

Influence of Information and Communication Technological (Ict) Tools in the Teaching and Learning of Flowcharts in Mathematics in Secondary Schools

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Abstract: Information and Communication Technology (ICT) is beginning to be seen as one of the major instructional element especially in mathematics. This study investigated, the effect of ICT tools on students' understanding of flowchart concepts in Mathematics, the impact of ICT-supported instruction on students' ability to create and interpret flowcharts in Mathematics and determine teachers' perceptions of using ICT tools for teaching flowchart concepts in Mathematics. This study was conducted in Petauke district in Eastern province, Zambia. The targeted population comprised of 10 Randomly selected Secondary schools in the district, 50 mathematics teachers and 150 pupils formed the study sample. The study employed questionnaires as analysis guide in data collection. The questionnaire was analysed using chi-square (X²) statistical technique from spss version 25. The frequency count of each item in the questionnaire was tallied and raw score computed into simple percentages. Also, chi-square (X²) statistical technique was employed to analyse the research hypothesis. The results of this investigation established that ICT tools play a significant and positive role in the teaching and learning of flowchart concepts in secondary school Mathematics. Students exposed to ICT-enhanced instruction demonstrated better understanding, improved ability to create and interpret flowcharts, and higher engagement levels than those taught through conventional methods. Teachers also expressed positive attitudes toward ICT integration, although infrastructural challenges remain. Overall, the findings indicate that effective and well-supported use of ICT tools can substantially improve both teaching practices and student learning outcomes in flowchart-related Mathematics concepts. Integrating ICT in Mathematics education is therefore not only beneficial but essential for modern, skill-oriented learning. This study then recommends that more time should be allocated to the teaching of mathematics on the time-table in our secondary schools so that there will be enough time for the use of ICT tools. Also, mathematics teachers should not be too overwhelmed with too many assignments so that they will have time to plan ICT enhanced classes. Since ICT Tools depends on power supply, the entire power supply needs to be improved upon throughout the country. Also, school authority should improvise for alternative source of power supply such as generator set in case of power failure.

Keywords: Information and Communication Technology (ICT), Mathematics Education, Flowchart Concepts, ICT-Enhanced Learning, Secondary School Education, Student Understanding, Flowchart Interpretation.

I. Introduction

Information and communications technology (ICT) is an important part of most organizations these days (Zhang & Aikman, 2007). To borrow the words of Adomi (2010), the ability to (2007) adduces that "information and access to ICTs are now a human need and basic right". This research intends to exam the influence of ICT tools on the teaching and learning of linear motion in physics in Secondary School. ICT stand for Information Communication and Technology and define as a set of technological tools and

resources used to support, to create, to enhance, to store and manage information. Information and Communication Technology is divided into two main viewpoints in education such as; ICT for education and ICT in education. Information and Communication Technology (ICT) for education is understood as the development of information and communication technology for learning and teaching purpose while Information and Communication Technology (ICT) in education involves the fostering of general components of information and communication technology in practical use in teaching and learning processes. Today, information and communication technology has increasingly become a vital element for firms to compete and develop. This chapter includes background of the problem, statement of the problem, objective of the study, research questions, research hypothesis, and significance of the study and scope of the study.

Background of the study

This study concentrated on the influence ICT has on the teaching and learning of flow charts in mathematics. The society at large has experienced changes in technology; everyday students are influenced by these technologies which play a central role in their life. The aim of education is to prepare learners for their future roles undoubtedly Information Communication and Technology (ICT) are and will be part of the future hence students should be taught in a way that they become well-informed with ICT and how they can be applied in solving problems of academic nature and outside circles of schools. Education needs to prepare students for their adult lives in today's and tomorrow's world, in order for them to contribute actively not as passive but as empowered participants (Pachler, 2007). The world is experiencing an information blast of extraordinary proportions. Not only is the volume of new information large, but it is also growing tremendously.

Rapid changes in many fields are making basic knowledge and skills outworn. In the technological world of the 21st century, the meaning of the phrase to know means more than simply having information stored in one's memory; it means having access to information and knowing how to use it. Education is to create technologies for learning that draw both from knowledge about human cognition and from practical application of how technology can initiate complex tasks in the workplace. In this rapidly changing world, where employment requirements and basic literacy expectations are quickly changing, education must also be transformed to meet these demands. The essence of education has been to spread society's cultural heritage to successive generations and to foster competencies that will permit children to successfully participate in a society. To that end, Information and Communication Technological tools must become an important part of the general education curriculum so students are prepared to meet future technology challenges.

The notion that teaching and learning can successfully take place through the application of electronic communication facilities between teachers and students is one which had imparted hope and dismay and at the same time, excitement and fear. Hope that many more learners can be reached at a more convenient pace that had been the case, dismay that the infrastructures necessary for deploying an effective Technology Tools

platform is lacking in low-income countries (Olakulehin, 2007). However, the use of Information Communication and Technology (ICT) Tools in the education process has been divided into two broad categories: Information Communication and Technology (ICT) Tools for Education and Information Communication and Technology (ICT) Tools in Education.

Information Communication and Technology (ICT) in teaching and learning of mathematics can be understood as implementation of ICT tools and equipment in mathematics teaching and learning process. It is the pedagogical integration of technology in the teaching of mathematics to bring about effective learning. That is, technology in mathematics is not only limited to the establishment of networks and or the installation of equipment, but includes the use of ICT tools in schools to improve the teaching quality and methods adopted by teachers in schools and to facilitate learning and educational development. It implies a process of appropriate, regular and regulated use of interactive technology with incurred beneficial changes in school practices and student learning. Despite the broad nature of mathematics, its teaching is to bring about mathematical reasoning in students, a mind-set that requires students to test out, through experiments. However, through the use of ICT Tools, whether computers, projectors, power points, smart boards, internet etc the teaching and learning of mathematics is very interesting and effective. According to (O.Osunade, 2003), internet is a valuable source of information for students looking for ideas for project and assignment. (Nzewi, 2003) Believe that secondary school students who were exposed to video-based instructions in mathematics had outstandingly better results than those who were taught using the conventional method.

It is against this background of looking at ICT tools as a medium of instruction in teaching and learning of mathematics in secondary schools that this study is conceived. Therefore, the study is an attempt to establish through statistical model the influence of ICT tools in teaching and learning of flow charts in mathematics in secondary schools.

Statement of the problem

Today, traditional educational practices no longer provide students with all the necessary skills to survive economically in today's work place. When Information Communication and Technology (ICT) tools are widely used at all levels of education in developed countries, schools are yet to take maximum advantage of Information Communication and Technology (ICT) in developing countries. Ajayi (2008) claimed that "today's" schools are organized around yesterday's resources and they are not even doing very well. (Mallow., 2019) in the study on assessment of secondary school teachers use of ICT, found that teachers lack skills and knowledge in the use of computer and software and the result is lack of,

- Effective Information Communication and Technology ICT training remains one of the major obstacles for integration of instruction. (Aramide, 2014), study reveals that there were no enough training opportunities for teachers in the use of ICT in a class room environment. Many times, teachers are just sent for training

programmers' does he/she need the duration for profitable training programmers is usually long and teachers may not be allowed.

- Currently, the state government has sent many of its workers including teachers on ICT training but the training these teachers have received seems not to have impacted their use of these technologies. (Aramide, 2014) Propounded that providing pedagogical training for teachers rather than simple training in ICT is significant.
- The lack of ICT facilities in some secondary schools, most of the secondary schools are lacking ICT facilities like computers, multimedia projectors, tablets, smart phones etc in the computer laboratory for teaching and learning.

