BINDURA UNIVERSITY OF SCIENCE EDUCATION

DEPARTMENT OF EDUCATION

FACULTY OF EDUCATION

AN INVESTIGATION ON THE IMPACT OF INFORMATION COMPUTER TECHNOLOGY(ICT) AIDED INSTRUCTION HAS IN THE TEACHING AND LEARNING OF ORDINARY LEVEL MATHEMATICS AT MKWABENE HIGH SCHOOL IN INSIZA SOUTH MATEBELAND SOUTH PROVINCE.

BY

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A PROJECT SUBMITTED TO BINDURA UNIVESITY OF SCIENCE EDUCATION IN PARTIAL FULLIMENT OF THE REQUIREMENT FOR THE BACHELOR OF SCIENCE EDUCATION HONOURS DEGREE IN MATHEMATICS.

2018

RELEASE FORM

BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF EDUCATION

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TITLE : An investigation on the impact of information computer technology(ICT) aided instruction has in the teaching and learning of ordinary level mathematics at Mkwabene high school in Insiza south Matebeland south province.

DEGREE PROGRAM : Bachelor of Science honours degree in mathematics

YEAR GRANTED : 2018

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DECLARATION

I, Hebert Meluleki Bhebhe declare that this research project for the Bachelor of science honours degree in Mathematics at Bindura University of science education is my own in design and execution. I further certify that the document has not been presented for a bachelor of science Education in mathematics to this university or other University faculty.

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ABSTRACT

This study is meant to investigate the impact of ICT aided instructions in the teaching and learning of mathematics at O level at one of the High schools in Insiza District .4w pupils were considered in research. The research sampled 20 pupils from a total of 45pupils Four teachers were also part of the sample population. Data was collected in forms of observations, interviews, questionnaires and tests. The data collected was analysed using tables, bar graphs and pie charts. The researcher used the chi-square tests in some areas to check for an association between variables. Sample of 20 pupils were tested using the pretest and post-test. On pre-test they did not perform well, however, after the use ICT tools,majority of the students managed to pass. The research findings indicated that the use of ICT tools improves learning and teaching of mathematics at high school. It is therefore important for schools to buy adequate ICT tools so that every teacher can use them in their lessons.

ACKNOWLEDGEMENT

Firstly, I wish to sincerely acknowledge the assistance, consideration and encouragement given to me by my project Supervisor Mr Ndemo whose approachability and fatherly assistance contributed immensely to the success of this research study.

Secondly, I also wish to express my grateful appreciation to my family members especially my father and mother (Mr A Bhebhe and Mrs G Bhebhe) as well as my young brother and my lovely daughters Nobukhosi Bhebhe and Tracy Bhebhe for their unwavering material support and prayerful support.

Thirdly, my colleague Mr M zvokureva (workmate) is thanked for his professional and moral support and editing my project. I cannot forget my college mate Mandlenkosi Ngwenya ,Priscilla Mpofu and Salani Ncube for information support and encouragements.

Finally, I wish to thank all those I haven't mentioned by names who offered encouragement and assistance enabling me to bring this work to function.

DEDICATION

The project is dedicated to my father Air force Bhebhe , my Mother Gladys Manyathela and my daughters Nobukhosi Bhebhe and Tracy bhebhe for their inspirational support

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CHAPTER 1

1.0 INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Mathematics has been there since time immemorial and ancient people used it to calculate the position of the sun, counting their possessions or even the months and years. Mathematics is all around us in our daily lives it is a part of everything that we do in our lives from the simple, like

buying things at the shops, in reading time, counting and sports or the complex like engineering. This is supported by Ojose (2011) when he says that Mathematics is very important in our daily lives since it deals with real life situations in our daily activities. The introduction of the education system incorporated mathematics into the world education curriculum in general and Zimbabwean in particular, following the inevitable role it has played in the ancient society. According to Umamer (2011), education in mathematics is the bedrock and an indispensable tools for scientific technological and economic advancement of any nation. It is for this reason that mathematics is now compulsory for most employment opportunities. Regardless of the importance of mathematics, learners continue to fail the subject.

In an effort to advantage both pupils and teachers the government of Zimbabwe 2000 localised examinations by introducing a new board ZIMSEC under which all examinations are now run. The government wanted to curtail foreign currency costs, utilising the existing Professionals and more importantly to expose the pupils to something more related to their nation. Surprisingly the pupils have continued to underperform in mathematics.

The examination board has since not ceased amazing people with reports of low pass rates in

Mathematics, the situation is more pathetic in the rural schools. It is by this reason that the

Minister of Education has called for every teacher to have teaching qualifications for example,

Post Graduate Diploma in Education (PGDE), in a bid to curb the under performance in the

Education system. Mathematics workshops and seminars are being conducted in anticipation

of yielding some changes in the quality of results. The rapid growth of information computer technology aided instruction have brought remarkable changes in the twenty-first century, as well as affected the demands of modern people. Computer aided instruction is becoming increasingly important in our daily lives and in our educational system, therefore, there is a growing demand on educational institutions to use computer aided instruction to teach the skills and knowledge students need for the 21st century in Zimbabwe. The recent diffusion of new information computer technology naturally raised some discussions about the effect of computers on the "how and what" of teaching mathematics at Ordinary level in Secondary Schools. This introduction of new technologies has brought on many changes in contents,

strategies and attitudes in education. A key aspect of the use of computer aided instruction an aid to learning mathematics is its possibility of presenting the subject in an interactive form. The computer technology is unarguably the commonest means of communication, which play a pivotal role in extending the possibilities for teaching and learning in mathematics.

There is substantial evidence at Mkwabene high school in insiza District that teachers and pupils are not using computers in their mathematics lessons at Ordinary level. The parents and politicians firmly established that its introduction into High Schools in the District does not by itself improve the quality of education or raise attainment because schools are not implementing it. The government also saw the need of computer aided education in High Schools by donating computers. Effectively introduction of information computer technology into schools is also largely dependent upon the availability and accessibility of computer aided instructions. Resources like hardware, software and communications infrastructure. Zimbabwe has an Information and Communication Technology (ICT) Policy requiring all school and college students to be exposed to computer skills (Government of Zimbabwe, 2004). ICT literacy skills have assumed to important in today's world, especially for teachers who have the responsibility for preparing the nation's children for a future dominated by ICT technology.

Modern learning theories emphasize the importance of constructivism when incorporating ICT in teaching and learning. Constructivist based learning is seen as a building process in which learners have an active role and obtain new knowledge by constructing it on the basis of previously acquired knowledge. Regardless of the classroom setting, a major concern of those who teach mathematics

at Ordinary level is how to ensure that the students understand mathematical ideas and able to apply what they learn in real world situations. A pragmatist philosopher John Dewey cited in Child, (2012) advocates that education is not a preparation for life but is life itself. This implies that what is taught in the classroom should reflect what is out there.

The lack of computer aided instruction in mathematical lessons in the district is rendering problems to teachers, students, government, commerce and industry. Therefore the researcher finds it fruitful to students, teachers, administrators, community, policymakers and the whole nation to research about impact of computer aided instruction in teaching and learning mathematics at Ordinary level at Mkwabene high school in Insiza District.

1.2 STATEMENT OF THE PROBLEM

This study will make an investigation on the impact of information computer technology aided instruction has in the teaching of mathematics at Ordinary Level at Mkwabene high school in insiza district matebeland south Province

1.3 RESEARCH SUB QUESTIONS

1.1.1 Why are the teachers not embracing ICT in the teaching and learning of Mathematics since it is more appealing to the pupils compared to the traditional methods of teaching?

1.1.2 Is the use of ICT in teaching Mathematics consistency with the topic being taught ?

1.1.3 Will ICT help pupils to improve their understanding of Mathematics?

1.1.4 Does ICT change the attitude of pupils towards the subject?

1.4 Hypothesis Test

H° = ICT changes the performance of pupils in mathematics

H^{1} = ICT does not change the performance of pupils in mathematics.

1.4 Objectives of the study

1.4.0 To give an insight into the merits of using ICT in teaching and learning of Mathematics at O level

1.1.5 To promote the use of ICT in the teaching and learning of Mathematics

1.1.6 To stimulate confidence in the pupils to learn Mathematics

1.1.7 To improve the learning atmosphere in the classrooms

1.1.8 To give pupils the opportunity to use ICT while learning Mathematics

1.1.9 To find the best ways of using ICT in enhancing pupils' understanding of Mathematics

1.5 SIGNIFICANCE OF THE STUDY

The study will give an insight into the use of ICT in teaching of mathematics, its benefits to both the teacher and the pupils. It will also give feedback of knowledge about learning and applying ICT as a teaching tool in mathematics. The results of the study is expected to be useful to

(i) students and

(ii) teachers.

1.5.1 Students

The use of ICT will help pupils to understand the concept of Mathematics much easier as well as to elicit pupils' knowledge to go into real situations. It will also help pupils to visualise on the concepts taught and this will enhance pupils' knowledge on the subject. ICT is more appealing and stimulates the interests of the pupils and makes the subject more enjoyable.

Students sometimes give right answers for wrong reasons or wrong answers may be the result of rational thinking (Pubinky and Tall 1993).This statement is a brief summary of the new paradigm of learning. Learning can occur by giving the student the opportunity to construct their own knowledge. This could be provided by rich information computer technology environments in making abstract ideas more concrete. The computer promotes the minds of the children, causing a shift from concrete to abstract, iconic to symbolic (Kelly,1984). Computers also assist the child to develop abstract modes of learning to learning to direct them to higher levels of conceptual understanding. Through design, coding and revision and debugging of a new computer program students can have an opportunity to develop higher mental skills such as deductive reasoning and problem solving. Therefore it becomes more critical to incorporate computer programming into existing mathematics curricula .Children should be actively engaged into the activities which they

are exposed to (Kelly 1984). In that way the learners can use a computer in the positive sense. As opposed to passive learning which is enhanced by the readymade packages, the student can have better learning experiences.

1.5.2 Teachers

Teachers are to benefit from this research findings. Use of technology makes ideas tangible, teachers can move easily. This research is expected to be useful information and positive contributions especially in teaching Mathematics topics such as mensuration of solid shapes, functional graphs, geometrical construction and plane trigonometry which are a challenge to pupils with the help of mathematics softwares. The teachers are expected to use ICT in teaching new Mathematics concepts and other subjects in the curriculum of the school.ICT

(i)Emphasizes the connections among mathematical concepts

(ii)Connect abstractions to real world settings. The ease and speed of obtaining information from the internet definitely helps the teachers to empower themselves. It gives teacher the opportunity to gain more information about the topic he is teaching. He can learn current methods in teaching from other countries that may be utilized in his /her class to strengthen pupils-esteem. He can make the content more colourful and purposeful by integrating slide show and videos related to the topic. He can succefully impart education by imparting instructions, collaborative learning multidisciplinary problem-solving and promoting critical thinking skills. Technology provides different assessment tools such as check list, rating scales and rubrics to assess the 21 century skills such as creativity, problem solving, decision making and leadership skills which are criteria for project based learning .The rubrics for research report document, power point presentation, role play helps the user.

1.6 DELIMITATIONS

The researcher is teaching three classes 4e and 4w at Mkwabebene High School but the study will be conducted in 4w because they seem to have a challenge in grasping the concepts being taught.Interviews for both teachers and the pupils would be conducted.Pre and post-test questions for pupils to analyse the impact of using ICT on teaching Mathematics

The researcher will focus on the topic of mensuration of solid shapes, functional graphs and geometrical transformation because pupils had the notion that the topics are difficult.

1.8 LIMITATIONS

1.7.1 Finance -financial constraints will pose an adverse impact on the research results .The researcher will not be able to cover printing costs.

1.7.2 |Time -Considering that the researcher has only few months to submit his project time is going to be limitation. A research requires ample time if results are to be more sound. As a result the researcher will make use of weekend days and request for permission to conduct his the research.

1.7.3 Internet Services: The researcher resides in a rural set up and as a result internet services such as Wi-Fi are not available internet services are required to access information, the researcher will therefore make use of his smart phone.

1.7.4 Computer illiterate by math's teachers. There are some computer illiterate math's teachers who are supposed to integrate computer aided education in their teaching. This is a major challenge to the researcher in her findings .It will be very difficult to get genuine results from such teachers

1.8 Ethics

Permission will be sought from the head to conduct the research at the school. Permission will also be sought from the ministry of primary and secondary education. The respondents will not be asked to write their names on the questioners so as to maintain confidentiality.

CHAPTER 2

LITERETAURE REVIEW

2.0 Introduction

This chapter will cover the literature review on use of ICT tools in the teaching and learning of mathematics. Information is processed data. Communication is a two way process of sending information between two people (Bates, 2000). Koontz and Weihrich (1980: 688) define communication as ‘’ the transfer of information from the sender to the receiver with the information being understood by the receiver.” Bruce (2003; 132) says communication is ‘’ the transmission and reception of a message or idea from one party to another in such a fashion that it is mutually understandable. Bates (2000) define technology as tools, techniques, equipment and machines that help people to pass information from a teacher to student in a classroom. These technologies include computers, the internet, broadcasting technologies (radio and television), and telephone. Hernes (2002) define Information and Communication Technology as an umbrella term that includes information and communication devices or applications. These encompasses, radios, telephones, cell phones, computers and network hardware and software, satellite systems and the various services and applications associated with them such as video conferencing and distance learning

Mathematics instruction is among the most explored research area in education. There have been considerably varied computer applications in instruction (Hatfield, 1984). The teachers of mathematics are confused with the extensive amount of suggestions on how to teach mathematics with a computer. According to Kasekende (2008) introduction of Information and Communication Technology is usually associated with lack of instructors. This is also echoed by Bruce (2003) who indicates that when it was introduced in African schools, planners and policy makers did not consider human resource availability within countries. It means that the introduction of ICT into schools in Zimbabwe is likely to suffer the same fate. Teachers have little or no knowledge about the new technology. On the same note, Song (2007) supports the above notion.by indicating that due to lack of human resources, maintenance of ICT equipment is very poor. The computers are exposed to various forms of viruses because they are operated by non-professionals in the field on Information Communication Technology. The introduction of ICT into schools will continue to be

less useful without benefiting both students and teachers especially if the issue of maintenance is not given a close consideration. At Hillside Teachers' College, ICT was introduced in (2011), at Bondolfi Teachers' College; it was introduced in 2008 which is evidence to show that there is still a critical shortage of human resources since the majority of teachers do not have adequate ICT knowledge. Teachers' attitudes towards computers vary mostly as a function of teachers' age or years in service. Complete 'ignorance' attitude towards computers still continues, although its magnitude is weaker compared to past years This attitude is mostly shared by teachers who had their training before the start of the computer age who have the most negative attitudes towards its pedagogical use and who insist on using the traditional modes of teaching. Second major attitude is not being able to abandon their traditional habits completely foreseeing its potential for the future of education. Most prevalent and widening attitude is the realisation and acceptance of the importance of computers for education.

There are three broad categories of the applications of computers in the field of mathematics education:

- computer assisted instruction (CAI)
- student (educational) programming
- general purpose educational tools such as spreadsheets, databases and computer algebra systems

2.1 What is technology?

Technology is the making, modification, usage, and knowledge of tools, machines, techniques, crafts, systems, methods of organization, in order to solve a problem, improve a preexisting solution to a problem, achieve a goal or perform a specific function. It can also refer to the collection of such tools, machinery, modifications, arrangements and procedures.

2.2 History of Use of Technology in Mathematics

The use of technology when studying mathematics it's not a new issue, since humankind always has been looking for solutions to avoid time consuming routine work. The use of technology has a long history in mathematics education. Starting from magic slate, book, magic lantern, Blackboard, radio, Slide rule video tape, Television, Calculator, computer, Interactive Board, Apple I pad all come under technology. Paper money and coins, beans, bears, buttons, and other

small items are helpful for counting and computation skills. Straws, grouped by tens, are great for teaching Mathematics. Geo boards are useful for introducing geometric concepts. Clinometers are useful for teaching and learning of Trigonometry. An abacus allows children to conceptualize math formulas by working with tangible objects.

