EFFECTS OF COMPUTER TUTOR ON CHILDREN'S ACADEMIC PERFORMANCE IN THE CONCEPT OF SUBTRACTION OF MATHEMATICS ACTIVITIES IN PRESCHOOLS OF ILDAMAT WARD IN KAJIADO

COUNTY, KENYA

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DECLARATION

This research project is my original work and has not been presented for any academic award at any other university.

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This research project has been submitted for examination with our approval as university supervisors.

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I dedicate this work to my lovely children:

Israel Lenkai and Cindy Neema Nenkishon.

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ABBREVIATIONS AND ACRONYMS

AERA: American Education Research Association

APBET: Alternative Provision of Basic Education and Training

COS: Curriculum Support Officer

CPU: Central Processing Unit

DFID: Department for International Development

ECDE: Early Childhood Development Education.

ERIC: Education Resources Information Centre

ICT: Information and Communication Technology

KCPE: Kenya Certificate of Primary Education

MOE: Ministry Of Education

MOEST: Ministry Of Education Science and Technology

PRIMR: Primary Math and Reading

RCT: Randomized Controlled Trial

SPSS: Statistical Packages of Social Sciences

TCER: Texas Center for Educational Research

USAID: United States Agency for International Development

ABSTRACT

The purpose of this study was to investigate the effects of computer tutor on performance of subtraction among pre-school children on Ildamat ward in Kajiado central, Kenya. The objectives of the study were: to determine the effects of teacher's computer literacy on children's performance of subtraction concepts in early childhood education, to assess the effects of access to computer tutor on child's performance of subtraction concepts in early childhood education, to examine the effect of gender difference on how computer tutor affect their performance in subtraction among pre-school children on Ildamat ward in Kajiado Central, Kenya. This study employed a quasi-experimental approach of the pre-test – posttest type. The target population for this study was 16 preschool teachers and 316 preschool children. There were 10 pre-school centers in Ildamat ward. Multi-stage cluster sampling and purposive sampling were used to select the sample. The sample size for this study was drawn from two schools and it consisted of 44 pupils and 4 teachers drawn from the target population of 316 preschool children. The sample of schools selected represented 20%, pupils 14% and teachers 25%. Questionnaires and pupils competence test were used to collect data and analyzed using descriptive statistics and inferential statistics like analysis of variance (ANCOVA) and student t-test. Data on the teachers' computer literacy was used to categorize the pupils into two groups; control and experimental. The results indicated that the teacher's computer literacy had a significant effect on the child's performance in subtraction. Those children who were taught by teachers who were computer literate performed better in the posttest than those children who were taught by teachers were not computer literate. To establish the effects of using computer tutor on child's performance in subtraction the researcher subjected the data on pretest and posttest. The findings revealed that there was a statistically significant difference in the mean score of the two groups; control and experimental. The pupils who were taught using computer tutor (experimental group) performed better in subtraction than the control group. From the findings, the use of computer tutor in teaching mathematics enhanced learning outcomes. The following were the conclusions of the study. Teachers with insufficient computer skills find it difficult to integrate computer technology in their instructional approaches, a factor that negatively affects lesson delivery leading to dismal learning outcomes. The use of computer technology helps teachers to improve instruction. The technology assists the children to develop mathematical ideas that broaden their thinking and knowledge. It was revealed that the difference was not statistically significant between genders in mathematics performance for pupils who were taught using computer tutor. The following recommendations were made that the national government should come up with a policy that guide ECDE training colleges on how to incorporate computer studies in training teachers. The following were recommended for further research; a similar study should be carried out in the entire Kajiado County to find out if the use of computer tutor improves learning outcomes to enhance the generalizability of the study.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The use of Information and Communication Technology (ICT) has become very essential in almost all human activities and the operation of institutions and organizations. ICT is defined as any technology that is used in gathering, storing, processing and distribution of information (Beckinsale & Ram, 2006). The rapid development in technology has changed the world in almost all sectors and the way human beings communicate. The use of computers in teaching and learning has revolutionized instructional strategies and the way content is delivered in the classrooms. Computer technology when it's effectively used, it supports learning through a tailor made and differentiated content that addresses individual needs of each learner (Rastogi & Malhorta, 2013). It provides opportunities for efficient learning, interaction, accessibility and the quality of instruction. Research has demonstrated that the use of modern technology in education improves the quality of learning outcomes (Weller, 2005; Carlson & Gadio, 2008; Piper, Zuilkowski, Kwayumba, & Strigel, 2016).