As a response to this situation, there is an increasing emphasis on provision and improvement on the use of Information Communication and Technology (ICT) tool in teaching and learning. The concern of this study therefore is to investigate the influence of information and communication technological tools in the teaching and learning of flow charts in mathematics in secondary schools.

Purpose of the study

The main purpose of this study was to investigate the influence of information and Communication Technological (ICT) tools in the teaching and learning of flow charts in mathematics in secondary schools in Petauke district.

Objective of the study

The main objective of the study was to investigate influence of ICT tool in the teaching and learning of flowcharts in mathematics.

Specific objectives

Teachers' perceptions of using ICT tools for teaching flowchart concepts in Mathematics.

The effect of ICT tools on students' understanding of flowchart concepts in Mathematics.

The objectives of the study were to investigate;

The impact of ICT-supported instruction on students' ability to create and interpret flowcharts in Mathematics.

Research Questions

What are teachers' perceptions of using ICT tools to teach flowchart concepts in Mathematics?

What impact does ICT-supported instruction have on students' ability to create and interpret flowcharts?

How do ICT tools influence students' understanding of flowchart concepts in Mathematics?

This research is guided by the following questions;

Significant of the study

This research work finds relevance in the growing literature on ICT tools adoption and uses in education. The increasing awareness of the usefulness and relevance of ICT tools in the teaching-learning process as well as teachers in the actualization of mandates of educational institution put study like this on the research agenda of many countries, including Zambia. This study is of benefits to students, teachers, educational administrators, curriculum planners and the society as a whole.

The study will help students to understand the benefits of ICT tools by reducing the amount of direct instructions given to them by their teachers and enable them to get authentic information on any area of knowledge they desire. It may also help reduce students' total dependence on teachers and enable them to work on their own.

The study will play a role in the development of students' skills and helps students' motivation towards learning of mathematics in secondary schools and also offers the opportunities for students particularly those living in the rural communities, to broaden their employment prospects.

The study will help teachers to understand the importance of ICT tools in teaching and enable them to effectively utilize and implement ICT tools in their pedagogical practice. It may help the educational administrators to critically monitor the activities of both students and teachers in order to ensure the implementation of ICT tools in mathematics teaching-learning process in secondary schools and to make the school system developed. Since the governments are the curriculum planners, the study will enable them to understand the importance of ICT tools in mathematics teaching and learning and the need to implement it into mathematics curriculum and also enable them to provide the necessary facilities and equipment's for ICT tools implemented.

Lastly, the study will help the society as a whole in the production and the development of the necessary manpower needed to survive in this information society.

Research Hypothesis

The following null hypotheses were formulated for this study;

HO1: ICT tools have no significant effect on students' understanding of flowchart concepts in Mathematics.

HO2: ICT-supported instruction does not significantly improve students' ability to create and interpret flowcharts.

HO3: Teachers have no positive perception of using ICT tools to teach flowchart concepts in Mathematics.

Scope of the study

The study focused on the influence of using information and communication technological (ICT) tools in teaching and learning of mathematics. The sample was selected secondary schools in petauke district. The study covered the teachers and students in selected secondary schools in petauke district. This is because attempt to all the secondary schools in Zambia will be futile due to limited resources therefore the research was limited to its present scope.

Limitations

The following are the limitations to this study

Limited Access to ICT Resources

Not all students or schools may have equal access to ICT tools (computers, projectors, software, internet), which can affect the implementation and outcomes of ICT-based instruction.

Teacher Proficiency with ICT

The effectiveness of ICT in teaching depends heavily on the teacher's ability to use it. If the teacher has limited training or confidence with ICT tools, this could reduce the potential impact.

Student Familiarity with Technology

Students with limited exposure to or skills in using ICT tools may struggle more, affecting their learning experience and the validity of the results.

Narrow Scope of Content

Focusing only on flowcharts in mathematics might not capture the broader impact of ICT on mathematical thinking or problem-solving as a whole.

Small or Non-representative Sample

If the study sample is small or not diverse (e.g., only students from one school or region), the findings may not be generalizable to other populations.

Short Duration of Study

A short-term study may not be sufficient to observe long-term effects or changes in understanding and skills that result from ICT integration.

Reliance on Self-reported Data

If the study uses surveys or interviews, responses might be biased due to social desirability or misunderstanding of questions.

Limited Measurement Tools

The tools used to measure learning outcomes (e.g., tests, quizzes) may not fully capture conceptual understanding or the benefits of ICT-enhanced instruction.

Distractions from ICT

Technology can sometimes be a source of distraction rather than a tool for engagement, especially if not well managed in the classroom.

Technical Issues

Power outages, software glitches, or other technical failures could disrupt the learning process and affect the study outcomes.

Operational Definition Terms

Influence: the power or capacity of causing an effect.

ICT: Information and Communication Technology

ICT tools: device or application, including radio, television, mobile phones, computer and tablets, projector, internet etc used in teaching and learning.

Teaching: the process of attending to people's needs, experiences and feelings and intervening so that they learn particular things and go beyond the scope.

Learning: the process of acquiring new understanding, knowledge, behaviour, skills values, attitudes and preferences.

Secondary school: this refers to schooling offered after primary school, that's from grade 8 to grade 12.

Computer: An electronic gadget for storing and processing data, typically in binary form, according to directives given to it in a variable program.

Projector: A device that is used to project rays of light, especially an apparatus with a system of lenses for projecting slides or film onto a screen.

Smart white board: Is a large interactive lay out, that connects to a computer.

Internet: The Internet is the worldwide system of linked computer networks that use the Internet protocol suite (TCP/IP) to link billions of devices worldwide.

Podcast: A digital audio file provided on the Internet for downloading to a computer or portable media player.

Blog: A web page, typically run by an individual or small group that is written in an informal or conversational style.

Self-efficacy: One's ability to succeed in specific situations or accomplish a task.

Pedagogy: The method and practice of teaching, especially as in academic subject or theoretical concept.

Chapter summary

- Information and Communication Technology (ICT) plays an increasingly important role in education.
- In mathematics, the use of ICT enhances visualization, interaction, and understanding of abstract concepts.
- Flow charts are essential tools for representing logical sequences and problem-solving strategies in mathematics.
- Despite the proven benefits of ICT in education, its application in teaching flow charts in mathematics remains limited.
- There is a need to explore how ICT can be effectively utilized to enhance the learning experience

Literature review

In this chapter, related review literatures on the influence of ICT tools in teaching and learning of flow charts in mathematics in secondary schools was reviewed under the following sub-headings;

- Use of ICT in classroom Instruction
- Conceptual Framework of the Study
- Concept of information and communication technology (ICT)
- Components of the ICT
- The Role of mathematics in the Society
- The Role of ICT in mathematics.
- Influence of Self-Efficacy in the Use of ICT in Teaching and learning of mathematics.
- Attitude of mathematics Teachers and Students towards the Use of ICT
- Barriers to the Integration of ICT in mathematics teaching and learning
- Factors contributing to the use of ICT tools in the classroom

Use of ICT in Classroom Instruction

Computers began to be used in schools in the early 1980s, and several intellectuals proposed that ICT will be a cardinal part of education for the next generation . Up-to-date technology provides many approaches of enhancing classroom teaching and learning . Dawes (2001) stated that new technologies have the capacity to upkeep education across the curriculum and offers opportunities for efficient student-teacher communication in ways not possible before. ICT in education has the potential to change teaching. Promoting technology into curricula with the sole aim of persuading positively the teaching and learning process has been expanding since 1980 when a number of countries in the world introduced computers in their education systems.