2.3 Digital technologies / Information Communication technologies

For thousands of years, humans made presentations using only the tools they were born with: their voice and body. That was followed by tools such as chalkboards and projectors, and then by digital tools such as PowerPoint. More recently other tools have emerged, such as Sliderocket, Prezi, Glogster, Animoto, and Magic Magnify. Since the 1980's, the importance of computer support in the teaching and learning of mathematics has been emphasized more and more. Information and Communication Technology (ICT) is basically an umbrella term that encompasses all communication technologies such as internet, wireless networks, cell phones, satellite communications, digital television computer and network hardware and software; as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs etc. that provide access to information.

2.4 Why use technology?

According to Suppes et al. (1968) the change that was to come through computers could only be compared to how books had changed the way of people looking at the world. Computers would change the face of education in a very short period of time by eventually removing the teacher from the classroom scene. Looking in retrospect, can it really be said that his predictions were realized? Or is it just a "techno-romantism" (Underwood and Underwood, 1990) to believe that the computer is a panacea for all of the problems in education. Although not having been able to solve all of the problems of education by itself, this powerful machine, no doubt, will continue to occupy a very central place in education. `A major figure in the history of computers, besides Suppes, in education is Seymour Papert who is famous for his work "Mindstorms" (1980) which presents quite revolutionary ideas about the place of the computers in education. He, like Suppes argued that the computer would change the face of education, but unlike Suppes he advocated the use of the computer not as a teaching machine but as a device to develop learners' intellectual

skills through writing their own programs to direct the computer and not let the computer direct themselves.

It seems that the effect of computer technology on education is greater in mathematics than in any other discipline. This may be because of the close links between the two disciplines. In fact the computer science was a part of mathematics and afterwards gained independence as a sole discipline. "Our aim was to encourage far higher levels of active student engagement, where knowledge is obtained by sharing, problem-solving and creating, rather than by passive listening. This classroom enables both active engagement and equal access," by lead researcher, Liz Burd of Britain's Durham University. (2012) .Don Knezek, the CEO of the International Society for Technology in Education, compares education without technology to the medical profession without technology. “If in 1970 you had knee surgery, you got a huge scar,” he says. “Now, if you have knee surgery you have two little dots.” Einstein famously said that his pencil was more intelligent than he was - meaning, that he could achieve far more using his pencil as an aid to thinking than he could unaided. There is a need to recognize that mathematical digital technologies are the pencils of today‘ and that we will only fully exploit the benefits of digital technologies in teaching, learning and doing mathematics when it becomes unthinkable for a student to solve a complex mathematical problem without ready access to digital technological tools.

Mathematics is regarded as the queen of all Sciences. For long, the role of Mathematics was limited to purely academic domain. Now, the role of Mathematics is not restricted to purely academic domain. It has entered the domain of Technology and Industry. New fields in Mathematics such as Operation Research, Control theory, Signal Processing and cryptography have been generated which need technology. Technology can reduce the effort devoted to tedious computations and increase students’ focus on more important mathematics.

Technology can be useful to the extent it focuses student thinking in ways that are germane, not extraneous. In primary school, it is important to learn to do arithmetic fluently. Using technology to do this thinking for the student would be inappropriate. In secondary school, however, students have mastered arithmetic and should be focused on more advanced skills and concepts. Computational support can be very important. Use of technology makes Ideas tangible. Piaget discovered that children first develop ideas concretely and later progress to abstractions (Piaget,

1970). In designing learning environments, it is often helpful to apply this principle in reverse: to help students learn an abstract idea, provide them with more tangible visualizations. Researchers have found that when technology makes abstract ideas tangible, teachers can move easily (Bransford, Brown, & Cocking, 1999; Roschelle et al., 2001;diSessa, 2001)

2.5 How to use Technology as tools of Teaching

There are various types of technologies currently used in traditional classrooms. Among these are: Radio, television, audio tape, video tape, slide projector, overhead projector are of passive learning when interaction of the learner is less.

2.5.1 Computer in the classroom: Having a computer in the classroom is an asset to any teacher. With a computer in the classroom, teachers are able to demonstrate a new lesson, present new material, illustrate how to use new programs, and show new websites.

2.5.2 Mobile devices: Mobile devices such as clickers or smart phone can be used to enhance the experience in the classroom by providing the possibility for professors to get feedback

2.5. 3 Interactive Whiteboards: An interactive whiteboard that provides touch control of computer applications. These enhance the experience in the classroom by showing anything that can be on a computer screen. This not only aids in visual learning, but it is interactive so the students can draw, write, or manipulate images on the interactive whiteboard.

2.5.4 Online media: Streamed video websites can be utilized to enhance a classroom lesson. Online study tools: Tools that motivate studying by making studying more fun or individualized for the student.

2.6 Software used for teaching learning Mathematics

By tools what is meant is the computer packages by which the learner can develop his/her thinking skills. In this context the spreadsheets such as excel, computer algebra systems (CAS), the databases, communication facilities, word processing will be analysed. Those are the tools that are used in the educational computing.

There were very optimistic expectations from student programming moment. But the realization of the fact that it failed to satisfy these expectations caused a shift towards general purpose software tools such as databases and spreadsheets (Case & Walsh, 1990). As stated in the Mathematical

Association report (1992) these general purpose packages present an alternative vehicle for programming. The skill in the handling of the algorithms which is the essential parts of programming can be developed by the use of these spreadsheets and databases.

The Mathematical Association (1992) summarises different uses of spreadsheets in the mathematical curriculum. • drawing graphs comparing the graphs of $y=x^2$ and $y=x^3$ finding the second and thirds roots of numbers through iteration. Finding for instance, length of the inside edge of cubicle box given the volume numerically. • calculating the area under a curve . • introducing the function concept. For example, a set of numbers in one column and another set of numbers in another column can be represented by the symbols x and y. The function can be defined as relation between two sets of data. • solving differential equations .With the use of spreadsheets data handling can be done in a minimum amount of time and effort, allowing the students interact with the data focus on the interpretation of it. Hence, children can understand data more easily, so they can get rid of any unnecessary calculations which inhibit the learning of important mathematical concepts which are the main objectives of a mathematics lesson.

Computer spreadsheets which are readily adaptable for problem solving, can also enhance the user's insight into the development and use of algorithms and models, free students from being hampered by laborious manipulation of numbers, and allow students to see the progression of calculations on the screen as they are generated (Masalsky, 1990)

Malara et al. (1992) in a review about the use of spreadsheets in teaching typical topics in high schools such as algebra, calculus, and statistics and concluded that there are many advantages as well as problems (in Dettoori et al., !995). One particular problem; according to Dettori et al. (1995) is with the use the sign "=" differently in algebra and in computer languages. In the former it represents equality while in the former it is a relation. This problem may cause misunderstandings in the learning of algebra.

In their analysis about the use of spreadsheets in algebra Dettori et al. (1995) conclude that spreadsheets are very useful tools in the introduction of many algebraic concepts. With the use of these tools they can understand meaning of "solving an equation" and can learn the concept of "approximations".

Sutherland (1993) investigated the effects of participation in computer spreadsheet sessions on learners' understanding of mathematical symbols, and found that participation improved students' attitudes toward problem solving. According to Nevile (1995) the spreadsheets are useful tools for the students to understand processes in the problem solving situation, and that they can recognise that codification and symbolization in word problems is not arbritary.

Databases are organizational structures into which information is placed and from which the information can be retrieved. These programs can provide cognitive experiences for the user.- Databases are useful in stimulating a process oriented curriculum (Underwood and Underwood, 1990). Brown and Howlett (1994, in Underwood et al., 1994) list the arguments for the educational uses of databases which include stimulating the ability to classify objects and symbols, facilitating multiple representation of data (e.g. a numerical data can be represented by a straight line), developing the ability to compare data, encouraging skills in the selection of the data and modes of representing it, developing questioning skills and the understanding of scientific method.

Computer Algebra Systems (CAS) are digital devices used to manipulate symbols. Monaghan (1995) lists five basic things that a CAS can do, which include simplifying algebraic expressions, doing calculus.(calculate limit, integral etc.), evaluating functions in several areas such as statistics, physics, and engineering,, doing matrix algebra, and analysing two or three dimensional objects (Cartesian or polar or parametric representations). The computer packages like Derive, Mathematica, Mathcad, Mathlab, and Maple are all included in this category.

Their difference from the spreadsheets lies on the fact that these programs are specifically designed for solutions of mathematical problems with which students can enhance their learning.

All computing technologies in general and CAS in particular offer many opportunities for the mathematics curriculum in designing new ways of teaching mathematics topics, making advanced topics more easily understandable, providing a different approach to thinking about a particular topic and working more effectively in modelling and the applications (Rothery, 1995).

With the use of such packages many aspects of teaching and learning will be affected and that they have the power to change the nature and sequence of the mathematics curriculum. Traditional skills that were taught the students will not be taught any more in the near future, since the skills

can now be performed by these packages. CAS can act as a bridge between teaching and learning by matching the teachers' program of work to students' learning. Maximising a cone , devising parametric equations for a family of curves,and graphical representation of derivatives are some of the topics that can be taught by using computer algebra systems (Rothery, 1995).

Hunter et al. (1995) in a study in which used a computer algebra system in the topic "quadratic functions" with 14-15 year old students found out that graphical work could not be made easier by the use of CAS in graph sketching or drawing, or through computer generated graphs and that a CAS is advantageous in learning abstract algebra if the students are mathematically ready to use it.

• Graphic Calculators

• Dynamic graphing tools (Geo gebra)

• Dynamic geometry tools

• Microsoft Excel / spreadsheet

• Microsoft Mathematics

• Geo Gebra

• Auto shape

• Mat lab 4.3. Learning resource centre (Indian system of Education)/Websi

2.7 Impact of technology on Teaching & learning Mathematics

Researchers have found that the move from traditional paper-based mathematical notations to on-screen notations (including algebraic symbols, but also graphs, tables, and geometric figures) can have a dramatic effect. In comparison to the use of paper and pencil which supports only static, isolated notations, use of computers allows for "dynamic, linked notations" with several helpful advantages.

1. Computer assisted instruction (CAI) and its effects on mathematics curriculum 1.1. Behavior modification programs before CAI There are two major events that had a great influence on

education in general and mathematics education in particular in 1958 (Dick, 1986). The first one is the Sputnik event, the satellite launched by the Russians. The other one is the paper presented by Skinner, an influential and famous neo-behaviorist, on programmed instruction.

Behaviorism is considered to be the theory underlying CAI. Hence, it is understandable that the CAI programs are mainly behavioral control programs (Hartley, 1981). An example is Skinner's Programmed Instruction (PI) which was designed to change the behavior of the learners. Fundamental approach of Skinner was to identify the desired behaviors, then to prepare situations in which successive approximations of the behavior would be reinforced. All the students study the so called "linear text", the instructional material used by Skinner. When students complete the text, they were assumed to have acquired the behaviors required from them. The basic characteristic of programmed instruction is the small steps approach, meaning the division of the task into small manageable units, and the immediate feedback given to students from each response they give.

The teaching machine is the box designed to expose the programmed instruction text one frame at a time. It is commonly considered to be ancestor of the device called the "computer" to be used for educational purposes. Skinner's programmed instruction formed a basis for the computer assisted instruction movement (Dick, 1986).

Among several other trends Skinner's PI became more widespread than the others. Other major movements in that tradition which followed PI chronologically were Glaser's individually prescribed instruction (IPI) and Keller's personalized system of instruction (PSI). Both approaches contributed to the individualization of instruction movement in similar ways. In Keller's (1968) PSI there were self-paced courses in which students were required to master successive unit tests. Bloom's (1976) is considered to be the last widespread individualized approach to instruction, before computer assisted instruction movement. The method involve the mastery of certain subject area (e.g. trigonometry) before passing to another.

According to Hilgard (1986) these approaches to instruction had important consequences for educational psychology. • the individualized instruction based on the idea that best learning outcomes can only be obtained with one to one tutoring approach. The claim related to those behaviorist models of instruction was that they could provide learning environments closer to one-to-one tutoring (Bloom, 1976). • the diagnostic teaching which is based on the immediate feedback

obtained from the responses of students to the questions being asked during the instructional process. • the step-by-step approach they presented in the instruction of a certain learning task. Those programs advance in a way such that one sub-task followed the other, in other words one frame at a time as in teaching machines. Therefore, in each step, what is expected from the user should be specified in terms of observable behaviors.

According to Mager (1962) a behavioral objective has four basic components. The first component is the actor or the learner who is supposed to act in the prescribed manner. Second component is the behavior itself. The condition(s) under which that action would occur and the criteria to judge if the behavior is applicable are the third and fourth components respectively.

2.7.1 Impacts on Student's Learning Process

Appropriate use of ICTs allow Learners to have the freedom of choice to decide their own time, place, pace, or path to study. Learning materials that are enhanced with various media such as sound, narration, video, animation, graphics etc. provide learners choices to enhance their different intelligence or learning styles. If designed and implemented properly, ICT-supported education can promote the acquisition of the knowledge and 21st century skills such as Creativity, critical thinking and problem solving. Learners are able to exchange ideas more personally and directly. The new ways of teaching and learning are underpinned by constructivist theories of learning and constitute a shift from a teacher-centered pedagogy to one that is learner centered. The philosophy Student programming movement started from the realization that there are strong connections between thinking processes of learners during writing their own computer programs and many aspects of mathematical thought (Hatfield, 1985). Its main assumption is that, computers can help students in learning certain mathematical topics by programming the computer which can be considered as an anti thesis to CAI. Most CAI programs were criticized because they were mainly drill and practice based which could unlikely 'relational understanding' (Skemp, 19??) of the content presented.

Seymour Papert, an influential figure in this movement, proposes that, the use of computers as teaching machines gives nothing to students (Papert, 1980). "Programming the computer, not being programmed by it" was his motto. He also argued that the students can develop their thinking skills through writing their own programs rather than using programs that were developed for them previously. Underwood and Underwood (1990) note that the open ended programs like LOGO for

instance are like pencils and bicycles, in the sense that they are tools to make students reach the ultimate goal: to develop thinking. CAI programs are criticized in the sense that they have known and well defined goals which inhibits discovery.

Students sometimes give right answers for wrong reasons or wrong answers may be the result of rational thinking (Dubinsky and Tall 1993). This statement is a brief summary of the new paradigm of learning. Learning can occur by giving the student the opportunity to construct their own knowledge. This could be provided by a rich computer environment with which the students can develop new mathematical ideas and play with them. Another important feature of computer environments is their power in making abstract ideas more concrete. The computer promotes the minds of the children, causing a shift from concrete to abstract, iconic to symbolic (Kelly, 1984). Computers also assist the child to develop abstract modes of learning to direct them to higher levels of conceptual understanding. Through design, coding and revision, and debugging of a new computer program students can have an opportunity to develop higher mental skills such as deductive reasoning and problem solving. Therefore, it becomes more crucial now to incorporate computer programming into existing mathematics curricula.

Children should be actively engaged into the activities which they are exposed to (Kelly, 1984). In that way the learner can use a computer in the positive sense. As opposed to passive learning which is enhanced by the ready made packages, the student can have better learning experiences. Kelly labels CAI programs as “second-hand programs which have been prepared for them by others."

Underwood and Underwood (1990) criticises the use of computers as teaching machines in that it encourages passive learning which result in undesirable outcomes. On the other hand students can understand conceptually rather than merely acquiring the facts through programming the computer themselves. The prepositional knowledge (the facts), and the procedural knowledge (the algorithms) are less important than the relational knowledge (the process and the insights of the subject) (Kelly, 1984). The computers is a very suitable tool to provide opportunities for the learner who asks “why" rather than “what" or “how”. Papert (1980) pointed out that education has to change its attitude towards the learning process. A shift is seriously needed from quantitative knowledge towards qualitative one. The important thing, then, is not to have more knowledge but doing something with the existing knowledge.

