a research project on "How the aspects of computer ergonomics affect the experiences of the first grade learners in a Gauteng School, This is a one year study. I therefore request permission to utilize your school as a site for the project.

I am aware that the GDE has to approve the collaboration between the school and the researcher/s. This letter serves as a preliminary request document if research can be conducted at your school, a more comprehensive document with all details of the project can be presented to you at your request. At this stage the following is kindly requested:

- a letter granting permission to conduct research at your school (provided that permission is granted by the GDE for this provincial project);
- a date and initial meeting between yourself and me as researcher.

Yours faithfully

.....

S.R Ngcapu (Mrs.)

Researcher: Med Student

The Research Supervisor: Professor D Van Der Westhuizen

Contact Numbers: 082 809 1953

(011) 489 3236

I, the undersigned, Mlobela F.T ..... do hereby indicate that I have read and understood the aim and the reasons for undertaking of the above – mention research study. I hereby give my written consent to Ngcapu Sibongile R, to continue with the inquiry of the study.

Signed F.T Mlobela ..... Date 5/03/06 .....