This change was mainly as a result of hardware and software evolution, computer accessibility in educational settings and popular instructional 17 technology trends. Technology integration cover a wide area ranging from instruction on programming skills, self-directed drill, testing, instructional delivery, and Internet based accessibility to information and communication technology. It has been argued by certain scholars that the use of new technologies in the classroom is essential for providing opportunities for students to acquire

knowledge and skills that will enable them to function in an information age . It is therefore evident, as Dawes (2001) argued that traditional educational environments do not seem to equip the learner with adequate skills to be productive in their places of work in today's society. She asserts that organizations which do not integrate the use of new technologies in schools cannot assert to prepare the learners for life in the new technological age. There are many roles that ICT can play in the teaching and learning process. First, ICT has a great potential to enhance learner achievement . A number of theorists and scholars claim that the use of computers can make the learners to become well informed, lessen the amount of direct instruction given to them and give a learning environment where teachers can assist learners with peculiar needs.

Conceptual Framework of the Study

The use of information and communication technological (ICT) tools is becoming an important part of Education in many parts of the world. Zambia is not left behind as ICT gradually finds its way into the Educational systems despite chronic limitations brought about by economic disadvantages. Fundamentally, education is a discipline like any other; it is a branch of human knowledge which is initially concerned with getting the young in the society ready when they come of age. According to Gbamanja (2005), education is a process, which seeks to change the behaviour of a learner. Overall, behaviourist view education as, the process of changing the behavioural pattern of people. Behaviour in this sense refers to the way we change the learner, his or her thinking, his or her feelings and his other overt actions . Hence, education is the process by which society intentionally transmits its cultural legacy through schools, colleges, universities and other institution. Realistically, several researchers admitted that ICT have an influence in learning and teaching. Globally, the use of information and communication technological (ICTs) tools is fast gaining fame and becoming one of the most important components defining the basic knowledge of student. The role of ICT in teaching and learning is rapidly becoming one of the most important and widely discussed issues in contemporary education policy. Rosen (2006) most experts in the field of education agreed that, when used well, ICT tools hold high promise to enhance teaching aids learning in addition to shaping work force opportunity

Concept of information and communication technology (ICT)

ICT is a scientific, technological and engineering discipline and management methods used to handle information, its implementation and communication with social, economic and cultural matters . ICT stands for Information and Communication Technologies. ICT is a part of our lives, for the last few decades it has affected our society as well as individual life. Information and communication technology encompasses computer and telecommunication. ICT encourages communication and collaboration in science research activities . According to Gillespie (2006), new technologies can be used in science education to enable 26 learners to collect information and interact with resources such as videos and images to encourage communication and co-operation. As Brush, Glazewski and Hew (2008) have claimed, ICT is used as a tool for students to find new learning topics, solve problems, and provide solutions to the issues in the learning

process. ICT makes knowledge gain more accessible, and ideas in learning areas are understood while engaging students in the application of ICT. ICT build students' new knowledge in their areas of learning .ICT gives more creative solutions to different types of learning inquiries. For instance, in a reading class, e-books are usually used in reading aloud activities. It focuses on the use of technology in handling acquiring processing, storing and dissemination of information. Thus information and communication technology is any technology used in constructing, arranging and passing information through. Likewise, oxford advanced learners Dictionary sees ICT as electronic media used in processing, analyzing, storing and sending out information.

Components of the ICT

The information and communication technology is made up of a wide range of components that made its implementation and use achievable by man. The components of ICT could be subsided into 2 main categories namely software and hard ware. Semenov (2013), software is the name given to the coded instructions that tell computers what to do and it comes in many different forms. Here in this report we focus on software tools that are useful for schools thus.

- i. Operating system.
- ii. Personal productive tools.

Hardware

The hardware is the term applied to computers, storage, media, input, and output devices and all the connecting devices like modems, telephones and satellites use for information processing and communication across the globe.

The ability of each technology differs according to how it is used. Drexler (2001) identify five levels of technology use in Education, that is, presentation demonstration, drill, and practice, interaction, and collaboration.

Each of the different ICTs –print, tablets, radio and TV broadcasts, computers or the internet- may be used for guidance and demonstration, the most core of the five levels.

How are TV and radio broadcasting been used in Education?

Television and radio have been used globally as educational tools since the 1920s and the 1950s, respectively.

There are 3 general methods to the use of Radio and TV broadcasting in Education.

School broadcasting

This involves the provision of broadcast programming - not to substitute for the teacher but, rather, to enrich traditional classroom instruction (particularly where resources would not otherwise be available). Often deployed with print materials, cassettes and CD-ROMS, school broadcasting is geared to national curricula and developed for a range of subject areas; teachers decide how they will integrate the materials into their classes.

Direct class teaching

This involves broadcast programming as a substitute for a teacher on a temporary basis. With regard to radio, the primary example discussed here is Interactive Radio Instruction (IRI), which was first implemented in Thailand in 1980; Indonesia, Pakistan, Bangladesh, and Nepal moved out their own IRI projects in the 1990s. IRI has also been implemented in Latin America. As part of IRI, 20-30-minute face-to-face teaching and learning exercises are provided via radio to the classroom on a daily basis. Built around specific learning goals at particular levels of mathematics, science, health, and languages in national curricula, these lessons are deliberated to improve the quality of classroom teaching and to act as a constant, structured aid to poorly trained classroom teachers in under-resourced schools. According to this article, "Extensive research around the world has shown that many IRI projects have had a positive influence on learning outcomes and on educational equity. And with its economies of scale, it has proven to be a cost-effective approach relative to other interventions."

General educational programming

This involves providing non-formal educational opportunities for all types of learners over community, national, or international stations. This programming could include news programmes, documentary programmes, quiz shows, educational cartoons, and so on.

The Role of mathematics in the Society

The study of mathematics involves the pursuit of truth; hence, it implants intellectual honesty, diligence, perseverance and observation in the learners . Physics education therefore empowers the learner to gain problem-solving and decision-making skills that provides ways of thinking and inquiry, which help them to answer to widespread and radical changes in industry, health, climatic changes, information technology and economic gain. These changes are requesting for knowledge of scientific principles in order to handle them . The teaching of mathematics provides the learners with understanding, skills and mathematical knowledge needed for mathematical research, fostering technological and economic growth in the society, where they live thus improving the standards of living , currently called Kenya Institute of Curriculum Development(KICD).

In spite of the recognitions given to the mathematics subject as one of the essential at the secondary school level as contained in the National Policy of Education, the achievement of students and the number of candidates who choose mathematics have become worrisome to the generality of the people, most especially mathematics educators and researchers . Many researchers have come up with different solutions among which is the use of different Instructional approaches such as guided discovery, concept mapping, field trip,

demonstration method and use of ICT. Okebukola (1992) confirmed that the use of appropriate instructional strategies can influence the performances of low achieving students as well as making the lesson interesting.

The Role of ICT Tools in mathematics

The popularity of natural sciences and technologies - especially mathematics - as well as the interest in those fields are being depreciated in the schools worldwide from year to year – as seen by research studies in pedagogy. The main contradiction is however, that the world of the 21st century cannot be understood and governed; the main worldwide challenges cannot be managed well without a fundamental knowledge of natural sciences. mathematics classes have to be made more eye-catching and interesting, if we want to let our students leave the secondary school with high level and relevant skills in mathematics, and with an advanced knowledge in natural sciences. To turn classes more enjoyable it is necessary to take advantage of the opportunities provided by ICT. stated: Sim Video are interactive learning tools integrated with SimReal which contains video-lectures, video- simulations, interactive simulations, task review and applications with opportunities for continuous exchange between different components without losing the direction in the temporarily abandoned item.