Papert (1980) also noted that the traditional curriculum which he calls “the worksheet curriculum should be abandoned as quickly as possible and allow minds of the children develop through the exploration of computer stimulated micro worlds. This necessitates a revolution in the educational practice all over the world. Salamon (1988) draw attention to the major misuse of computers. that is, the distinction between machines that work for us those that work with us. In the first category there is drill and practice programs while in the second the use of computers as programming devices (in Underwood and Underwood,

1.2. The types of CAI programs CAI means, in broader terms, the use of a computer to provide the course content in the form of drill, practice, tutorial, and simulations. Demonstration, testing, information, and communication are the main facilities provided by CAI. Hatfield (1985) counts eight basic types of CAI. The first type of CAI includes “drill and

 practice” programs. Here, the students rehearses different elements of teaching and develop related skills. They are presented to students in the educational software produced for school and home computers. That type of program relies heavily on positive reinforcement. That means, a reward follows a correct response, negative reinforcement is also used but not frequently. A good example for drill and practice programs are the ones designed to help children learn multiplication tables. The drills might be presented to students with a car race game for instance. The rule is simple the refueling of the car depends on the correct answer the student gives to a multiplication question .Besides drill and practice facilities the use of “computers as tutors” are as widespread as the former. The tutorial programs are the one designed to teach basic concepts or methods as well as certain subject in mathematics for instance. Those type of programs try to behave like a good stimulating teacher. It involves explanations, questions, as well as feedback and correctives. For example, when the user asks for help in a certain step he/she may need help for handling the problem.

The third type,” simulation” is really a very useful advantage that CAI provides for the users. It is the facility to set up the reality in the classroom, which makes CAI very attractive for the users. This feature of CAI presents great advantages for the science curriculum. With this way, experiments that are difficult, time consuming and costly could be realized in the classroom (Watson, 1984). It is also useful in the mathematics curriculum. There are many of the three

dimensional objects that are very difficult to be visualized by the students. These objects can, then be presented to the learner through the screen of a computer.

"Gaming", the fourth type of CAI is the most stimulating use of computers. These programs are a kind of simulation offering competitive situations in which one or more persons can play and win. That does not mean that all games are educationally useful. The stress here is upon the ones that produce worthwhile learning situations related to the objectives contents and processes in the mathematics curriculum (Hatfield , 1984).

They are other types of games which are not necessarily based upon a winning and loosing theme. Such programs give opportunity to the user to work as team and explore the environment with other team members. For instance the game DEFCIT asks to form two themes, both having the goal of balancing the budget (Watson, 1984). The programs really offer great opportunities for the mathematics students to work within a co-operative environment to learn difficult mathematical concepts.

The idea that games can be used to enhance the learning of mathematical concepts stems from two different views (Dugdale 1985) • "Making mathematics fun": mathematics is uninteresting and difficult. It can be made easier and enjoyable by playing computer games. • By providing the structured environments with which students manipulates things in mathematics: mathematics is useful and interesting. Effects of CAI on mathematics teaching and learning The view that complex learning behaviors comprise of a network of stimuli response associations is the fundamental idea underlying the application of CAI programs. This idea has been the natural continuation of the behavioristic mode of teaching.

Hartley (1981) stated that the stimuli response bonds are established by providing positive reinforcements such as knowledge of results. Then, it was the teacher (or the organiser of the instruction) who was responsible for the selection and arrangement of content to help the desirable responses to be elicited. Then, this process leads to the discovery of feedback, the message which follows the response made by the learner. This, in fact acts as a positive reinforcement for the learner. It is also the information which shows the error and informs the student to correct this error. This is called feedback-corrective cycle. Learning takes place by rewarding the correct associations by questions and answers (Howe and du Boulay, 1981) which is known as the reinforcement learning.

CAI also brings the possibility that student interaction with the computers may result in less interaction with the teacher and the classmates. This, in fact is very harmful for the process of socialization provided by the school environment. Most of the applications of CAI have been based on the individualized learning, one student working with one computer. The model proposed by Johnson et al (1978) was a group based model. They found that the co-operative CAI was far more effective compared to the individualistic CAI approach in mathematics and concluded that the assumption being “all CAI should be individualistically oriented" is not a valid argument.

The Turkish Online Journal of Educational Technology – TOJET April 2005 ISSN: 1303-6521 volume 4 Issue 2 Article 4

Hartley (1977) was the first person who meta-analysed the findings of CAI on mathematics achievement (in Kulik et al, 1983). He found that CAI had a significant effect (effect size 0.41) on the achievement levels of primary and secondary school mathematics students. Burns and Baseman (1981) also reviewed the findings on the effect of CAI on mathematics achievement. The effect size he found was almost the same (0.45 for tutorial, 0.34 for drill and practice) verifying the results of previous analyses.

In brief, this review of literature revealed that most of the CAI studies and reviews of those studies, as expected, were done in the USA, most of which suggested the effectiveness of CAI It must be noted, however, that main focus of those studies are generally easily observable measures such as achievement, not more complex phenomena such as cognition

There are two basic traditions in programming. They have their own philosophy and teaching styles (Cope and Walsh, 1990). The first one is the BASIC-PASCAL tradition. The other tradition, LOGO is rooted from the artificial intelligence and supported by Piaget’s cognitive development theory (Papert, 1980).

BASIC Although it is not widely used any more, BASIC had a strong impact on mathematics education in the previous years. It is indeed an easy language. Students could write their own programs to explore mathematical ideas. They could be used for the purposes of problem solving, investigation and practical work. Although its applications were very limited, it was and (may be) is being used because of its ease of use.

LOGO Seymour Papert in 1970 wanted to design a computer language that is suitable for children, not able to use complicated programming languages such as BASIC and PASCAL. It should be easy to manipulate and have the power of a structured programming language.

LOGO, the outcome of this effort, is a general purpose programming language. The programs in LOGO can be written to perform different tasks. It can be used to write programs across many different subjects in the curriculum, mostly in mathematics. The turtle geometry, a part of LOGO helps young children program the computer. It is used to draw whatever the learner likes, such as geometrical figures.

Programming in LOGO combines with use of micro worlds. Then through programming certain problem area can be explored. With LOGO children are assumed to develop useful practices as a result of programming in micro worlds. Contrary to the other programming languages, LOGO is often taught in an open ended and child centred fashion. The learner himself /herself gives directions to his /her learning. Children using LOGO develop a knowledge of how programming works through testing hypothesis.

The Mathematical Association (1992) lists different uses of LOGO across mathematics curriculum. • the concept of ratio, for instance, is easier with LOGO graphics • the idea of measurement: distance on a floor can be described in terms of units of • moment of a robot toy. • the perception of a function as a procedure taking a number as a input and after an algorithm giving the output • natural number concepts can be developed through guessing the number. Computer generates a random number student makes prediction the program gives a feedback for the accuracy of that prediction. With that way, student gets closer to the number and finally finds it . • the program comments “turn” and “corner” changes the direction of moving object helps the understanding of the concept of the angle . • It is very difficult to visualise 3-D objects and draw it on a sheet of paper. It is an easy test in LOGO. Indeed LOGO can produce 2-D representations of 3-D objects. For instance the turtle can move in the directions as if it is moving in 3-D space.

The early findings of Papert (1980) indicated that LOGO had an effect in improving cognitive skills. Clements (1983) also found that LOGO was also effective in problem solving skills. Clements and Gullo (1984) compared the effects of CAI and computer programming on young children’s cognition, and found that programming was more efficient than CAI in various measures of cognition, such as reflectivity and divergent thinking. Roblyer (1989) reviewed 82

studies to provide information about the effect of computer use in schools on student achievement, attitudes, dropout rate, and learning time. The effects of Logo applications on problem-solving and general thinking skills were found to be significant.

2.7.2 Technology helps teacher in lesson Planning

The ease and speed of obtaining information on the Internet definitely helps the teacher users to empower themselves. 1. It gives teacher the opportunity to learn current innovations in teaching from other Countries that may be utilized in his/her her class to strengthen pupils' self-esteem. It adds further information about the topic he/she is teaching. He/she can make the content more colourful and purposeful by integrating slide show and videos related to the topic. He/ She can successfully impart education characterized by imparting instructions, collaborative learning, multidisciplinary problem-solving and promoting critical thinking skills as highlighted by National curriculum framework 2005 (NCF 2005)

2.7.3 Technology provides evaluation tools.

Technology provides different assessment tools such as Checklists, rating scales and rubrics to assess the 21st century skills such as creativity, problem solving, decision making and leadership skills which are criteria for project based learning. The rubrics for Research Report document, Power point presentation, Role Play helps the user The teachers can access number of printable worksheets for Mathematics. Checklists, rating scales and rubrics are readily available in some educational websites. The students can do self evaluation through different online tools and get immediate feedback for correction. The advantages include:

1. instant feedback to students

2. greater flexibility with respect to location and timing

3. Improved reliability.

4. improved impartiality

5. greater storage efficiency

6. Enhanced question styles which incorporate interactivity and multimedia.

2.7.4 Collaborative learning

There are a lot of internet sites providing interactive learning tools for students. Blogs, Forums, Communities, Webcast, Pod Cast, User Groups, Picassa (Google) and Flickr (Yahoo), W3Schools.com, Wikis, Web conferencing, Video Conferencing, Chat, E-mail, Instant Messaging, Bulletin Board, Data Conferencing, Shout Box, Image Board, YouTube, Slide Share, Think quest, Schools online ,e-pal and British Council Schools online. Seeing what your friends are doing, and being able to fully participate in group activities, offers new ways of working in class, the researchers say. The findings published in the journal Learning and Instruction, show that children using these Synergy Net classrooms improve in both mathematical flexibility and fluency, while children working on traditional paper-based activities only improve in flexibility.

2.8 Barriers of use of Technology

• Not enough or limited access to computer hardware & computer software

• Lack of time in school schedule for projects involving ICT

• Lack of adequate technical support for ICT projects

• Not enough teacher training opportunities for ICT projects

• Lack of knowledge about ways to integrate ICT to enhance curriculum

• ICT integration is not a school priority

• Students and Teachers do not have access to the necessary technology at home.

2,9 Curriculum

Increasingly the specification of modern laptop and e-book portable computers is such that virtually all of the major mathematical technologies now run on them. Similarly there have been significant improvements in broadband Internet connections and collaborative tools. The expansion of pupils' access to technology is less of an issue than the leadership and management of the resources at school and college level. If digital technologies are to be embedded in the mathematics curriculum then the knowledge and skills required by both teachers and learners to use them should be explicitly specified.

Summary

Technology provides New Ways of Learning Technology can reduce the effort devoted to tedious computations and increase students' focus on more important mathematics. Equally importantly, technology can represent Mathematics in ways that help students understand concepts. In combination, these features can enable teachers to integrate project based learning. Calculators and other technological tools, such as computer algebra systems, interactive geometry software, applets, spreadsheets, and interactive presentation devices, are vital components of a high-quality mathematics education. With guidance from effective mathematics teachers, students at different levels can use these tools to construct knowledge and develop 21st century such as critical thinking, problem solving and decision making. 8.2 New Roles of the Teacher

In the present time the teacher's role in teaching mathematics is facilitator. The teacher has to facilitate the learning by providing students with access to instructional technology, including appropriate calculators, computers with mathematical software, Internet connectivity, handheld data-collection devices, and sensing probes. The teachers can find the means to more easily to engage students in learning and to cater to the various needs of different students. Technology provides opportunity for his /her students to collaborate with others. This case indicates that the Internet cannot replace the role of the teacher as facilitator, as she must set up the task, pose questions, provide appropriate websites, and give feedback. 8.3 Teaching Mathematics Better and Teaching Better Mathematics. In order to educate students to be life-long learners and successful contributors to the new global market, educators must change the way they teach and the way students learn. Curriculum and assessment in school mathematics should explicitly require that all young people become proficient in using digital technologies for mathematical purposes. High-stakes assessment needs to change in order to encourage the creative use of digital technologies in mathematics classes in schools and colleges. What needed in schools and colleges are student-led mathematical modeling, problem solving and computer programming which makes use of the powerful Mathematical digital technologies that are widely used in society and the workplace. Computer science had separated from a mathematical logic, and gained independence. That means the improvements in computer science are changing mathematics Hence mathematics education is changing. It caused the revision of the mathematics curricula in many of the leading countries in the world.

This survey of literature indicated that various computer applications in mathematics education contributed greatly to classroom practices. But the limitations of a computer should be kept in mind that it will not solve all deep-rooted problems of mathematics education.b) ICT plays a role in students' achievement Kulik's (1994) meta-analysis study revealed that, on average, students who used ICT-based instruction scored higher than students without computers. The students also learned more in less time and liked their classes more when ICT-based instruction was included. Sosin et al. (2004) constructed a database of 67 sections of introductory economics, enrolling 3,986 students, taught by 30 instructors in 15 institutions in the United States of America during the spring and autumn semesters of 2002. They found significant, but low, positive impact on student performance due to ICT use. But they showed that some ICT seems to be positively correlated to performance while others are not.

Fuchs and Woessman (2004) used international data from the Programme for International Student Assessment (PISA). They showed that while the bivariate correlation between the availability of ICT and students' performance is strongly and significantly positive, the correlation becomes small and insignificant when other student environment characteristics are taken into consideration. The analysis of the effects of these methodological and technological innovations on the students' attitude towards the learning process and on students' performance seems to be evolving towards a consensus, according to which an appropriate use of digital technologies in higher education can have significant positive effects both on students' attitude and their achievement.

Attwell and Battle (1999) examined the relationship between having a home computer and school performance, for a sample of approximately 64,300 students in the United States. Their findings suggest that students who have access to a computer at home for educational purposes, have improved scores in reading and maths. Coates et al. (2004) showed that students in on-campus courses usually score better than their online counterparts, but this difference is not significant here. Li et al. (2003) pointed out: "First, web-based instruction presents information in a non-linear style, allowing students to explore new information via browsing and cross-referencing activities. Second, web-based teaching supports active learning processes emphasized by constructivist theory. Third, web-based education is enhanced understanding through improved visualization and finally, the convenience, it could be used any time, at any place".

ICT use can enhance learning by making education less dependent on differing teacher quality and by making education available at home throughout the day. Authors argue that the use of ICT can positively transmit knowledge to students. Furthermore, ICT use can help students exploit enormous possibilities for acquiring information for schooling purposes and can increase learning through communication.Coates et al. (2004) surveyed three matched pairs of faceto-face and online principles of economics courses taught at three different institutions. The students' score in the Test of Understanding College Level Economics (TUCE) given at the end of the term is used as the measure of learning outcomes. After taking into account selection bias and differences in student characteristics, they report that the average TUCE scores are almost 15% higher for the face-to-face format than for the online format. Anstine and Skidmore (2005) surveyed two matched pairs of on-campus and online courses, one in statistics, and the other in managerial economics. They report that after taking into account student characteristics and selection bias, students in the online format of the statistics class exam scored 14.1% less than in the traditional format, whereas, for the managerial economics class, the test scores within both formats were not significantly different.

Navarro and Shoemaker (1999) surveyed a matched pair of on-campus and online sections of a class on principles of macroeconomics. The students self-selected the instruction format, with each section having approximately 30 students, and there was no difference in the demographic composition of each section. They used a simple comparison of means of test scores and reported no significant difference in academic performance between the two formats. Terry, Lewer and Macy (2003) surveyed 240 students in a programme offering courses in the three formats of online, on-campus, and hybrid. Using a standard regression model where final exam score is the dependent variable and student characteristics are the independent variables, they report that predicted exam scores for students in the online courses were significantly less than those of students in the on-campus and in the hybrid formats. However, with the comparison of exam scores between students in the hybrid and students in the oncampus classes there was no significant difference.

Brown and Liedholm (2002) surveyed students in a matched pair of online and face-to-face principles of economics course taught by the same teacher. They reported that exam scores, after

taking into account differences in student characteristics, were approximately 6% higher for the on-campus format than for the online format. They attribute the relatively better performance in the on-campus classes to the benefit of in-person teacher-student interactions, and attribute the relatively poorer performance of the students in the online class to the lack of self-discipline necessary for successful independent learning in the online environment. Leuven et al. (2004) concluded that there is no evidence for a relationship between increased educational use of ICT and students' performance. In fact, they find a consistently negative and marginally significant relationship between ICT use and some student achievement measures. Students may use ICT to increase their leisure time and have less time to study. Online gaming and increased communications channels do not necessarily mean increased achievement. Many other explanations were presented.In fact, all else is not equal.

ICT based instruction induces reallocations, substituting alternative, possibly more effective, forms of instruction. Given a constant overall instruction time, this may decrease student performance. Also, given that budgets are not perfectly elastic, the introduction of ICT based instruction can result in a reallocation of funds in favour of ICT, possibly substituting more effective instructional materials. ICT can distract learning. This may be particularly salient at home, where Internet access could be a source of distraction because of chat rooms or online games, reducing the time spent in doing homework or learning. Thus, the impact of the availability of ICT on student learning will strongly depend on their specific uses. ICT-based instruction could restrict the creativity of the learner. ICT tends to allow acting only in a predefined way with limited interactive possibilities. This might reduce the students' abilities in terms of problem solving and creative thinking in predetermined schemes but not their ability to come up with independent creative solutions on their own"

CHAPTER 3

Research Methodology

3.0 Introduction

This chapter describes the research design, techniques and methods that the researcher applied in collecting data for the research. Thus it looks at how the gap in the existing body of knowledge identified was bridged. The study will also outline the research instruments, and data collection procedures, tools and method to be used in the presentation and analysis of data. Arguments for the choice of research instruments and techniques will also be forwarded in this chapter.

3.1 Research Design

Borg and Gall (1982:24) asserts that, "Research design refers specifically to the researcher's choice of methodology and casual relationship between variables or phenomenon". The research design gives direction and systemizes the research. The researcher employed both the quantitative and qualitative research methods .A research design has been viewed by Church hill (2007), as a set of plans or parameters for the study used as guide in data collection and analysis. Cresswell (2009), viewed a research design as a well-organized step used to fulfill the purpose of the study. He went on to say that the research design reduces the chance of collecting haphazard data and ensures that data collection fits into the objectives of the research. Moreover, the author highlighted that there are three major types of research design which include descriptive, explorative and casual.

3.1.2 Descriptive Research Design

Babbie et al (2005) asserts that descriptive research design refers to studies designed to obtain Information directed towards determining the nature of a situation as it exists at the time of the study. Gwimbi (2006) was of the view that this method gives the researcher a chance to employ

different data collection techniques used since it provides an accurate description of the variables in the model. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or is happening. Saunders et al (2006) outlined that the descriptive research focus on determining the frequency with which something happens or the extent to which two or more variables are related.

The researcher found descriptive survey suitable for this research because unlike other research designs it is not only limited on observing with the physical eye, it rather offers the platform for interviews and questionnaires to be conducted,

3.2 POPULATION AND SAMPLING PROCEDURES

3.2.1 POPULATION

According to Tuckman (1994:16) asserts that "population refers to that group about which the researcher is interested in gaining information and drawing conclusions." Population is further defined by Kryason (1996:33) as "any group of individuals that have one or more characteristics in common that are of interest to the researcher.".

Kaplan (2003), defines research population as a collection of all groups or cases under study.

According to Burns et al (1998), research population constitutes the whole elements underlying the study as defined by research objectives. Rickle (1992) highlighted that target population refers to any group of individuals that have homogeneous characteristics which are of crucial importance to the research. For the purpose of making the research effective in achieving its defined objectives the researcher focused on 45 4**w** pupils and four Mathematics teachers at Mkwabene High School .

3.3 Research Sample

Levin (2003), defines sampling as a collection of part but not the whole elements of the population under study, used to describe the population. Henry (2005), argued that using

sampling techniques makes possible a higher overall accuracy than a census. Moreover, according to Saunders (2001), selecting a few number of the entire population means that the researcher collects information that is detailed and also devotes more time to obtaining data from more difficult cases. Cooper (2003), added that the value of information obtained through research depends on how well a sample represents the total population. According to David S. Fox (2005), in the social sciences, it is not possible to collect data from every respondent relevant to our study but only from some fractional part of the respondents.

The process of selecting the fractional part is called sampling. The sample consisted of 20 4w pupils, from Mkwabene High Schools in Filabusi. The school was chosen because there school in the district in which the researcher was teaching for the duration of the research. Stratified random sampling was used to select the sample because it enabled the researcher to choose every possible character of the pupils so as to come up with something which is all inclusive.

3.3.1 Sample size

Saunders (2001), defines sample size as the smaller number of total population for which data is needed to be collected. Twenty people were chosen to represent the total population, this sample being determined by costs involved and the time frame in which the research project was required to have been completed and labour resources. The researcher believed that a sample of 20 people gives a true representative of the population as indicated below.

3.3.2 Sampling procedure

Oppenheim (1992) asserted that sampling procedures are methods that facilitate the researcher to reduce the amount of population from which to collect data by taking into account only data from sub-group rather than all possible cases. Respondents were categorised into two sub groups, teachers and pupils. Stratified random sampling was used to select the sample because it enabled the researcher to choose every possible character of the pupils so as to come

up with something which is all inclusive. The researcher also used judgmental and convenient sampling.

3.3.3 Judgmental sampling

According to Babbie (2001), judgmental sampling is whereby the researcher uses his or her own judgment to identify representatives of the population. The author added that the sample is selected based on the knowledge of the population and purpose of the study. The teachers were chosen using judgmental sampling because the researcher needed mathematics teachers. Of the four teachers chosen only one does not hold a teaching qualification.

3.3.4 Convenience sampling

Http://mmr.sagepub.com (2017:1705), stated that under convenience sampling a sample is selected from the population as they are convenient to the researcher and the major concern here is whether representativeness is achieved using this sampling method. In addition according to this sampling technique the most readily available participants are selected.
The researcher found convenience sampling suitable to apply on parents because it helped gathering useful information that would not have been possible using probability sampling techniques, which required more formal access to lists of population. Compared to probability sampling the relative cost and time required to carry out a convenience sampling are small, this enabled the researcher to achieve a sample size he wanted in a relatively fast and inexpensive way. Convenience sampling has also been preferred by the researcher because it is easy to carry out with few rules governing how the sample should be collected. In addition a convenience sample was easy to access; the sample took less time of the researcher and required little of his effort.

3.3.5 Stratified sampling

According to Piertson (2010) stratified sampling is when the population is divided into subgroups or stages on the basis of variable chosen by the researcher, such as gender, age or level of education. The pupils chosen were Ordinary level students (both form 3 and 4). Stratified random sampling was used to select the sample because it enabled the researcher to choose boys and girls which is all inclusive. As defined by Castillo (2009) sampling is a process of taking a subset of subjects that is representative of the entire population. The researcher used simple random sampling which according to Borg and Gall (1996) is a procedure in which all individuals in the field in the defined population have equal chance and independent chance of being selected as a member of the sample. From the 4w Class of forty five (45) pupils, twenty two are boys and twenty three are girls. Ten pupils girls and ten boys where to be selected so as remain with a sample of twenty pupils. To eliminate the twenty five from the population, the researcher write 23 identical cards and only 10 of them were labelled with a red mark so as to qualify the sample and the remaining were labelled with blue mark which represent those who do not qualify to be the sample. The selection was done for boys first followed by the selection for girls. Twenty pupils picked the card with a red mark and qualified to be the sample.

3.3.5.1 Advantages of random sampling

As a sampling technique, simple random sampling has many advantages and one of them is that it reduces any possibility of bias since individuals have an equal chance of being chosen. As a result, the group of pupils selected for the research study is composed of slow, average and fast learners. "Random samples yield research data that can be generalized to a larger population within margin of error that can be determined systematically", (Borg and Gall 1989:23). This made the researcher to be in a position of being able to make some recommendations to all educational practitioners teaching the subject in various secondary schools in Zimbabwe.

Despite having various advantages, simple random sampling is also characterized by different weaknesses. It becomes ineffective when there is a very large population size and a smaller sample is taken. Also since the selection depends on chance, there is a probability of selecting pupils with

similar strengths and weaknesses. This technique does not put into consideration the need for gender balance.

3.4 Data Sources and Collection Techniques

Cooper at al (2003), defines data as the facts presented to the researcher from the study environment. It is from this data that the researcher draws conclusions for the research study. Data is set into two forms namely primary and secondary data. Primary data refers to data structure that have been specifically collected and assembled for the current research problem

3.4.1 Primary sources

As asserted by Kerlinger (1979), primary data is data which is captured at the point where it is generated and such data is captured for the first time and with specific purpose. Primary data was used. Primary data were advantageous to the researcher in the following manner:

 With primary data sources, the researcher obtained first-hand information from pupils, teachers and parents which is very relevant to the research.

The researcher managed to obtain the current information needed for the study due to the current nature of primary data sources. The data is of current nature due to the fact that the subjects are involved in the situation which is prevailing at that moment.

3.4.2 Secondary data sources

Secondary data refers to that data that has already been collected and analysed for another purpose as purported by (Wilkson 2001). Concurring with this, Leedy (1990) defines secondary sources of data as data that already exists and is used for some purposes other than for which it was originally collected for. External data sources enabled the researcher to have a starting point and provided information that could not be obtained through interviews and questionnaires. It was also inexpensive to use this data because it was already available

3.4 Research Instruments

Afe (2012) says these are measurement tools (for example questionnaires or scales) designed to obtain data on a topic of interest from research subjects. He further adds that the researcher must ensure that the chosen instruments are reliable and valid. The researcher used questionnaires and interviews. A questionnaire was used to collect data. A pilot study was conducted to check on the relevance and usability of the instrument before the main study.

3.4.1 Observation

The study used participant observation as one of its instruments for gathering data. According to Borg and Gall (1996) observation means to watch accurately and note the phenomenon by which behaviours occur in the nature with regard to the cause and effect of mutual relations. Marshall and Rossman in Kawulich (2005:79) define observation as "the systematic description of events, behaviours, artefacts in the social setting chosen for study." The researcher thus had an opportunity to observe other practitioners teach while the pupils learnt with the aim of understanding behaviours of both the teachers and the learners.

The researcher observed two lessons being delivered by two of the mathematics department teachers in the classroom. He recorded how those two teachers conducted their lessons, teaching methods used, aids used and the motivational ways used by the teachers to boost the pupils' interest in the learning of mathematics at O level. The same teachers were invited to observe the lesson delivery by the researcher, and then they had to evaluate his lesson delivery using method on the study.

3.4.1.1Advantages of using observations

The researcher used observation in gathering data because it enabled him to collect data in a practical situation. The researcher observed actual lessons thereby getting appropriate information. The researcher's position as a teacher gave him the opportunity to observe pupils' behavior during the lessons. The pupils observed did not have the opportunity to pretend seriousness hence accurate information was gathered. Data can be collected without any interference of the one observed and hence information reflects the true events.

3.5.1.2 Disadvantages of using observations

One of the main draw-back of observation is that it is at times difficult to get accurate information. Some teachers could try to impress the observer and use child-centered approaches such as group and pair work when being observed only giving inaccurate results due to false judgments and conclusions made during the observation.

Despite having advantages and disadvantages as discussed above, the researcher chose it as a data gathering device because it was the only means by which he was able to actually examine the pupil's textbook ratio, teaching aids used by teachers when teaching mathematics as well as their behavior or conduct during the lessons.

As a way of overcoming these short comings, non- participant observation was used, that is, the researcher observed from a distance and pupils were not really aware that they were being observed since some of the lessons were conducted off session where pupils were taught outside the classroom. The researcher decided to give the whole population the exercise and tests with the sampled population so that they would not realize that they were being observed.

3.5.2 Questionnaires

According to Donald R (2003), a questionnaire is defined as a format containing a list of questions sequentially ordered to obtain information relevant to the objectives of the study. It

is not only a list of questions used to obtain responses; it is specifically intended to obtain

particular kind of data. Glynis (2006) was of the view that a questionnaire can be described as

a document that asks the same questions to all respondents or individuals of the sample. The

questionnaire was chosen because as Cohen and Manion (2011) observe, has the ability to

reach many respondents who live at widely dispersed addresses and preserves anonymity

Which encourages greater honesty? For the purpose of this study the researcher designed a

Questionnaires for the pupils and as well for teachers. The questionnaire was designed in such a way that responses .Would best address the research questions and objectives of the study .This questionnaire comprised of closed and opened ended questions.

3.5.2.1Advantages of questionnaires

 Responses are gathered in a standard way and are more objective than interviews.

 It is quick to collect information.

 Information can be collected from a large sample.

 Respondents have enough time to consider their responses carefully.

 it permits anonymity.

 It easy to analyse and can be done with computer software.

 Questionnaires reduce bias. There are no verbal or visual clues to influence respondents.

 there are less intrusive than telephone or face to face interviews. Respondent is free to respond at their own time.

3.5.2.2 Disadvantages

 Open ended questions in a questionnaire can generate large amounts of data that can take a long time to process and analyse.

 Respondents may answer superficially especially if the questionnaire is too long.

 It may be difficult to get good response often there is no motivation for respondents.

3.5.2.3 Validity and reliability

According to C Phelan (2006) Reliability is the degree to which an assessment tool produces stable and consistent results. He further says that validity refers to how well a test measures what it is purported to measure. To ensure validity and reliability the following steps were taken. Questions were made with no technical terms for easy comprehension and to avoid ambiguity. The researcher also used the Pearson product moment correlation to test correlation of some results.

The questionnaires were personally distributed by the researcher. Learners completed the

questionnaires under the supervision of the researcher to ensure that they did not share their views. The researcher collected the completed questionnaires from the students after completion.

3.5.2.4 Likert scale

The researcher made use of Likert scale to measure the attitude of respondents. Likert scale has been defined by Earl (2005), as a psychometric, one dimensional scale commonly used to measure the attitude of respondents in questionnaires and survey research. This principle was developed by (Likert 1932), with the aim of measuring attitudes by asking many people to respond to a series of statements about a topic, in terms of the extent to which they agree or disagree to them. The Likert scale is the sum of responses on several Likert items, typically between four to seven items.

The odd numbered scale was be used for this research and the rating scale was: 4-strongly Agree, 3-Agree, 2-Disagree and 1-Strongly disagree.

The likert scale was employed for its benefits to the study which are as follows:

 They do not expect a simple yes or no answer from the respondents but rather allow for degrees of opinion and even no opinion at all.

 Each item is of equal value so that responses are scored rather than itemized.

 Data can be analysed with relative ease as quantitative data is obtained hence are easy to read and complete.

However the principle is associated with central tendency bias as results of respondents may avoid using extreme response categories. Respondents may agree with statements as presented to portray themselves or their organizations in a more favourable light.

3.5.3 INTERVIEWS

Borg and Gall (1999), advocates that an interview is whereby an interviewer interviews an interviewee either via a telephone or face to face. For the purpose of this research the entire Interviews were conducted on face to face basis. 20 students and 4 teachers were interviewed. Interviews can be grouped into two groups namely structured and unstructured interviews

Argyle (1967:28) states that an interview is "a two person conversation initiated by the interviewer for a specific purpose or obtaining relevant research information on the specified objectives". The researcher used an interview guide to pose questions to form fours and 4 Mathematics teachers. The respondents were informed and requested to be interviewed at any time before the session. The researcher prepared in advance his interview guide.

During the interview session, the respondents were interviewed individually in a private place. The researcher took down major points about the responses of the interviewees. The researcher used the unstructured interview in gathering the necessary data that he required for the study. Hitchcock and Hughes (1995:162), asserts that, "in the structured interview, there is scope for the interviewer to introduce new material into the discussion which had not been thought of beforehand but arose only during the course of the interview.

3.5.3.1 Structured Interviews

Nicholas (1991) described them as a social survey where the range of possible answers to each question is known in advance. The questions include open ended and closed ended.