Community resource is a good learning resource teacher can always survey in teaching mathematics . In Zambia there is problem of electric power supply, because of this many electronic experiments in mathematics that requires the use of electricity is not always reliable. For instance, soldering of transistors, resistors, and other active electronics elements may be done showing videos of electronics technician at work already recorded in the town to the students. Through this approach students can learn how to construct this activity even though not delivered in the class directly by their teacher. There are many experiments very challenging to carry out in the laboratory due to its nature, such experiment could be revived.

Computer Assisted Instruction (CAI) tools like spreadsheet and word-processor is used to collect and analyse data. For example, in waves, there are graphs and functions challenging to accurately draw but when spreadsheet is use; it can show various types of graphs for students to learn. When it comes to display information in different ways such as text, picture, tables and graph, ICT is a best tool to be used, especially to visualize an abstract process in Physics teaching. This information can be exploited on a computer so that mathematics students can make adjustments and at the same time evaluate the adjustments made. Feedback is very cardinal in teaching and learning process, because it enhance student learning. This could be done using a computer. For instance in a word- processor student can learn how to spell words accurately when text is being underlined by the computer.

ICT improve student learning when they spend quality time working or practicing any skill already learnt in mathematics. Learning activities could be communicated using e-mail system . Teacher could be away from school and yet be in contact with the student by sending learning activities through e-mail. Many students

project have been supervised through this system without the meeting of student and teacher for more than just once. Social network and online chat are another means by which teacher and student can communicate. Both teacher and student can communicate together without necessarily be in face to face classroom situation through internet. This could be done through Yahoo messenger, zoom cloud meeting or Skype; many mathematics concepts could be learnt by student through these methods. Internet is a good resource for learning mathematics; students can learn through Google, Wikipedia and other internet website or blog. mathematics articles in Journal are uploaded into website or blog to access for learning; example of such article is refraction and absorption of microwaves in wood through European Journal of mathematics to an e-mail address.

Influence of Self-Efficacy on the Use of ICT Tools in Teaching and Learning of Mathematics

Self-efficacy is grounded in social cognitive theory and was developed by Albert Bandura. Bandura (1995) described self-efficacy as “the belief in one’s abilities to organize and execute the courses of action required to focus prospective situations” (p. 2). Bandura (1995) further described self-efficacy beliefs as behavioural determinants of how people think, behave, and feel. Self-efficacy is developed through mastery experiences, social modelling, social persuasion, and psychology responses. In education, a teacher’s self-efficacy can be defined as “judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even 30 among those students who may be difficult or unmotivated” .

Research has suggested that a teacher’s belief in his or her own ability to have a positive impact on student learning is critical in the actual success or failure of his or her own teaching behaviour . Woolfolk (1990) stated, “Researchers have found few permanent relationships between characteristics of teachers and the behaviour of learning of students. Teachers’ perception of efficacy is an exception to this general rule”(p. 81). Pre-service teacher beliefs about one’s own abilities are likely to influence their success for technology integration as they begin careers as educators .

Attitude of Mathematics Teachers and Students towards the Use ICT Tools

The success of any initiatives to initiate technology in an educational program depends greatly upon the support and attitudes of teachers engaged. It has been proposed that if teachers believed or perceived proposed computer programs as accomplishing neither their own or their students’ needs, they are not likely to try to introduce technology into their teaching and learning. Among the factors that influence the successful use of computers in the classroom are teachers’ attitudes towards computers . Attitude, in turn, constitutes many dimensions. Some examples of these are regarded usefulness, computer confidence , training , gender , understanding about computers, unease, confidence, and liking .

In many developed countries, almost all schools are equipped with the infrastructure to conduct ICT mediated teaching and learning. Positive teacher attitudes towards computing are important if computers are to be effectively uplifted into the school curriculum. A main reason for studying teachers' attitude towards computer use is that it is a main predictor for future computer use in the classroom . Khine (2001) noted 184 pre-service teachers and found a remarkable relationship between computer attitude and its use in the institution. This finding was conspired by Yuen and Ma (2001) who, using the Chinese Computer Attitude Scale for Teachers (CAST), discovered that 216 secondary teachers in Hong Kong had reported the instructional use of computers and their results showed that affective attitudes, general usefulness, behavioural control, and pedagogical use to be important in determining the use of ICT.

Khine (2001) reported that main teachers believe that the amount of computer experience has a positive impact on attitude towards computers. Jackson, Ervin, Gardner and Schmitt (2001) showed that female users, compared with males, are more bias to hold negative reactions to computers and such differences may have resulted in the different methods of using computers. In support of the importance of teachers' attitude towards computer use, Mishra (2012) provided evidence to propose that the attitudes of teachers are straight related to computer use in the classroom. For instance, teachers usually view the computer as a tool to achieve housekeeping tasks, govern their students more efficiently, and to communicate with parents more easily. The success of student learning with computer technology tools will depend largely on the attitudes of teachers, and their willingness to embrace the technology . Gaining recognition of the teachers' attitudes towards computer use may give useful insights into technology tools integration and acceptance and usage of technology tools in teaching and learning.

Although the term Technology Tools implies far more than simply access to personal computers, students generally view using computers as having a positive impact on their learning. Kulik (1994) reinforces the claims of earlier empirical studies; it has been found that using computer technologies in developmental classrooms positively shapes students' attitudes toward writing and increases both the appearance and quantity of student writing. Attitudes influence teachers' behaviours. Additionally, they have a considerable impact on openness to new experiences, as well as on reflecting and administer change. Positive attitudes towards Technology Tools, though too limited, support their use in classes. The effectiveness of Technology Tools investments can be achieved with their effective application in the classroom as a part of the curriculum. By so doing, learner-based learning environments can be developed. As Kozma (2003) claim, ICTs can affect the pace at which the learning gap is bridged in developing countries, both domestically and in relation to other nations.

The great challenge is to harness the advantages of these technologies, in order to improve the delivery and quality of educational services, as well as to speed the rate at which knowledge is provided and learning opportunities and outcomes are equalized throughout society . A study conducted about factors which

stimulate or limit the innovative use of Technology Tools by teacher educators in the Netherlands. The study utilised questionnaires for 210 teachers and interviews for 4 of those teachers who had provided feedback. Their findings showed that several factors such as a student-oriented pedagogical approach, a positive Technology Tools attitude, computer experience, and personal entrepreneurship of the teacher educator have a direct positive influence on the innovative use of Technology Tools by the teacher. Also, comparison between these factors in predicting computer use identified that attitude toward computer contributed more in explaining Technology Tools use by teachers .

Teachers' attitudes have been found to be major predictors of the use of new technologies in instructional settings . The successful use of technology tools in the classroom depends to a large extent on the teachers' attitudes toward these tools. Positive attitudes often encourage less technologically capable teachers to learn the skills necessary for the implementation of technology-based activities in the classroom. Rainer (1992) found that participants with negative computer attitudes were less skilled in computer use and were therefore less likely to accept and adapt to technology than those with positive attitudes. They concluded that changing individuals' negative attitudes is essential for increasing their computer skills. Therefore, if teachers want to successfully use technology in their classes, they need to possess positive attitude to use technology. Such attitude is developed when teachers are sufficiently comfortable with technology and are knowledgeable on its use.