3.5.3.2 Unstructured Interviews.

According to Nicholas (1991) these are informal interviews, not structured by a standard list of questions. Questions are asked in any order, researcher can probe deeper and richness of data depends on the interviewer.

The researcher decided to use unstructured interviews.

3.5.3.2.1 Advantages of Interviews

 the researcher quickly obtained responses and this helped a lot considering that the research had to be completed within the stipulated time frame.

 the researcher made further enquiries on questions not well responded to and this opened new ideas not previously thought.

 the researcher could possibly persuade the respondents to provide the answers to questions that were avoided based on confidentiality.

3.5.3.2.2 Disadvantages

 the respondents could not reveal all that the researcher wanted because they felt part of the information confidential though it was vital for the study; as a result the researcher had to ask the same question in dissimilar ways till the information was disclosed so as to collect the reliable data.

3.6The Intervention Strategies

3.6.1 Tests: Pre-test and Post-test

Pre-test afford teachers an opportunity to acquire an extensive picture of the depth and scope of pupils' knowledge of subject matter Kasambira (1993). The pre-test was administered using the information already obtained in the classroom and the assumption of the coverage of the topics at ZJC Syllabus and any other adjustments. After each intervention strategy pupils were given an exercise and practice questions. After the intervention strategies the researcher administered a post-test with the intention of finding how well pupils can perform a specific skill after intervention Kasambira (1993).

3.6.1.1.Advantages of using tests

Pre-tests expose areas of difficulty and error in the pupils' first attempt. The post-tests indicate whether the programme of action research made any differences in the pupils' performance

compared to the results obtained from pre-tests. Tests also provide teachers with data on teaching effectiveness and student comprehension

3.6.1.2 Disadvantages of using tests

Tests measure specific items or content and not everything that pupils have gathered. Pre-tests de-motivate those pupils who would have not done the subject before and post-test cannot be useful as some pupils will end up monitoring instead of conceptualising the concept taught.

To overcome these shortcomings, the researcher gave pupils more individual work and home work for more practice. Pupils were given enough time to attempt some questions alone.

3.7 The Intervention Strategy

The researcher, working with a sample of twenty pupils, administered a pre-test which was meant to check the pupils' level if their performance in perfect using any other teaching method than when using ICT. It was noted that almost all the pupils had challenges with the concept as they could not even show interest and some seriousness in the test therefore the performance was partially poor and some wrote only the formulas as the test was on area and volume shapes. The pre-test thus, served as an indicator to the pupils' misunderstandings on the concepts and the difficulties in answering some of the questions tested.

Having diagnosed the problem the researcher applied some of the strategies in an attempt to help pupils acquire the skill and understanding the concept in mathematics better. An exercise was given after each intervention phase to see whether the implemented strategy was fruitful.

3.7.1 Phase 1

The researcher started by using other methods in delivering the concepts as the school was still organizing how they could allow the researcher to use ICT tools i.e. the projector the venue to conduct lessons and other accessories to be used. The researcher introduced topics normally and mostly formulas and demonstrations without further giving real life examples. The researcher drew shapes and asked pupils to label the sides and to give formula for area and volumes. Only a few had the idea on the concepts some had assumptions.

The researcher then explained the concept on the areas and volumes. The pre-test was given and pupils performed poorly only 20% of the class passed the test. The researcher continued with the

topic until the school had finalized the dates and time to use the computer lab to use ICT tools in delivering some of the concepts.

3.7.2 Phase 2

A recall of the previous lessons was used to introduce the lesson. The researcher put forward various shapes on the side of chalkboard and pupils were asked to write formulas and explain what they know. The researcher gave notes to pupil definitions of terms and played a video which explains further the concept on volumes and area with real life examples.

The teacher stopped a video on projector and asked pupils questions on what they have seen on the video and how to relate the concept to real life situations and to link mathematics with other subjects. There was improved pupil participation compared to previous lessons. 70% of those who came to demonstrate questions on the slides got the answers correctly. The teacher also went on to give pupils group work activities and the teacher walked around observing how the task was being conducted.

There was strong competition among the groups as everyone wanted to be the first to present their answers on the chalkboard. Pupils were actually motivated as there was a lot of pupil to pupil interaction. Pupils learnt from each other as they were explaining to those who did not understand. The researcher asked for feedback from the groups. There was great competition as each group wanted to be the best in drawing ledger accounts.

All the groups managed to calculate the area and the volumes of the shapes that were given as group work and pupils were assigned to go and thoroughly revise the topic on area and volume of shapes as a preparation for test to be written during the next lesson. Since the time table for mathematics to use the computer lab was on schedule, the teacher continued to use ICT and other teaching methods.

The researcher continued to use ICT tools and other various teaching methods throughout the course. This was done so to avoid concentrating on using ICT than other teaching methods. Exercises, home works, tests were administered to the whole class without notifying the pupils the class about the researchers intentions.

3.8 DATA PRESENTATION AND ANALYSIS TECHNIQUES

The findings of the research instruments, views and opinions shall be presented in the next chapter. The data will be presented in form of tables, pie charts and bar graphs. The researcher recorded the number of people who were interviewed both the teachers and the pupils.

3.8.1Tables

Tables provide a more precise, systematic and orderly presentation of data in rows and columns. In this research, the tables will be used to record the results on interviews, number of interviewees who respondent to particular questions, the marks of both the pre- and post-tests, type of questions and the number of pupils who got those questions correct and wrong.

3.9.1.1 Advantages of using tables

Tables are suitable for column oriented or tabular data that is often stored as columns in text file or spread sheet. For example, you can use tables to store experimental with rows representing different observations and columns representing different measured variables. Tables can also be used to collect mixed type of data.

3.9.1.2 Disadvantages of using tables

Tables record only related values, for example you can only see the increasing and decreasing values of x and y uniformly. It is hard to find the y – intercept if x values are not given. When using tables, you need to determine the type of function which relates x and y.

3.8.9.2 Graphs (Pie-chart, bar chart/histograms, e.t.c)

Graphs are the most effective method of visually presenting statistical data as well as results of the findings. These statistical graphs will show the representation of data and will display how the data is distributed within the categories of the findings.

3.9.2.1 Advantages

Graphs give a visual impression of what the researcher obtained in confined shapes with the given percentages. They are also easy to interpret and compare the obtained data

3.8.2.2Disadvantages

Graphs are time consuming; more time is needed for decisions made in advance for layout and colour. Technical graphs in nature need audience knowledge to interpret or understand.

3.9 Summary

This chapter presented how the researcher conducted the study using questionnaires and interviews as research instruments. The target population was the ordinary level pupils at four schools from which a sample was drawn using probability and non-probability sampling. The chapter further outlined the data collection procedures and data analysis techniques to be used. This chapter having explained how the data was collected, in the next chapter the researcher will be looking at the presentation, analysis, and discussion of results.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.0 INTRODUCTION

The previous chapter focused on presentation of research methodology in which the researcher highlighted the research instruments that were used and the steps taken when gathering data. In this section will focus on intervention strategies like the use of Pre-tests and Post-tests, interview and observations guides as well as some of the exercises that were administered. The outcomes from the strategies will be shown in tables and graphs and the information will also be analyzed.

4.1 PRESENTATION OF DATA AND ANALYSIS

The pre-test was administered to assess pupils level of understanding of the content regarded as assumed knowledge when teaching the concepts on area and volumes, functional graphs and geometrical construction at ZJC Level. The test was also to check the performance of pupils as well as the methods being used to deliver mathematical concepts. The test was for 35 minutes and maximum supervision was offered to minimize copying and discussion of the questions. The results obtained are presented below

PRE-TEST RESULTS TABLE 1a

Marks(x) %	$0 \leq x < 10$	$10 \leq x < 20$	$20 \leq x < 30$	$30 \leq x < 40$	$40 \leq x < 50$	$50 \leq x < 70$	$70 \leq x < 100$
Number of pupils	2	5	2	3	4	3	1

Table 1b

Mark %	Midpoint	f	fx	fx^2
$0 \leq x < 10$	5	2	10	100
$10 \leq x < 20$	15	5	75	5625
$20 \leq x < 30$	25	2	50	2500
$30 \leq x < 40$	35	3	105	11025
$40 \leq x < 50$	45	4	180	32400
$50 \leq x < 70$	60	3	180	32400
$70 \leq x < 100$	85	1	85	7225

$E(x) = \frac{\sum f(x)}{n} = \frac{705}{20} = 34.25$

From the results shown on the table 3.2.1a above, notable is the point that most of the learners failed the test and a few managed to score above 50% which is about 20%, the rest 80% failed to score above average. The results show that pupils have difficulties in their academic performance. The researcher observed that many pupils were leaving gaps and had no idea about the topics of the questions in the test. The pre-test act as an indicator of pupils' weaknesses in 4w and where pupils need assistance.

The mean mark which is shown in table 3.2.1b also reflects that the class performance was below standard. If the class was on a better shape they should have scored a mean mark of 50 at least. This showed that the class needed special attention so as to pass mathematics.

Following the marks, there was a follow-up on the questions of the pre-test that were answered by pupils to see how many pupils managed to give correct solutions per question. The following table

relates the data compiled on the questions answered and the number of pupils who came up with correct solutions.

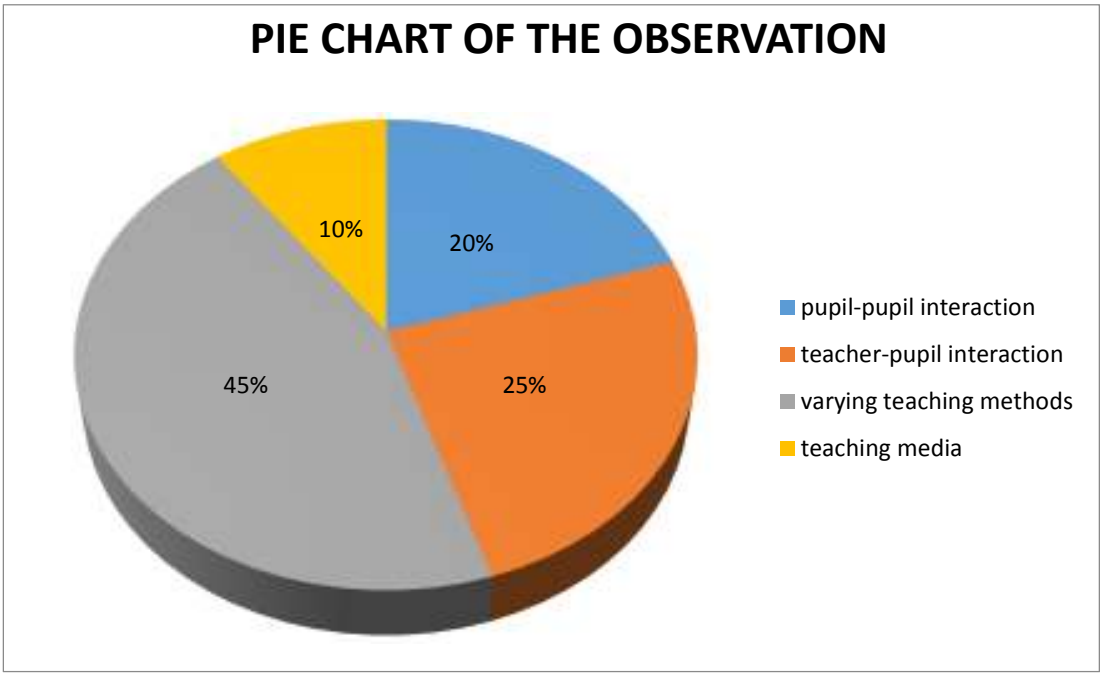
Table 2 Number of pupils who answered each question.

questions of the test	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
no. of pupils answered	17	12	3	6	2	3	2	3	1	1

From the table above it can be noted that questions 1 and 2 were easy for pupils and had general concept of the assumed knowledge. However the other questions were a challenge to pupils as they comprised of more complex question which gives only 25% of correct solutions which also very low. Therefore this concluded that the concepts on the questions that were not answered to be revisited using another method.

Figure 1

Lesson Observations



The pie chart above shows the results gathered from the observation compiled by the researcher. The researcher managed to observe different qualified teachers teaching form 4 classes at Mkwabene High School. During observation, the researcher noted that pupils' involvement was very low which lead to poor communication in the class, resulting in 20% pupil to pupil interaction, pupil to teacher interaction and vice versa. This was caused by lack of teaching media, use of teacher centered methods rather than pupil centered techniques during lesson delivery.

Lack of motivation resulted in pupils misbehaving during the lessons and the greater use of recap in the lessons introductions led to a boring lessons. The researcher also observed that the qualified staff failed to incorporate ICT in an of the lessons that they were teaching and dominated by a 45% of lack of varying in teaching methods which contributed to misbehaving of pupils during lessons.

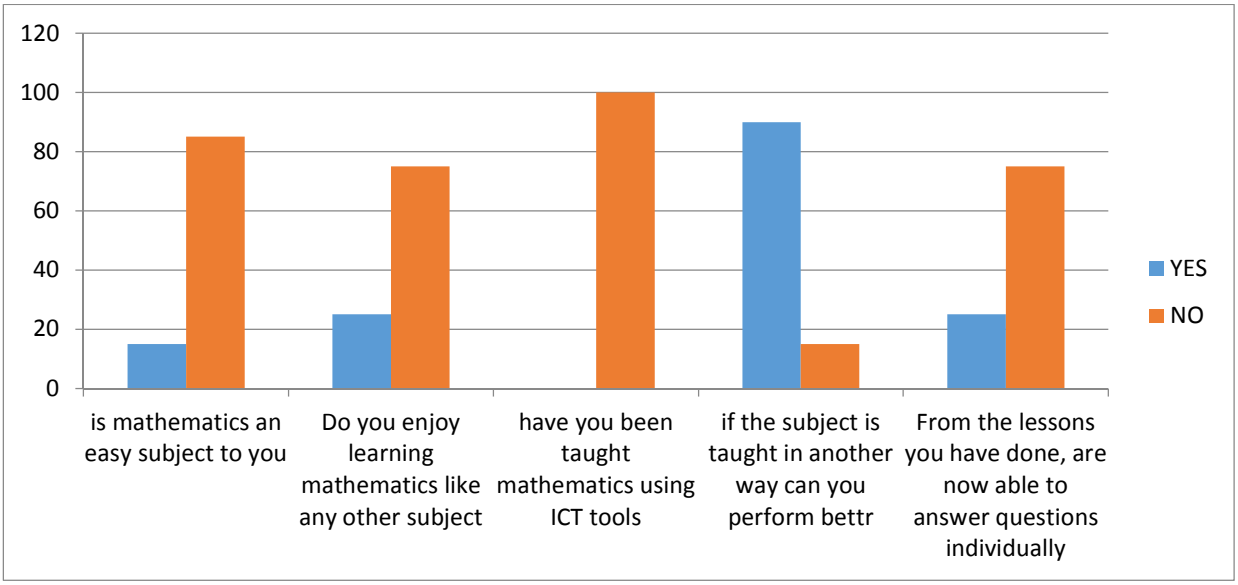
From the results it can be deduced that many teachers had problems in teaching mathematics using learning media. The researcher went on to interview both the teachers and the pupils to find more about why pupils fail mathematics.

Data obtained from interviews from pupils

Following the pre-test, the researcher carried out an interview on pupils in order to obtain information on the challenges they are facing in mathematics and how do they view the subject as compared to other subjects. The graph below has the information obtained from pupils as the researcher was continuing with the investigation.

Figure 2

Graph showing results from the pupils' interviewed



The bar graph above shows the results obtained from pupils' interviews. The graph indicates that out of 20 pupils sampled, 85% found mathematics difficult to them while for the remaining 15% found it easy for them to capture the concepts. Those who had challenges with mathematics seemed that they never understood the concept from the beginning and wondered if there could be a better way that can make them understand mathematics. Because of the attitude they have towards the subject therefore 75% on the graph do not enjoy learning mathematics they are learning it because of the curriculum of the government. The graph also showed that they have never been taught using different teaching methods even ICT.

However learners have the hope that if the subject is taught in another way that can make them understand they can improve. Some pupils still have problems as shown on the graph because about 85% of the pupils are not able to calculate or solve mathematical problems on their own. All the information obtained showed that there is attention that has to be taken to improve the standard of learning of pupils at Mkwabene High School.

Cycle 1

The researcher started by using other methods in delivering the concepts as the school was still organizing how they could allow the researcher to use ICT tools i.e. the projector the venue to conduct lessons and other accessories to be used. The researcher introduced topics normally and mostly formulas and demonstrations without further giving real life examples. The researcher drew shapes and asked pupils to label the sides and to give formula for area and volumes. Only a few had the idea on the concepts some had assumptions. Though they knew the formulas, pupils failed to substitute the values to come up with correct answers.

The researcher then explained the concept on the areas and volumes. The in-class test was given to pupils so as to check if there were improvements. The researcher monitored the test to avoid copying and discussion of solutions. The researcher continued with the topic until the school had finalized the dates and time to use the computer lab to use ICT tools in delivering some of the concepts. The results of the test are shown on the diagram below.

Figure 3

The stem and leaf diagram showing results of the test

stem	leaf
1	1 4 5
2	3 5 6
3	1 4 5
4	0 1 3 5 7
5	0 3 4
6	2 7
7	1
8	

KEY

2 | 0 means 20%

4 | 0 1 means 40% and 41%

The results of the test one shows that the pupils were still having problems on areas and volumes of shapes despite the efforts that were put by the teacher. 14 out of 20 pupils failed the test and only 6 passed the test which gives a 30% pass rate. The researcher had to set down with the pupils to find out what might have been the cause for them to fail. The researcher had to investigate the reasons by interviewing 4w pupils.

Table 3

Interview results for the pupils on their performance

Questions	Yes	No
Are you satisfied about being in this class?	12	33
Are you happy about your performance comparing to other classes?	6	39
Do you think if mathematics can be taught differently you would perform better?	37	8
Do other teachers attend lessons than other classes	0	45

Table 3 indicates that 4w were not satisfied with being in their class and have no problem with it. These learners also strongly agreed that they were not happy about their performance in their school work as compared to other classes. Even though pupils in 4w were failing they believed that if mathematics can be taught in another manner there is room for improvement, but the question was which method the researcher could use to assist the pupils? As one of the last classes the researcher had at Mkwabene High School, teachers were not at their interest as revealed by their attendance to carry out lessons in this class. After finding out that it was not 4w pupils that had problems, the researcher suggested that the pupils should be taught mathematics with another method which will motivate them, giving pupils self-esteem and confidence to relate mathematical concepts with other subjects, the method that will make them realize that mathematics is not a difficult subject rather it's a practical subject which needs more practice. The method was to use ICT in conjunction with its tools to teach all the classes the researcher had although the research was based on 4w. This is why the researcher opted to venture into cycle 2 and incorporate ICT in the teaching and learning of mathematics to see if is true that ICT enhances the performances of pupils.

Cycle 2

The researcher conducted numerous lessons trying to check if the use of ICT on topics of the questions where pupils failed to respond in pre-test. The topics were arranged in order geometrical construction, Area and volumes of shapes and lastly functional graphs. The researcher used ICT as a teaching method to deliver the concepts. Exercises and assignments were given to the whole class though the researcher was working with sample. During lesson delivery the researcher involved pupils in the use of ICT tools and even teach them how to operate them. Pupils were also encouraged to participate in class regardless of the subject being taught.

Group works and pair work were done so as to involve pupils in the lesson. Pupils showed some interest of learning as the researcher gave them class work. They participated very well in class and at the end of every lesson there was a video which shows the applicability of the concept taught on that lesson. This even draws attention from mathematics teachers on how to conduct lessons using ICT. The department had to buy its own ICT Kit as they saw that the pupils were enjoying being taught mathematics using ICT.

After all the lessons were done, the researcher had to test pupils' performance by giving them a test to see if there was change in their performance. Pupils were given an in-class test to check if there were any improvements. This exercise was for 30 minutes so as to have room for revision. There was a maximum supervision to avoid pupils from copying each other and discussing the solutions. All pupils in the class wrote the exercise although the researcher was more concerned on the sample so as not to draw the attention of the pupils in the class.

Table 4

Results for the Post-test

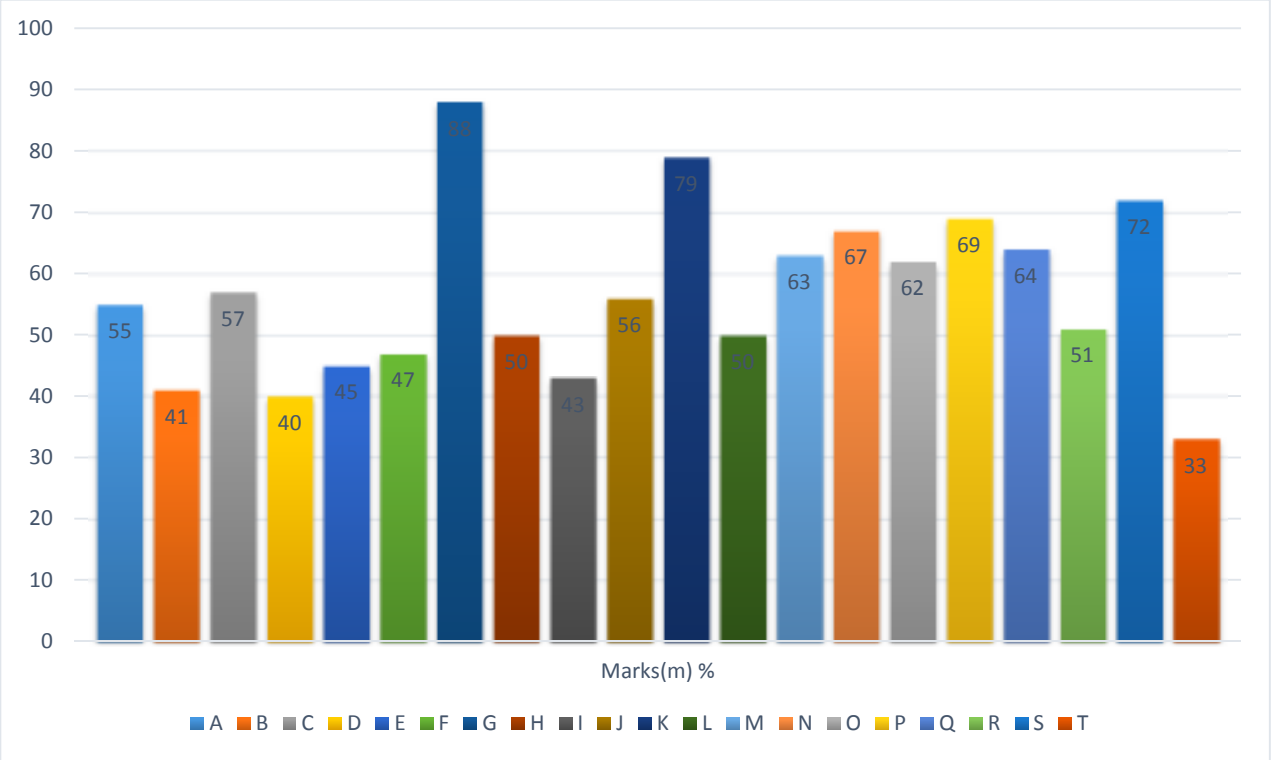
Mark(m) %	Number of pupils
$0 \leq m < 40$	1
$40 \leq m < 45$	3
$45 \leq m < 50$	2

50≤m<60	6
60≤m<70	5
70≤m<80	2
80≤m<100	1

The table shows the result of the test. The researcher notice a huge improvement from pupils, there was an 85% pass rate from the class with a highest score ranging from 80≤m<100. There were a few individuals who failed the test. The researcher noticed that that those who failed needed special attention which other qualified teachers do not give them. The information is further represented by the graph below.

Figure 4

Graph showing results of the test.



The graph above shows the marks obtained by individuals after writing a test. The sample was given such letters to avoid bias of the marks. The chart also shows that 6 pupils failed the test with marks lower than the average, giving a percentage of 30%. The rest of the sample scored above average giving a 70% pass rate. It also reflects the lowest mark of 33% and the highest mark of 88%. This shows that pupils managed to capture concepts in the test written. Because of these results obtained for the test, the researcher decides to analyze to check if the findings are to prove if the use of ICT as a teaching tool is effective.

DATA ANALYSIS

Data analysis is the process of systematically applying statistical and / or logical techniques to describe and illustrate, condense and recap, and evaluate data. According to Shamoo and Resnik (2003) various analytic procedures "provide a way of drawing inductive inferences from data and distinguishing the signal, the phenomenon of interest, from the statistical fluctuations present in data".

In the final analysis of how far the pupils had been helped, tremendous improvement can be noted. The highest number of pupils in a single classification fell between 50% to 60% which was really commendable. It should also be noted that a few pupils, four out of fifteen failed and three learners making 20% scored between 65% and 80% which was a great improvement. The rise of the marks portrayed to the researcher that the giving of notes and counseling had helped.

3.3 DISCUSSION

Comparing with the pre-test results of pupils only three pupils passed and twelve failed, the researcher concluded that the intervention was effective as the majority in the post-test (eleven) scored above average with only four learners ranging between five and nine marks.

Table 5

Comparison of pre-test and post test results

Mark	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Frequency Pre-test	8	2	2	0	3	0	0	0	0	0

Frequency Post-test	0	0	2	2	1	7	2	1	0	0

In table 5 pre-test and post-test results are compared. The pre-test results' climax is reached between 41% to 50%. In the post-test the highest number of pupils is a single classification fell between 61% to 80%. This was clear evidence that performance of learners had improved since the start of the research project. The pupils who got the lowest mark in the pre-test got 55% in the post-test, the highest scored 80%. This served as an illustration that effective or positive learning had been gained by students.

The results of the post-test sowed significant improvement, eleven pupils managed to score above half in the post-test whilst twelve learners had failed the pre-test. It can be noted that with the introduction of intervention strategies there was an increase in pass rate

Out of the intervention given to the learners, the pre-test was badly done with only 20% and 73% was achieved on post-test overall. These patterns indicated that without motivation and resources, learners were performing badly and after the intervention strategies, the pass rate went high. This improvement was due to high self-esteem and great participation from the learners which yielded high results.

Moreover, as indicated by the interview, most of the teachers portrayed a negative attitude towards the slow learners and this was the root cause of the students' failure. It indicated that learners were not motivated and given enough chance to perform better. Even when the pupils put their level best no one was appreciating their effort in class most of the 2 Sykes learners performed very great in sports where they were appreciated by their teachers and given chance to show their talents. Some students performed bad in academics because they were naturally not gifted.

From the interview that the researcher had with the teachers on how they felt about teaching the 2 Sykes learners, most of them indicated that they did not like teaching this class because they are lazy. The researcher realized that lack of effort and motivation from the teachers was one of the factors influencing the failure of students. To overcome this problem, the researcher counseled the learners to remove the belief that they were dull and also motivated them to instill interest of concern and participation in their school work.

Class participation

All the teachers (80%) pointed out that the use of ITC tools increase pupils participate in class .They attributed this to motivation and boost of interest by the media. The researcher then sought to find out whether the teacher's claims were true or not. The Pearson product moment correlation coefficient was then used to find out if there is any association between class participation and the use of ICT tools. The researcher wrote down the number of times a student participated over a two week period in a class with ICT tools and then gave them a test and noted the marks. Participation involved answering questions using a computer in class and also being actively involved in peer teaching. From the sample of 20 pupils two of them did not write the test because they were absent hence only 17 pupils were used.

Table 6

Summary of the findings

Number of times of Participation X	Mark Obtained Y

14	8
16	6
22	12
23	12
30	16
34	17
19	12
27	14
33	14
33	15
10	6
6	6
2	2
35	17
26	13

Table 7.Calculation of PPMCC

Number of times of Participation X	Marks Y	x-$\bar{x}$	(x-$\bar{x}$)2	y-y	(y-y)2	(x-$\bar{x}$)(y-y)
14	8	-6.5	42.25	-3.3	10.89	21.45
16	6	-4.52	20.4304	-5.3	28.09	23.956
22	12	1.48	2.1904	0.7	0.49	1.036
23	12	2.48	6.1504	0.7	0.49	1.736
30	16	9.48	89.8704	4.7	22.09	44.556
34	17	13.48	181.7104	5.7	32.49	76.836
19	12	-1.52	2.3104	0.7	0.49	-1.064
27	14	6.48	41.9904	2.7	7.29	17.496
33	14	12.48	155.7504	2.7	7.29	33.696
33	15	12.48	155.7504	3.7	13.69	46.176
10	6	-10.52	110.6704	-5.3	28.09	55.756
6	6	-14.52	210.8304	-5.3	28.09	76.956
2	2	-18.52	342.9904	-9.3	86.49	172.236
35	17	14.48	209.6704	5.7	32.49	82.536
26	13	5.48	30.0304	1.7	2.89	9.316
20	12	-0.52	0.2704	0.7	0.49	-0.364
22	11	1.48	2.1904	-0.3	0.09	-0.444

17	6	-3.52	12.3904	-5.3	28.09	18.656
14	9	-6.52	42.5104	-2.3	5.29	14.996
32	15	11.48	131.7904	3.7	13.69	42.476
4	15	-16.52	272.9104	3.7	13.69	-61.124
22	12	1.48	2.1904	0.7	0.49	1.036
11	10	-9.52	90.6304	-1.3	1.69	12.376
472	260	0.06	2157.479	0.1	364.87	690.282

From table we have:

Sxx= Σ(x-x̄)2=2157.479

Syy= Σ(y-y)2 = 364.87

Sxy = Σ (x-x̄)(y-y) = 690.282

$$r_{xy} = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$$

where

$$S_{xy} = \sum (x_i - \bar{x})(y_i - \bar{y}) = (n-1)s_{xy}$$

$$S_{xx} = \sum (x_i - \bar{x})^2 = (n-1)s_i^2$$

$$S_{yy} = \sum (y_i - \bar{y})^2 = (n-1)s_y^2$$

$$r = \frac{S_{xy}}{\sqrt{S_{xx}S_{yy}}}$$

$$r = \frac{690.282}{\sqrt{(2157.479)(364.87)}}$$

=0.78

This suggests that there is a positive correlation between class participation and the use of ICT tools .It therefore means that the more are the ICT tools are used in class the greater the participates by pupils, the greater the chance of passing and the less the participation then underperformance might result.

To be absolutely sure the researcher decided to test the value of r for significance. This is when a correlation coefficient obtained from a sample is tested to find out whether it provided significant evidence that the correlation coefficient of the corresponding population is different from zero. The following t-statistic was used

$$R=\frac{r\times\sqrt{(n-2)}}{\sqrt{1-r^2}}$$

Where n = the number of pairs of observations

v=n-2

 If t < critical value, there is no correlation between the two variables.

 If t > critical value, there is a correlation between the two variables.

In our case n= 23 and r= 0.78 hence

v= 23-2

= 21

At 0.05 t tables= 2.080

$$t=0.78\sqrt{\frac{21}{1-(0.78)2}}$$

tcal= 5.7

tcal > t tables

5.7 > 2.080

Based on this sample there appears to be a positive correlation between class participation and use of ICT tools. Hence those pupils who do not participate underperform in mathematics.

Table 8

Category of responses	Frequency	Percent	Cumulative Percent
strongly	6	20	20
disagree	6	30	50
disagree	0	0	50
not sure	7	35	85
agree	3	15	100
strongly agree	20	100	
Total			

Table 9

Teachers responses

Category of responses	Frequency	percent	Cumulative percent
Strongly disagree	1	25	25
disagree	2	50	75
Not sure	0	0	75
Strongly agree	1	25	100
Total	4	100	

Most of the students (75%) did not agree that lady teachers are reluctant to use ICT tools. 25% agreed that ladies are reluctant to use computer technology in the teaching of mathematics at o level. Most of the teachers (75%) also disagree that Lady teachers do not use ICT tools.