Barriers to the Integration of ICT Tools in Mathematics Teaching and Learning

The act of incorporating ICT Tools into teaching and learning is a broad process and one that may encounter a number of challenges. These challenges are known as “Barriers” . A barrier is described as “any condition that makes it difficult to make progress or to accomplish an objective” (WordNet, 1997, as cited in .

Classification of the barriers

Different categories have been used by researchers and educators to classify barriers to teacher use of ICT Tools in science classrooms.

Main studies have divided the barriers into two groups: extrinsic and intrinsic barriers. However, what they meant by extrinsic and intrinsic varied. In one study, Ertmer (1999) referred to extrinsic barriers as first-order and quart access, time, support, resources and training and intrinsic barriers as second-order and quart attitudes, beliefs, practices and resistance; whereas, Hendren (2000), as stated in saw extrinsic barriers as pertaining to organization rather than individuals and intrinsic barriers as pertaining to teacher, administrations, and individuals.

Another perspective presents the obstacles as pertaining to two kinds of condition: material and non-material. The material condition may be the smaller number of computers or copies of software. The non-material condition obstacles involve teachers' insufficient ICT knowledge and skills, the challenge of integrating ICT

Tools in instruction, and insufficient of teachers' time. Some of the barriers to incorporation of Technology Tools into teaching and learning of physics include the following:

Lack of teachers' confidence

Several researchers indicate that one barrier that prevents teachers from using ICT Tools in their teaching is lack of confidence. Dawes (2001) views this as an issue-based factor which can act as a barrier. According to Becta (2004), most of the research aims that this is a major barrier to the uptake of ICT Tools by teachers in the classroom. In Becta's survey of practitioners (2004), the problem of lack of confidence was the area that attracted most of the answers from those that took part.

Some studies have explored the reasons for teachers' lack of confidence with the use of ICT Tools. For instance, claimed that teachers' "anxiety of failure" caused a lack of confidence.

Lack of teachers' competence

Another barrier which is directly related to teachers' confidence is teacher's competence in integrating ICT Tools into pedagogical practice (Beta, 2004). Newhouse (2002) discovered that many teachers lacked the understanding and skills to use computers and were not passionate about the changes and integration of addition learning associated with bringing computer into their teaching practices. Resent research has shown that the level of this barrier differ from country to country. In the developing countries, research reported that teacher's lack of technological competence is a main barrier to their acceptance and adoption of ICT Tools . Therefore, lack of teachers' competence is the strong barriers to the incorporation of ICT into education.

Resistance to change & Negative attitudes

According to Gomes (2005), found that science teachers' resistance to change concerning the use of new strategies is an obstacle to ICT Tools integration in science teaching. At a wider level, Becta (2004) declined that resistance to change is an major barrier to teachers' use of new technologies in education. Watson, an Australian researcher, (1999) assert that integrating the new technologies into educational settings needs change and different teachers will manage this change differently. According to him, considering different teachers' attitudes to change is cardinal because teachers' beliefs impact what they do in classrooms. Resistance to change is viewed to be a barrier itself; instead, it is a sign that something is wrong. In other word, there are reasons why resistance to change take place.

Lack of time

Several studies indicated that many teachers have competence and confidence in using computers in the classroom, but they still make little use of ICT Tools because they do not have enough time. According to Sicilia (2005), the most common challenge disclosed by all the teachers was the lack of time they had to plan technology lessons, survey the different internet sites, or look at different aspect of educational software.

Gomes (2005) concluded that one of the major reasons that science teachers do not use ICT Tools in the classroom is lack of time needed to accomplish plans.

Lack of effective training

According to Becta (2004), the issue of training is certainly complex because it is important to consider several components to ensure the effectiveness of the training. These were time for training, pedagogical training, and ICT Tools used in initial teacher training. Equally, recent research by Gomes (2005) associated to science education concluded that unavailability of training in digital literacy, lack of pedagogic and didactic training in how to use technological Tools, and absence of training involving the use of technologies in science specific areas were the challenges to using new technologies in classroom practice.

Lack of accessibility

Several research studies indicated that lack of access to resources, including home access, is another major barrier that discourages teachers from incorporating new technologies into education and specifically into science education. According to Becta (2004), the inaccessibility of ICT Tools resources is not always merely due to the non-availability of the hardware and software or other technological materials within the school. It may be the result of a number of factors such as poor coordination of resources, poor standard hardware, inappropriate software, or unavailability of personal access for teachers.

Factors contributing to the use of ICT tools in the classroom

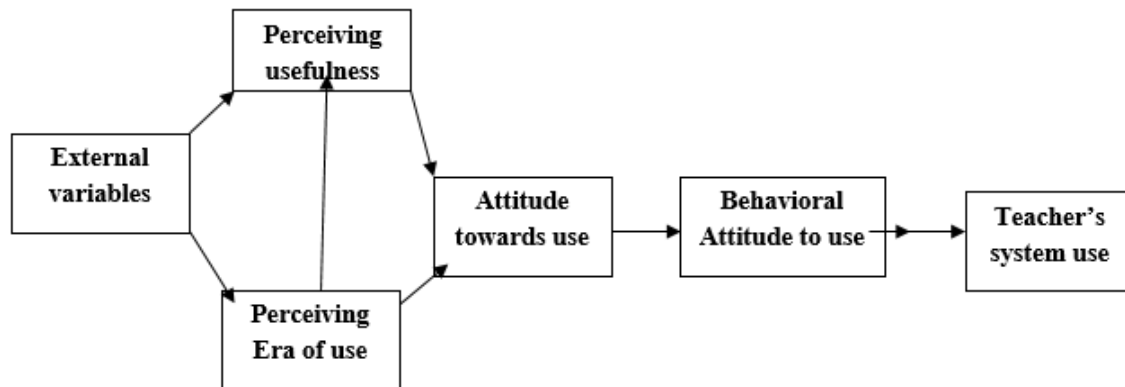


Figure 2:1 Technology acceptance model (TAM) (Davis; Bagozzi and warshaw, 2000)

According to Cox, (1999), there are a number of factors which have been identified to influence and support teachers in using ICT tools in the classroom. In order to investigate these factors further in relation to teacher's ICT tools use, the study make use of the technology acceptance model (TAM) developed by Davis (1989) which was on adaptation of theory of reason action by Fishbein (1992) to explore the reasons why teachers use ICTs. Their model shown in figure 2:1 links the regarded usefulness and ease of use with altitude

towards using of ICT tools and actual use - (system use). They tested this model with 1007 Adult users, who had been using a managerial system for 14 weeks. They discovered that people's use of computer was determined by their intentions to use it and that regarded usefulness was also strongly linked to their intentions.

External variables

In TAM the external variables represent the many influences on the teachers which come from outside their sphere of control these will include;

The requirement of a national curriculum or national guidelines the changes in society with the rapid growth in the uses of the internet and ICT in general; opinion of the colleagues, responsibilities of the teachers; pressure from the parents and students, the influences of the local education authority (LEA). Despite these been identified as very important by a number of research studies in leading teachers to understand the need for change and to question their professional practice, discussed earlier. Only a few could be investigated within the borders of this project. The main goal on this research was how teachers perceive ICTs contribution to teaching and learning. These factors come within Davis et al perceived usefulness and perceived ease of use components.