The researcher then sought to test whether the use of ICT is linked to gender or not. He took the responses of pupils and grouped them according to gender thus a chi square test was conducted at 5% significance to determine whether the use of ICT is linked to gender. A chi square test is used to determine whether there is a significant association between two variables. The researcher used a chi square to determine whether use of ICT is linked to gender.

Table 10

Observed Frequencies

CATEGORY	YES	NO
Male	6	3
Female	6	5
Total	12	8

Using a χ^2 test at 5% significance level to test if performance is independent of gender.

H0: There is no significant association between gender and use of ICT tools

H1: There is a significant association between gender and use of ICT tools

Degrees of freedom

= (r-1) (c-1)

= (2-1) (2-1)

= 1x1

=1

Table 11

category	yes	No	Row total
Male	6	3	9
Female	6	5	11
Column total	12	8	20

Table 12

Expected frequencies

category	Yes	No	Row total
Male	5.4	3.6	9
Female	6.6	4,4	11
column	12	8	20

Table 13

Calculation of chi-square

Observed	**Expected**	**(O-E)**	$(\boldsymbol{O-E})^{\mathbf{2}}$	$\frac{(\boldsymbol{O-E})^{\mathbf{2}}}{\boldsymbol{E}}$
6	5.4	0.6	0,36	0.067
6	6.6	-0.6	0,36	0.055
3	3.6	-0.6	0,36	0.10
5	4.4	0.6	0,36	0.081

$\chi^2 = \sum \frac{(O-E)^2}{E}$

χ^2 = 0.906Since χ^2 calculated < χ^2 5% (5%) critical, I accept H0 and conclude that there is no significant association between gender and use of ICT tools. Therefore the use of ICT tools is not affected by whether one is male or female.

Table 14 : **Does the level of qualification affect the use of ICT**

Category of Responses	frequency
Strong disagree	23
Disagree	17
Agree	30
Strongly agree	30

Responses of pupils

The researcher sought to find out whether level of qualification affect the use of ICT tools as the Media. Amond the four teachers at this school three are diploma holders and one has a degree.40% of the respondents disagreed with the assertion that teachers who are diploma holders can use ICT tools effectively. Those who agreed with this statement constituted 60%.This is in line with what Nyaumwe etal (2004) reported,that level of qualification has a bearing on the type of media.

The researcher also use chi-square test to test whether there is an independent association between level of qualification and ICT use.

Table 15: Does level of qualification affect use Determine the use of ICT

Category	Yes	No
Diploma holders	8	3
Degree holders	4	5
Colunm Total	12	8

H_0 There is an association between level of qualification and the ICT use.
H_1 There is no association between level of qualification and the ICT use

Using a chi-square test at 5% significance level to test whether level of qualification has an effect on the use of ICT tools.

Degrees of freedom=(r-1)(c-1)=2-1)(2-1)=1

Table 16

Category	Yes	No	Row total
Diploma Holders	8	3	11
Degree Holders	4	5	9
Column	12	8	20

Table 17

Expected Frequencies

category	Yes	No	Row Total
Diploma holders	6.6	4.4	11
Degree holders	5.4	3.6	9
Column total	12	8	20

Table 18

Calculating chi-square

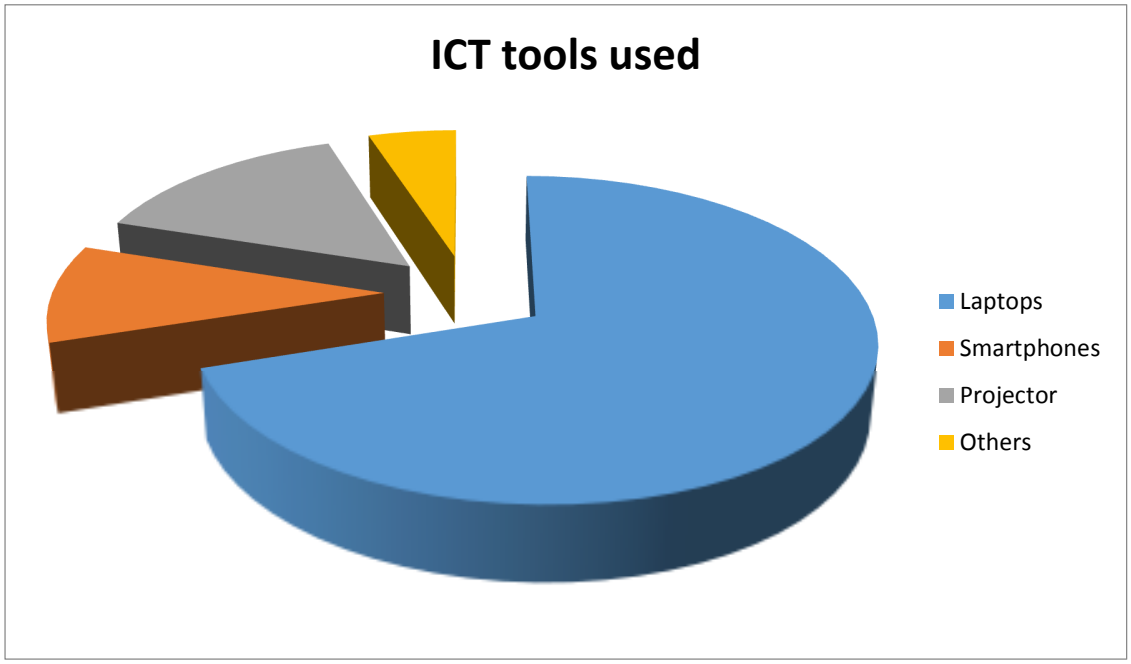
Observed	Expected (E)	(O-E)	$(O-E)^2$	$\frac{(o-E)^2}{E}$
8	6.6	1.4	1.96	0,297
4	5.4	-1.4	1.96	0.363
3	4.4	1.4	1.96	0.445
5	3.6	-1.4	1.96	0.544

$\sum \frac{(O-E)^2}{E}$ =1.649 χ^2 calculated < χ^2 critical

Since χ^2 calculated < χ^2 5% (5%) critical, I accept H0 and conclude that there is a significant association between level of qualification and use of ICT tools. Therefore the use of ICT tools is affected by the level of qualification .according to research findings diploma holders tend to shun the use of ICT tools .The reason might because there are not computer illiterate.

The researcher wanted to find out the most used ICT the data was summarized in the pie chart that follows

Figure 6 .ICT tools Used



According to the research findings the most commonly used ict tools are laptops which constitute 70% of the tools. Projector is the second most used which constitute 15%.Smartphones take a small share though expected to be the most dominate, this is because of the school policy which does not allow kids to bring phones to school.

The number of computers of ICT tools available at school has a n impact in the teaching and learning of mathematics. The research sought to find out the number of the tools available for use by the pupils. The table below shows the tools available.

Table 19 : ICT tools

ICT tools	Number
Computers	12
Smart phones	3
Projector	1

The number of tools is far lesson than the expected number.in a class of 45 pupils only 12 computers are available to be used during lessons. The pupil –to-computer ratio is too small .This reduces the impact of ict tools in the teaching and learning of mathematics.

Does the school have access to internet connection?

The researcher wanted to find whether the school has the access to internet services .internet help pupils to make research on net. Pupils can access current information and new mathematical ideas on net. Pupils can also down load essential software that can be used in maths lessons. It was found that the school is well connected with a satellite dish installed .However during the time of research the modem was non- functional. This had obvious affected the learning of maths during the time of research period. However 100% of those interviewed acknowledged fairly mobile phone connection to internet.

SUMMARY

Having made an analysis of the data, the researcher will in the next chapter draw conclusion and make recommendations so the use of ICT tools is used in schools can be appreciated and enjoyed as well in the teaching and learning of mathematics.

CHAPTER 5

Summary, Conclusions and Recommendations

5.0 Introduction.

This chapter presents the summary, conclusions and recommendations. The conclusions drawn are after the analysis of the research objectives of the study.

5.1 Summary

The purpose of this study was to determine the impact of ICT tools in the teaching of mathematics at Olevel in mkwabene high in insiza district in matebelaland, so that management interventions could be designed to enhance the use of information computer technology in the teaching and learning of mathematics. In chapter 1 an exposition was given to the nature of the problem which the researcher identified and felt the need to study. It was observed that ICT tools are not adequately used in the teaching and learning of mathematics at mkwabene high school. The aim of the study, research design and programme of study were highlighted in this chapter.

Chapter 2 which involved a literature study formed the theoretical framework for the study. In this chapter, the concept information computer technology ICT, reasons for use of technology, how to use technology and impact of ICTs in teaching and learning of mathematics were examined. The general implications of ICT to education were pointed out and the state of affairs in the period under study in the Zimbabwean education system was described.

Chapter 3 involved an exposition of the research design and methods employed in the study. A quantitative research design which used the descriptive sample survey method to collect data by means of questionnaire interview schedules and intervention strategies was deemed most suitable. The setting for this study was Olevel pupils at mkwabene high schools in Insiza South of Matabeleland South Province. A random stratified sample of 10 boys and 10 girls was selected for the study in a class consisting of a total of 45 pupils. The sample was fairly representative of Olevel pupils at mkwabene high school. A self -constructed, self -administered and self -contained structured questionnaire which was pilot tested with 6 respondents (Olevel pupils) was used to collect data from all the subjects in the sample. The researcher personally administered the questionnaire to respondents and waited while each respondent filled it on the spot and personally

collected it. Interview schedules were conducted personally by the researcher. This resulted in a 100% response rate.

Chapter 4 involved the analysis and interpretation data. The data was personally analysed qualitatively and quantitatively by the researcher. The study findings of the first objective which sought to give insight into the merits of using ICT in teaching and learning of mathematics at Olevel revealed that ICT improves performance in tests .A pre-test was showing poor performance more than 80% of pupils failed the test after the class was taught using ICT tools performance was enhanced, about 70 % pupils passed the test. In the final analysis of how far the pupils had been helped, tremendous improvement was noted. The highest number of pupils in a single classification fell between 50% to 60% , which was really commendable. It should also be noted that a few pupils, four out of fifteen failed and three learners making 20% scored between 65% and 80% which was a great improvement. The rise of the marks portrayed to the researcher that the use of ICT tools had helped.

Comparing with the pre-test results of pupils only three pupils passed and twelve failed, the researcher concluded that the intervention was effective as the majority in the post-test (eleven) scored above average with only four learners ranging between five and nine marks.

This part of the study discusses objective two and three which sought to promote the use of ICT tools and to stimulate confidence in pupils to learn mathematics. All the teachers (80%) pointed out that the use of ITC tools increase pupils participate in class .They attributed this to motivation and boost of interest by the media. The researcher then sought to find out whether the teacher's claims were true or not. The Pearson product moment correlation coefficient showed that there is an association between class participation and the use of ICT tools. It therefore meant that the more ICT tools used in class the greater the participation and the greater chances of passing. It also sought to assess whether the use of ICT tools is gender sensitive .Most of students 75% did not agree that ladies are reluctant to use ICT tools .Also 75% of teachers disagree with the view that ladies are reluctant to use ICT tools .The research used chi square test to determine whether there is a link between gender and the use of ICT tools ,which was found to be not related at all

Objectives five and six sought to improve the learning atmosphere in the class room and to give pupils the opportunity to use ICT tools while learning mathematics. Teachers should however be qualified to be able to create a learning environment which is conducive The researcher went on

to sought out whether level of qualification affect the use of ICT tools as the media.40 % of the respondents agree that those who are diploma holders fail to use computer instructions. This is in line with what Nyaumwe etal (2004) reported, that the level of qualification has a bearing on the type of media used. The chi square test indicated that there is a significant association between level of qualification and the use of ICT tools. Diploma holders tend to shun the use of ICT tools, reason might because there are computer illiterate. In order to create the enriched environment a variety of ICT tools should be used according to research findings the mostly common used ICT tools are laptops which constitute 70% .Projector is the second used which constitute 15% .Smart phones take a small share though expected to be the most dominate .The research also took stock of the number of computers which are available for use. There are only 12 functional computers in this school with 320 pupils .The number is far less than the recommended ratio .Therefore the environment is lacking adequate ICT tools. The school policy also banners pupils from bringing Smart phones in school.

The researcher wanted to find out whether the school was connected to internet services. The school was well connected with satellite dish installed , however during the time of research the modem was nonfunctional. This affected access to information. However 100% those interviewed acknowledged fairly mobile phone connection to internet

Chapter 5 presents the solvent aspects of the findings. The main conclusion drawn on the basis of the literature study and the results of the present study are highlighted. In this chapter guidelines and suggestions for the use of ICT tools are offered. The limitations of the present study are also presented here.

The pupils cited many reasons for why they there is less impact of ICT tools in the teaching of in mathematics. Firstly they said that the teachers do not use ICT tools in the teaching and learning in the class. It was also indicated that some teachers do not effectively use ICT tools in teaching and learning of mathematics. Teacher's responses showed that there don't have adequate soft wares to be used in the teaching and learning of mathematics .Lack of ICT tools also clearly defines the reason for less impact of ICT tools. The ratio of ICT tools to pupils was a cause of concern. Some pupils also pointed out that the internet services are not always available every month because the school sometimes fails to pay monthly subscription to net-one. Some respondents pointed out that diploma holder shun the use of ICT tools maybe because there are computer

illiterate. This led the researcher to conduct a chi-square test to test whether there is an association between level of qualification and uses of ICT tools. The results pointed out that use of ICT tools was dependent on the level of qualification. Some pupils cited the issue of gender as a contributing factor to poor use of computer technology in the teaching of mathematics. This also lead to the researcher to carry out a chi-square tests to check whether there is an association between the use of ICT tools and gender .The results showed out that the is an association between the two variables.

Teachers cited that their work loaded affected their work which led to underperformance and failure to employ ICT tools in their lessons. They also cited the lack of enough computers in the school. They also pointed out that children do not participate in class because of lack of resources and motivation; hence there are the ones who usually fail or underperform in mathematics. The researcher then tested for correlation between class participation and the use of ICT tools in class. The results indicated that there is a strong positive correlation between use of ICT tools and class participation. The post –tests also established that involvement of ICT tools increased pupils performance. The most common measures to curb underperformance indicated by teachers include giving students remedial work and extension work, pupils should get extra help from home, pupils should be encouraged to participate more and more information computer technology should be made available.

5.2 Conclusions

5.2.1 Conclusions from literature study

Although the introduction of Information and Communication Technology (ICT) into schools is associated with valuable opportunities, there is no one formulae for determining the optimum level of the ICT integration into these schools. Significant challenges that policy makers and planners, educators and other stakeholders need to consider include lack of human resources, poor infrastructure, distracters and financing. There are three educational challenges and opportunities that can be linked to the introduction of Information Communication Technology (ICT) into schools in Zimbabwe.

According to the Macmillan Dictionary (2007) challenges are things needing greater mental or physical effort in order to be done successfully. For this purpose, challenges are difficulties linked

to the introduction of Information and Communication Technology into schools. Opportunities are a set of circumstances that makes it possible to do something. Opportunities are advantages associated with the introduction of (ICT) into schools.

.The literature revealed that lack of human resources, poor or lack of infrastructure for the technology and distracters as main challenges. On the other hand, extension of educational opportunities to ethnic and minority groups, improvement in the quality of education and availability of learning resources will be taken as opportunities linked to the introduction of Information and Communication Technology (ICT) into schools in Zimbabwe.

5.2.1.1 Lack of human resources

According to Kasekende (2008) introduction of Information and Communication Technology is usually associated with lack of instructors. This is also echoed by Bruce (2003) who indicates that when it was introduced in African schools, planners and policy makers did not consider human resource availability within countries. The introduction of ICT at mkwabene high school in insiza south suffer the same fate. Teachers have little or no knowledge about the new technology. At Hillside Teachers' College, ICT was introduced in year (2011), at Bondolfi Teachers' College; it was introduced in 2008 which is evidence to show that there is still a critical shortage of human resources since the majority of teachers do not have adequate ICT knowledge. It is however imperative that administrators should manipulate these few ICT fluent teachers to share ideas with other teachers so that training should not only be shouldered on Government.

On the same note, Song (2007) supports the above notion by indicating that due to lack of human resources, maintenance of ICT equipment is very poor. All what it means is that although some schools received computers as donations from the President, from 2000, a lot of these computers are no longer functional due to lack of maintenance. The computers are exposed to various forms of viruses because they are operated by non-professionals in the field on Information Communication Technology. Mkwabene received a total of 37 computers but only 12 are now functional. Introduction of ICT into schools will continue to be less useful without benefiting both students and teachers especially if the issue of maintenance is not given a close consideration. Alternatively, schools can fundraise and seek for donations to enable them to hire ICT specialists. Such a move will ensure that ICT gadgets like computers are always maintained for the benefit of students

Furthermore, various competences must be developed throughout the education system for ICT integration to be successful (Harnes, 2002). The main challenge in Zimbabwe is that teachers who are already in schools lack pre-service and in-service training especially in Matabeleland South Province where in-service training is non-existent especially in the Insiza District. ICT is a swiftly evolving technology that even the most ICT fluent teachers need to continuously upgrade their skills and keep abreast of the latest developments and best practices. The fact that there is limited pre-service and in-service training, Information and Communication Technology is not likely to be useful especially in the rural areas. This problem, can, however be minimised by hiring ICT fluent teachers at an incentive to pre-service and in-service other teachers within schools

Leadership plays a key role in ICT integration. Many teachers' or students' initiated ICT projects have been undermined by lack of support from administrators due to ignorance and lack of technical skills in the area of Information and Communication Technology (Samuel, 2005). It means that the implementation of ICT into schools in Zimbabwe is going to be very difficult because there are a limited number of sustainable and effective administrators who are competent in the use of the technology and having a broad understanding of the technical curricular, administrative, financial and social dimensions of the ICT use in schools. This is due to the fact that the majority of administrators were not trained in ICT education since ICT education is a new development. In a bid to counter this problem, the policy makers should ensure that each administrator is acquainted with ICT knowledge through government sponsored workshops to be held at least thrice per year.

According to the World Bank (2006) there is lack of technical support specialists. This is not either provided by in-service staff or external service providers or both. This can be one of the challenges in Zimbabwe because in schools already using ICT, lack of technical support is hindering continued viability. Without this onsite technical support, much time and money is lost due to technical breakdowns of ICT equipment. This is due to lack of maintenance of technical equipment (including software), network administration, and network security. In the rural areas of Matabeleland South Province, lack of timely technical support in schools, disabled computers take months and years to be repaired since there are no technicians available in the immediate vicinity and so computers have to be sent to the nearest city hundreds of kilometers away. However, as a solution, School Development Committees can fund the training of at least two permanent local

teachers as a way of equipping them with technical support skills to minimize technical breakdowns of ICT equipment since these teachers are less likely to leave. In fact, schools should not solely rely on the government for funding if ICT introduction and implementation is to be successful.

5.2.1.2 Lack of Infrastructure for the technology

There might be lack of infrastructure as a disturbing challenge. Firstly, introduction of ICT will incur recurrent cost of building rooms to house the technology. In Zimbabwe, especially in the poor rural schools, there are no extra rooms to house the technology. The government donated the computers and non- government organizations, like World Vision, donated televisions and decoders, especially in Matabeleland South Province 5 years ago. These gadgets are rotting in strong rooms because the communities in these rural areas are failing to raise funds for building, electrifying and securing specialized rooms to house the technology. To solve this problem, existing electrified classrooms can be used for ICT teaching and learning. The only danger is that damages might be incurred in the process of shifting computers from strong rooms to classrooms and vice versa.

According to Kasekende (2008), in African rural areas where there are many old school buildings, renovations, electrifying, heating or cooling and ventilation requires exorbitant amounts of money which can only be raised through donor funding. It means that introduction of ICT into schools in Zimbabwe is likely to suffer the same consequences. To make matters worse the majority of rural schools are in the remotest areas of Zimbabwe like Binga, Chiredzi South and Gokwe and are not yet electrified. Without electricity, Information Communication Technology can be difficult to integrate. This problem can be solved by resorting to the use of solar power. Also the use of cell phones can be adopted since they do not require much power but are as useful as computes in acquiring information from the internet.

5.2.1.3 Distracters as a challenge

Introduction of Information and Communication Technology is associated with distracters on the part of students in form of pornography, games, music, videos, chartrooms, messages, emails and the face book (Cuban 2006). Usually, students are taught doing the wrong things. In fact it

perpetuates the hidden curriculum. In Zimbabwe, students already benefiting from the new technology are accessing destructive information like pornography especially through their phones which is somehow hindering academic achievement and enhancing teenage pregnancy and dropouts. Such a challenge and others like availability of games, music videos and the face book are likely to divert students from concentrating on the formal curriculum and leading to a high failure rate. The issue, can however, be dealt with during internet installation where specialists can block access to distracters such as pornography, music and others. Distracters can however be very difficult to control especially if students access the internet through their mobile phones because there is no way these distracters can be controlled.

5.2.1.4 Opportunities that can be linked to the introduction of ICT

5.2.2.4.1 Extension of educational opportunities to ethnic and minority groups

According to Muijis and Reynolds (2001) ICT is a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously undeserved communities scattered and rural population, groups traditionally excluded from education due to cultural, social or political reasons such as ethnic minorities, women and girls, persons with disabilities and the elderly, as well as all others who for reason of cost or time constraints are unable to enroll for formal education. It means that the introduction of ICT can be a blessing to the black communities in Zimbabwe because the majority of them were disadvantaged by the colonial policies which were discriminatory. The above opportunity, however, depends on the geographical location of schools. People in remote areas without electricity as well as phone and radio signals are likely to remain in the dark hence the use of solar power can be very expensive.

5.2.1.4.2 Improvement in the quality of education

Myhill (2006) denotes that the introduction of ICT into schools enhances the quality of education by increasing learner motivation and engagement by facilitating the basic skills. It shows that introduction of ICT into Zimbabwean schools would facilitate a shift from teacher centered learning to learner centered environment. ICTs such as videos, television and multimedia, computer software that combine texts, sound and colourful moving images can be used to provide challenging and authentic content that will engage the student in the teaching process. Interactive radio likewise makes use of sound effects, songs, dramatization, comic skits, and other

performance conversions to compel the students learn as they do in contrast to memorization based or rote learning. ICT increases learner engagement. According to Song (2007) ICT enhanced learning is called "Just-in-Time" learning in which learners can choose, what to learn, when they need to learn it. This opportunity however depends on the attitudes and knowledge of both teachers and learners on the use of ICT in the teaching and learning.

5.2.1.4.3 Access to a variety of educational resources

According to Samuel (2005), introduction of ICT would see teachers and learners no longer relying solely on printed books and other materials in physical media housed in libraries (and available in limited quantities) for their educational needs. It means, with the internet and the worldwide web, a wealth of learning materials in almost every subject and in a variety of media will be accessed from anywhere at any time of the day by an unlimited number of people. This will be very important for schools that have limited and outdated library resources and located in areas with electricity and Econet cell phone network. Also ICT facilitates access to resource persons, mentors, experts, researchers, professionals and peers all over the world. Bishop (2006) supports the above notion by indicating that ICT makes possible asynchronous learning, or learning characterized by a time lag between delivery of instruction and its reception by learners. On line course material may be accessed 24hours a day and 7 days a week. ICT based education delivery (e.g. Educational Programming Broadcast over radio or television) also dispenses without the need for all learners and instructor to be in one physical location. This, however also depends on the state of ICT knowledge and fluency on the part of both teachers and students on how to access information from the internet. Currently the ICT courses offered at colleges and universities produce half cooked graduates who are equipped with theory rather than practice. This is very commonly associated with Midlands State University where ICT module at undergraduate and post graduate levels is taken as a half course.

5.2.2 Conclusions from empirical investigation

5.2.2.1 Lack of ICT tools (resources)

The number of ICT tools is far less than the expected number that can significantly make the maths teachers and pupils realize the advantages of information computer technology.The researcher found out that there are only 12 functional laptops ,3 smartphones for teachers and only one

projector. This number has a little impact in the teaching and learning of mathematics .However the school has received 37 computers ,20 computers donated by the former president of Zimbabwe (R G Mugabe) and 17 donated by tools with a mission (NGO).About 25 have been damaged by virus because there were keep for long in strong room without being used. The school has only over-head project which 13 teachers share. The number of projectors is not adequate, teachers sometimes fail use projector in their lessons because someone would be using it. There are only three smart phones for teachers. According to the school policy pupils are not allowed to bring phones at school. However the SDC has installed a satellite dish which makes it possible to access internet services. However due to poor in income flows the school is failing to subscribe every month to tel-one. This affect the smooth access of information from internet.

5.2.2.2 Lack of Trained Staff in computers

Teachers are under qualified and are computer illiterate .There are three diploma holders who are teaching mathematics .these teachers don't have expertise to teach mathematics using ICT tools .Lessons observed indicated that there was little or no use of ICT tools. The researcher found out that 60% person of the responded agreed that that diplomas holders are failing to use ICT tools. The school has computer illiterate teachers since 2007.Computers donated are always in the strong room and are not used at all .The number of 27 non -functional computers is due to the fact that there stayed for too ;long without being used some hence there have been affected by virus and crushed. Some have small technical faults but there is no one trained or technical to fix the problems.

5.2.2.4 Improvement in the quality of education

The use of ICT in the teaching increased performance, this was evident when the post test was better done than as compared to pre- test which was given before the research used ICT tools in his lesson. All teachers (80%) pointed out that the use of ICT tools increase pupils participation in class. They attributed this to motivation and boost of interest by the media. ICTs such as videos, television and multimedia, computer software that combine texts, sound and colourful moving images can be used to provide challenging and authentic content that will engage the student in the teaching process. Interactive radio likewise makes use of sound effects, songs, dramatization, comic skits, and other performance conversions to compel the students learn as they do in contrast

to memorization based or rote learning. ICT increases learner engagement. The claim was tested using a Pearson product moment correlation coefficient, the results were positive.

5.3.Problems encountered during the conduct of the research and how these were minimized.

The problem encountered was lack of funds to finance this project. Sometimes the researcher failed to do printing in time because of lack of funds .It was very costly to travel from filabusi to bandura to consult supervise. Therefore it means the research struggled to come up with this project. The distance and cost of travelling real affected the submission time of this project. The time which was allocated to conduct this research was very little. The research was done in less than two months which then compromise the quality of the research findings. The research asked for permission to use school printers and photocopier, this real assisted him to finish his project in time. Instead of travelling the researcher consulted his supervisor using e mail and telephone.

5.4 Limitations and their implications to the study

The present study has a number of limitations. The results of this study must be interpreted and applied with several considerations in mind. First, the results of the present investigation only draw a picture of the impact of ICT tools in the teaching and learning of mathematics at mkwabene high school at a particular point in time. It is not known how stable these results are or whether they change over a longer period of time say for instance over a period of more than ten years.

The time and financial resources available for this study were not enough to carry out a large scale study hence concentrating on only one Olevel class at mkwabene high schools in Insiza South District was a major drawback. The researcher wished to conduct research on a macro scale including all schools in Matabeleland South Province was going to produce more reliable results. It should however be noted that the findings from this micro scale research may impact negatively on conclusions drawn to generalize a system used on a large scale like the whole country.

Secondly, the study was geographically restricted to one school in which the researcher is teaching because it involved only 20 o' level pupils from one class the impact of ICT tools in the teaching and learning of mathematics in other classes ,other rural schools urban schools, primary schools and colleges will remain unknown. The study is limited to the impact of ICT tools in one school in insiza south district.

The present section presented the limitations of the empirical investigations. In the next section, major recommendations and suggestions are provided.

5.5 Recommendations and suggestions

After making conclusion the researcher recommended the following to the pupils, teachers and parents

 Teachers should motivate their children and should also find ways of making mathematics enjoyable so that pupils do not lose interest

 Teachers should advance themselves in order to be at par with computer technology. Diploma holders to do computer courses . ICT is a swiftly evolving technology that even the most ICT fluent teachers need to continuously upgrade their skills and keep abreast of the latest developments and best practices. This problem, can, however be minimised by hiring ICT fluent teachers at an incentive to pre-service and in-service other teachers within schools This will make them relevant to this computer world.

 More software should be installed in computers that are relevant to the teaching of the subject examples include TEXMAKER and MARPLE software.

 The school to buy or source more computers so that the ratio of computers to pupils improves. School Development Committees can fund the training of at least two permanent local teachers as a way of equipping them with technical support skills to minimize technical breakdowns of ICT equipment since these teachers are less likely to leave. In fact, schools should not solely rely on the government for funding if ICT introduction and implementation is to be successful.

 During internet installation specialists can block access to distracters such as pornography, music and others. Distracters can however be very difficult to control especially if students access the internet through their mobile phones because there is no way these distracters can be controlled. The school to revise its policy on smart phones, it should encourage all kids to bring smart phones at school. However a clear effective system should adopted too curb any abuse of these gadgets.

 Schools should invite parents or guardians to encourage them to provide support and assistance to their children .Parents can assist kids by buying enough gargets for their kids and buy enough bundles for their children to access internet.

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Appendix I

Pupils' Questionnaire

An investigation on the impact of information computer technology aided education has in the teaching and learning of ordinary level mathematics at Mkwabene high school.

May you please respond to the following questions?

Instructions

1. Names should not be indicated on the questionnaire.

2. Responses should be shown by ticking and or provision of an explanation where appropriate.

QUESTIONS

1. Sex Boy ☐ Girl ☐

2.Teachers lady teachers do not use or effectively use ICT tools in the teaching and learning of mathematics.

Strongly Agree ☐ Agree ☐ Not sure ☐ Disagree ☐ Strongly Disgree ☐

3.Diploma holders teachers do not use or effectively use ICT tools

Strongly Agree ☐ Agree ☐ Not sure ☐ Disagree ☐ Strongly Disagree ☐

3. List the ICT tools mostly used by your teacher when teaching maths

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4. Do you use smart phones YES No

If no why

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5. What can be done to help pupils pass?

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6. What are your comments, contributions or suggestions to this study?

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Thank you for contributions.

Please contact 0712969038 or melulekihebert@gmail.com for any further enquiries or clarification.

Appendix II

Teachers questionnaires

An investigation on the impact of information computer technology aided education has in the teaching and learning of ordinary level mathematics at Mkwabene high school. Instructions

1. Names should not be indicated on the questionnaire.

2. Responses should be shown by ticking and or provision of an explanation where appropriate.

1. Sex M ☐ F F ☐

2. Highest qualification

Certificate ☐ Diploma in Ed ☐ Degree cert ☐

……

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3. Name specific maths software that are available in your computers

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4. What is your opinion with regards to school policy concerning the use of smart phones by pupils

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5 What do you think are the attributes of less impact of ICT tools in maths teaching and learning

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Thank you for contributions.

Please contact 0712969038 or melulekihebert@gmail.com for any further enquiries or clarification.

Appendix III

Interview guides for pupils

1Are you satisfied about being in this class

2. Is mathematics an easy subject to you

3.Are you happy about your performance comparing to other classes

4.Do you think if mathematics can be taught different you would perform better

5 Do other teachers attend lessons than other classes

6.Do you enjoy learning mathematics like any other subject.

7 Have you been taught mathematics using ict tools

8 .From the lessons you have done, are now able to answer questions individually

9 Do you use smart phone at school

10 .What can you say about internet access at your school..

Appendix IV

Interview guide for Teachers

1 How many computers available in your school

.2 How often do you use itc tools in your lessons?

3.Do you have a variety of softwares that you use in maths**?**

3.What is the school policy on smart phones and what is your reaction to this policy?

4.do you have computer competent skills to