III. Research methodology

This chapter deals with the research methodology that was used in the study, to know the influence of information and communication Technological tools in the teaching and learning of flowcharts in mathematics in secondary schools. The chapter is presented under the following sub-headings:

- Research Type
- Population Sample and Sampling Techniques
- Research Instruments
- Validation of Research Instruments
- Procedure for Data Collection
- Data Analysis Techniques

Research Type

This is a survey type of a research; questionnaires were used to retrieve information from the respondents. In this study, data was obtained from the sample population on the influence of information and communication Technological tools in the Teaching and learning of flowcharts in mathematics in secondary schools in Petauke district.

Population Sample and Sampling Techniques

The target population for this study comprised the secondary school mathematics students and teachers in some selected secondary schools in Petauke district. Fifteen (15) students were randomly selected using

systematic random sampling technique from each of the ten (10) senior secondary schools and in the case of the teacher; five (5) teachers were randomly selected based on the available sample from ten (10) senior secondary schools. In all, a total of one hundred and fifty (150) students and fifty (50) teachers form the study sample.

Research Instruments

The researcher used a questionnaire for the study. In carrying out this research, data was collected using two basic instruments namely; (1) effect of information and communication Technological tools on students' understanding of flowchart concepts in Mathematics Questionnaire (EICTTSUFMQ) and (2) impact of Information and communication technological supported instruction on students' ability to create and interpret flowcharts in Mathematics Questionnaire (IICTSISACIFMQ). The two (2) instruments were structured questionnaires that featured section A, B and C (in the case of the teachers' questionnaire). Section A was used to collect information on respondent data such as gender, class, name of school, length of service and academic qualification in the case of teachers' questionnaire. Section B of the teachers' questionnaire contain fourteen (14) items statement while that of the students contain fifteen (15) items statement each develop on a 4-point Likert scale. Section C of the teachers' questionnaire contains the list of ICT tools used by teachers in mathematics class. The respondents were expected to write where necessary or tick appropriate option in the space that was provided in front of each item. These options were, Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). The teachers and students were required to indicate which choice that best represent their interest.

Validation of Research Instruments

The validation of questionnaire on the influence of information and communication Technological tools in the Teaching and Learning of flowcharts in mathematics at secondary schools in Petauke district was adopted from validated set of questionnaires and was given to the researcher's supervisor for comment or suggestion.

Procedure for Data Collection

The researcher visited each of the selected schools with the permission letter from the District Education Board Secretary DEBS for the study to seek the permission/consent of the Head Teacher and the Deputy Head Teacher in order to administer the questionnaire personally to the teachers and students in the sample schools. The researcher then explained to the respondents the procedure for filling the questionnaires and the questionnaires were collected after it has been duly filled by the respondents.



Figure 3.1 students responding to the questionnaire



Figure 3.2 Teacher responding to the questionnaire

Data Analysis Techniques

The questionnaire was analysed using chi-square (X^2) statistical technique. The frequency count of each item in the questionnaire was tallied and raw score computed into simple percentages. Also, chi-square (X^2) statistical technique was employed to analyse the research hypothesis stated in the previous chapter.

IV. Data Analysis and Interpretation

This chapter presents the analysis and interpretation of the data collected for the study. The findings presented in this chapter were based on data collection of one hundred and fifty students and fifty teachers from ten randomly selected secondary schools and it was analysed using frequency count and percentage.

Data were analysed based on the research questions in line with class of students, sex of students, sex of teachers, teachers' educational qualification and years of teaching experience.

Table 4.1: Distribution of teachers by educational qualification

N	Educational Qualification	Teacher distribution	Percentage of distribution
1	Diploma	28	56
2	B.Sc.	17	34
3	M.Sc.	5	10
	Total	50	100.0

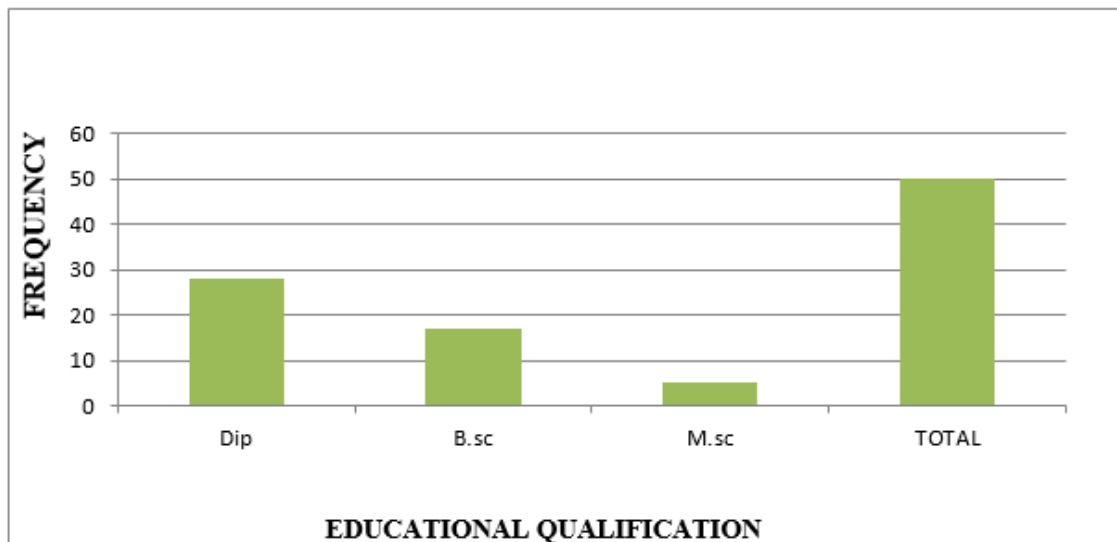


Figure 4.1: Distribution of teachers by educational qualification

Table 4.1 and figure 4.1 shows the distribution of teachers based on educational qualification. Twenty eight (28) out of the fifty (50) teachers of the sampled secondary schools used for this study has Diplomas, seventeen (17) of them had B.Sc. while five (5) of the teachers had M.Sc.

Table 4.2: Distribution of teachers by number of years of teaching experience

Years of teaching experience	Number of distribution	Percentage of distribution
1-5	25	50.0
6-10	17	34.0
11-20	5	10.0
Above 20	3	06.0
Total	50	100.0

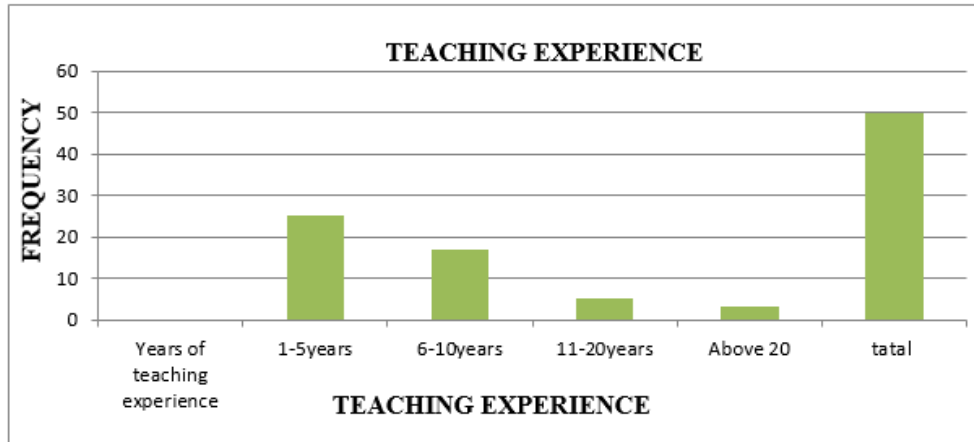


Figure 4.2: Teachers' years of teaching experience

Table 4.2 and figure 4.2 shows that twenty (25) out of the fifty (50) teachers have between 1 – 5 years of teaching experience, seventeen (17) of the teachers have between 6 – 10 years of experience while five (5) of them have between 11 – 20 years of experience and three (3) have more than twenty (20) years of teaching experience.

Table 4.3: Distribution of students by class

Class	Frequency	Student distribution (%)
Grade 10	30	20
Grade 11	45	30
Grade 12	75	50
Total	150	100

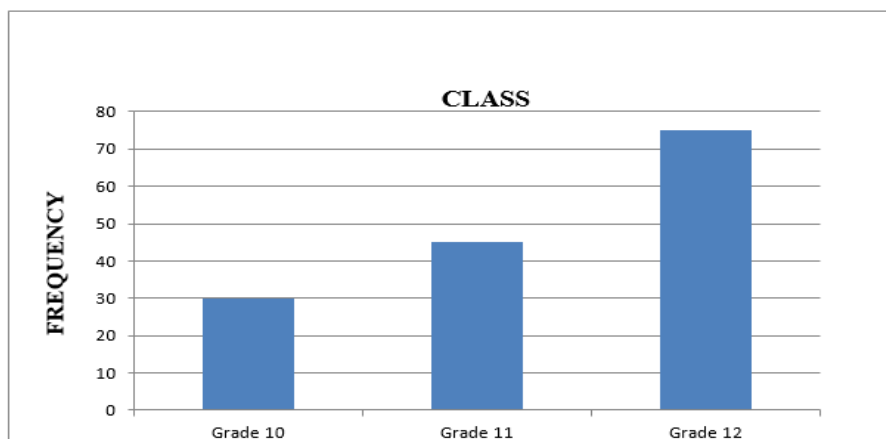


Figure 4.3: Distribution of students by class

Table 4.3 and figure 4.3 shows the distribution of students based on their classes. Thirty (30) students out of one hundred and fifty (150) students involved in the study are in Grade 10, forty five (45) of the students are in Grade 11 while seventy five (75) students are in Grade 12.

Table4. 4: Distribution of students by Gender

Gender	Frequency	Student distribution (%)
Male	97	64.7
Female	53	35.3
Total	150	100.0

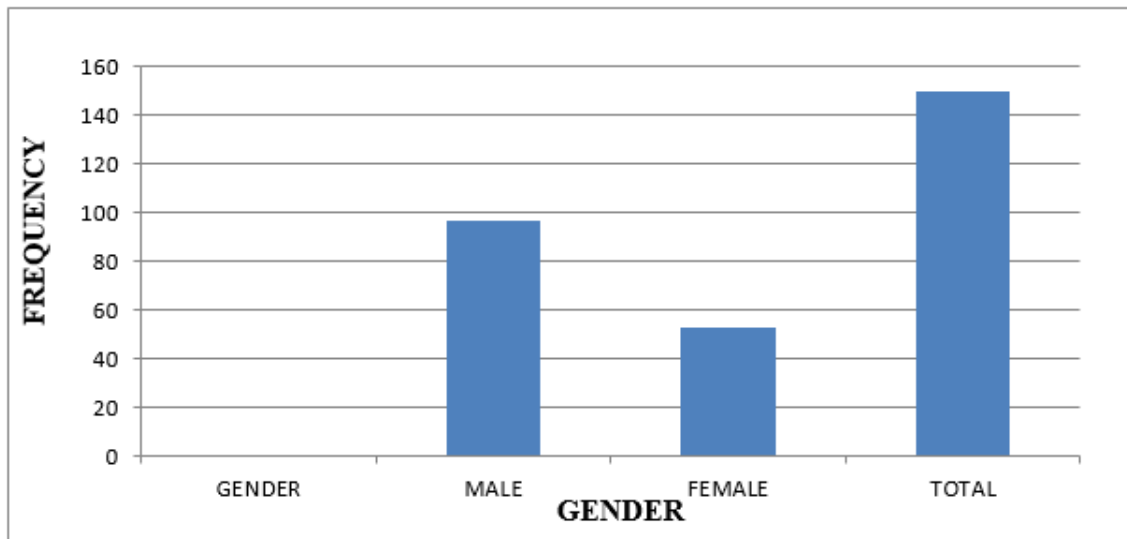


Figure 4.4: Distribution of students by gender

Table 4.4 and figure 4.4 shows that ninety-seven (97) out of the one hundred and fifty students used for the sample are male and fifty-three (53) students are female.

Results of Teachers' Response To Questionnaire

Table 4.5

Teachers' perceptions of using ICT tools for teaching flowchart concepts in Mathematics.

ITEM	SA	A	SD	D	TOTAL
1	30	17	0	3	50
2	20	25	1	4	50
3	3	16	7	24	50
4	20	26	0	4	50
5	21	26	0	3	50
47/TOTAL	94	110	8	38	250

Level of usage of ICT tools in teaching of flowcharts in mathematics.

ITEM	SA	A	SD	D	TOTAL
1	23	24	1	2	50
2	27	20	0	3	50
3	18	19	4	9	50
4	15	14	8	13	50
5	10	34	0	6	50
TOTAL	93	111	13	33	250

RESULTS OF STUDENTS' RESPONSE TO QUESTIONNAIRE

Table 4.7:

The effect of ICT tools on students' understanding of flowchart concepts in Mathematics.

Table 4.8

ITEM	SA	A	SD	D	TOTAL
1	53	82	5	10	150
2	45	74	7	24	150
3	74	53	3	20	150
4	9	13	47	81	150
5	2	19	51	78	150
TOTAL	183	241	113	213	750

Level of usage of ICT tools in learning of flowcharts in mathematics.

ITEM	SA	A	SD	D	TOTAL
1	72	63	1	14	150
2	51	87	0	12	150
3	63	72	6	9	150
4	95	52	0	3	150
5	13	15	54	68	150
TOTAL	294	289	61	106	750

ANALYSIS OF RESEARCH QUESTIONS AND HYPOTHESES TESTING

Research Question 1

How do ICT tools influence students' understanding of flowchart concepts in Mathematics?

Hypothesis 1

HO1: ICT tools have no significant effect on students' understanding of flowchart concepts in Mathematics.

Table 4.10:

Analysis on the effect of ICT tools on students' understanding of flowchart concepts in Mathematics
(Analysis of data from table 4.5)

Item 1

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.107 ^a	3	.551
Likelihood Ratio	1.689	3	.639
Linear-by-Linear Association	.322	1	.570
N of Valid Cases	50		

Item 2 Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.059 ^a	3	.787
Likelihood Ratio	1.251	3	.741
Linear-by-Linear Association	.046	1	.831
N of Valid Cases	50		

Item 3

Table 4.10

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.154a	3	.368
Likelihood Ratio	2.513	3	.473
Linear-by-Linear Association	.439	1	.508
N of Valid Cases	50		

Item 4

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.107a	3	.551
Likelihood Ratio	1.689	3	.639
Linear-by-Linear Association	.322	1	.570
N of Valid Cases	50		

Item 5

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.508a	3	.474
Likelihood Ratio	2.439	3	.486
Linear-by-Linear Association	2.039	1	.153
N of Valid Cases	50		

Research Findings

Finding 1: Effect of ICT Tools on Students' Understanding of Flowchart Concepts

Analysis of student performance and classroom observations indicated that learners exposed to ICT tools such as flowchart-simulation software, interactive tutorials, and multimedia explanations demonstrated higher comprehension of flowchart symbols, sequencing, and logic. Students in ICT-supported classes showed improved conceptual clarity and greater engagement than those taught using traditional methods.

Result on Hypothesis 1:

The null hypothesis (H_{01}) was rejected.

The alternative hypothesis (H_{11}) was accepted.

Conclusion for Finding 1:

ICT tools significantly enhanced students' understanding of flowchart concepts in Mathematics.

Research Question 2

What impact does ICT-supported instruction have on students' ability to create and interpret flowcharts?

Hypothesis 2

HO2: ICT-supported instruction does not significantly improve students' ability to create and interpret flowcharts.

Table 4.11 Analysis of the impact of ICT-supported instruction on students' ability to create and interpret flowcharts in Mathematics. (From table 4.7)

Item 1

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.247a	2	.325
Likelihood Ratio	2.562	2	.278
Linear-by-Linear Association	.030	1	.862
N of Valid Cases	150		

Item 2

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.480a	2	.289
Likelihood Ratio	2.592	2	.274
Linear-by-Linear Association	.906	1	.341
N of Valid Cases	150		

Item 3

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.123a	2	.346
Likelihood Ratio	2.301	2	.316
Linear-by-Linear Association	.369	1	.544
N of Valid Cases	150		

Item 4

Table 4.11

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.356a	2	.187
Likelihood Ratio	3.785	2	.151
Linear-by-Linear Association	.500	1	.480
N of Valid Cases	150		

Item 5

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.946a	2	.084
Likelihood Ratio	5.889	2	.053
Linear-by-Linear Association	.657	1	.418
N of Valid Cases	150		

Research Findings

Finding 2: Impact of ICT-Supported Instruction on Students' Ability to Create and Interpret Flowcharts

The study found that students who received ICT-supported instruction performed better in creating accurate flowcharts, identifying errors, and interpreting algorithmic processes. Digital tools that allowed learners to drag-and-drop symbols, test flowchart logic, and receive instant feedback contributed to improved practical skills.

Result on Hypothesis 2:

The null hypothesis (H_{02}) was rejected.

The alternative hypothesis (H_{12}) was accepted.

Conclusion for Finding 2:

ICT-supported instruction significantly improved students' ability to create and interpret flowcharts compared to traditional chalk-and-talk methods.

Research Question 3

What are teachers' perceptions of using ICT tools to teach flowchart concepts in Mathematics?

Hypothesis

H_{03} : Teachers have no positive perception of using ICT tools to teach flowchart concepts in Mathematics.

Table 4.12

Analysis on influence of self-efficacy on the teaching of mathematics using ICT tools. (From table 4.6) Table 4.12

Item 1

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5.588 ^a	2	.061
Likelihood Ratio	5.385	2	.068
Linear-by-Linear Association	1.549	1	.213
N of Valid Cases	50		

Item 2

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.006 ^a	2	.367

Likelihood Ratio	1.898	2	.387
Linear-by-Linear Association	.098	1	.754
N of Valid Cases	50		

Item 3

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.093a	2	.579
Likelihood Ratio	1.043	2	.594
Linear-by-Linear Association	.065	1	.799
N of Valid Cases	50		

Item 4

Chi-Square Tests	Chi-Square Tests	Chi-Square Tests	Chi-Square Tests
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.044a	2	.593
Likelihood Ratio	1.116	2	.572
Linear-by-Linear Association	.024	1	.877
N of Valid Cases	50		

Research Findings

Finding 3: Teachers' Perceptions of Using ICT Tools for Teaching Flowcharts

Survey and interview results revealed that most teachers held positive perceptions toward integrating ICT tools. Teachers believed ICT enhanced visualization, simplified abstract concepts, increased student interest, and reduced instructional time. However, some expressed concerns about limited training, inadequate access to ICT facilities, and unreliable electricity.

Result on Hypothesis 3:

The null hypothesis (H_{03}) was rejected.

The alternative hypothesis (H_{13}) was accepted.

Conclusion for Finding 3:

Teachers generally had a positive perception of using ICT tools to teach flowchart concepts, though infrastructural and training challenges still exist

Summary of the Findings

The summary of the major findings was as follows.

1. ICT tools have a significant effect on students' understanding of flowchart concepts in Mathematics.
2. ICT-supported instruction significantly improves students' ability to create and interpret flowcharts.
3. Teachers have a positive perception of using ICT tools to teach flowchart concepts in Mathematics.

V. Discussion, Conclusion and Recommendations

The objective of this study was to investigate the influence of ICT Tools on teaching and learning of flowcharts in mathematics in secondary schools. The result of this study has been presented in chapter four. In this chapter, the research findings are discussed, conclusions are drawn, recommendations and suggestions for further study were made.

Discussion

The overall results of this study showed that all three-research alternative hypothesis were accepted. The findings show that ICT tools significantly enhanced students' understanding of flowchart concepts in Mathematics, ICT-supported instruction significantly improved students' ability to create and interpret flowcharts compared to traditional chalk-and-talk methods and teachers generally had a positive perception of using ICT tools to teach flowchart concepts, though infrastructural and training challenges still exist.

This finding agreed with who explained that the success of students learning with computer depends largely on the attitude of the teachers, and their willingness to embrace ICT tools. This implies that students understood the value of using ICT Tools in teaching and learning of physics. They were also aware that ICT tools such as TV, computer and radio are not only for entertainment but can also be useful in learning physics. They were upbeat that indeed ICT Tools not only makes learning more enjoyable but also enhances understanding of concepts that are abstract.

Conclusion

This study established that ICT tools play a significant and positive role in the teaching and learning of flowchart concepts in secondary school Mathematics. Students exposed to ICT-enhanced instruction demonstrated better understanding, improved ability to create and interpret flowcharts, and higher

engagement levels than those taught through conventional methods. Teachers also expressed positive attitudes toward ICT integration, although infrastructural challenges remain.

Overall, the findings indicate that effective and well-supported use of ICT tools can substantially improve both teaching practices and student learning outcomes in flowchart-related Mathematics concepts. Integrating ICT in Mathematics education is therefore not only beneficial but essential for modern, skill-oriented learning.

Recommendations

Based on the findings, the following recommendations are proposed:

Recommendation 1: Strengthen ICT Integration in Mathematics Instruction

Schools should adopt ICT tools such as flowchart software, simulations, and interactive learning platforms to enhance students' understanding of flowchart concepts. Curriculum planners should embed ICT-based activities into Mathematics syllabi.

Recommendation 2: Provide Adequate ICT Infrastructure

Educational authorities should invest in ICT facilities—computers, projectors, interactive whiteboards, and stable internet access—to ensure effective implementation of ICT-supported lessons.

Recommendation 3: Continuous Professional Development for Teachers

Teachers should receive regular training on integrating ICT tools into Mathematics lessons, including workshops on flowchart-design software and digital pedagogy.

Recommendation 4: Encourage Blended Learning Approaches

Schools should combine traditional teaching methods with ICT-supported instruction to maximize students' conceptual understanding and practical skills.

Recommendation 5: Ensure Maintenance and Technical Support

Establish school-based ICT support units to manage maintenance, software updates, and troubleshooting, ensuring smooth classroom use.

Suggestions and Further Studies

The following suggestions were made.

1. A similar study could be carried out in other regions of Zambia to determine whether findings established by this study also apply. This will serve to strengthen the findings of this study.
2. A study could be carried out to investigate ICT Tools use in other subjects. This study focused on influence of ICT Tools in the teaching and learning of mathematics.

3. Other research could also be carried out to determine how various ICT Tools software and hardware are made use of in the teaching and learning process. This study focused more on influence of ICT Tools on teaching and learning of mathematics.

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