Based on large scale findings on the importance of using technology in teaching and learning, many countries have adopted this approach in an effort to improve the quality of education. The use of computer technology in education has been applied in teaching all subjects at all levels of education. The integration of computers in teaching and learning mathematics in early years of schooling has been considered as the only way to nurture technology mind set, skills, innovation and creativity. Wiest (2008) states that

integration of computers in teaching and learning can positively impact on pedagogy and the performance of the learners. Innovation in teaching and learning contributes positively to knowledge acquisition and the overall performance in the demonstration of the skills taught (Nadrljanski, Soleša, Nadrljanski, 2008). Computer technology has been considered as a solution to the challenges that face the education sector around the world. One of the greatest challenges that majority of the countries in the world are struggling with is low quality learning outcomes especially in mathematics and sciences (Jameel & Ali, 2016). This problem has continued to persist even when governments, non-governmental organizations and individual donors have continued to increase funding every year to improve the quality of learning mathematics and how learners perform in the subject.

In USA, a study by Barnes (2016) on the interventions for children who are performing below average in mathematics in Texas and California states noted that a significant number of preschool children were performing lowly in mathematics. It was established that preschool children who come from low-income backgrounds proceed to grade one with very low mathematical skills. This kind of performance is likely to affect performance in mathematics is subsequent grades. A longitudinal study by Bodovski and Farkas (2007) showed that children who start with low performance in mathematics, struggle with learning mathematics in elementary grades and in secondary schools. The study also established that a significant number of children especially from the low and middle income families lagged behind in mathematics performance compared to children from high income families.

In the UK, Banerjee and Lamb (2016) reported that children from low socio economic class were underachieving in mathematics. The researchers noted that despite the efforts

that have been made to widen participation and performance in STEM subjects, some children were still held back by circumstances such as neighborhood, gender and socio-economic background. Evidence based literature cited by the researchers indicate that the low performance in mathematics among children from poor backgrounds was associated to inadequate learning resources. Weller (2005) found that children who learning formally at home using computer technology were more likely to perform better in academics compared to children who use traditional methods of pen and paper. The contextual factors inhibit the curiosity of the children to explore their environment to develop and enhance mathematical skills. Even though studies have focused on the influence of availability and adequacy of learning resources on mathematics performance among preschool children, it remains unclear how the use of computer technology affects learning of specific mathematics concepts such as subtraction.

The problem of low performance in mathematics among children in early years of schooling is more pronounced in African countries. Owan (2012) reported that poor performance in mathematics among primary school pupils is a matter of serious national concern. The studies found that majority of the pupils were performing below standard in certificate examinations. The poor performance in mathematics was attributed to fear of the subject, anxiety and the perception that the subject is difficult. The problem seem to persist even to higher levels of education as demonstrated by Kamla-Raj (2009) who reported that the performance in mathematics among students in junior secondary schools was generally below average. Scholarly efforts that have been made to address this, consent that the problem of poor performance in mathematics among learners is associated with the poor instructional strategies used to teach mathematics. Meremikwu and Obinna (2010) established that instructional materials were significantly related to

mathematics performance. It was established that pupils in private schools that had enough teaching and learning resources performed better in mathematics compared to pupils in public primary schools.

In Ethiopia, Woldehanna and Gebremedhin (2016) found that in the recent years, there has been an increase in access to primary education but the performance of the children in achievement tests has deteriorated. The study compared mathematics performance of children aged 12 years between the year 2006 and 2013. It was established that the performance in mathematics had declined significantly during that period. The problem was found to be more pronounced in public primary schools. Children in public schools performed significantly lower in mathematics compared to their peers in private schools. It was noted that the poor performance in mathematics among children in the age bracket that was studied may be due to weak mathematics learning foundation at preschool.

In Muranga County, Gikungu and Karanja (2014) noted that mathematics performance of children in selected ECDE centres was below average. Majority of the children who were involved in the study were unable to perform basic mathematical activities that they had been taught. The study established that the below average performance in mathematics was associated with teacher factors, learner factors, teaching methods used and availability of teaching and learning resources. Alluding to the fact that teaching and learning resources affect the performance of children in mathematics, the study did not explicitly demonstrate the relationship between the specific types of learning resources such as the use of computers and mathematics performance. The present study aimed at bridging this gap to provide conclusive empirical data that can be used to enhance teaching, learning and performance in mathematics in early years of schooling.

Relatedly, Kamau (2010) found that there was a decline in mathematics performance in lower primary schools in Makuyu zone. The researcher found that most pupils regarded mathematics as a difficult subject that frustrates learners' efforts. The problem was associated with inadequate mastery of mathematical basic skills which cannot enable them to pass examinations.

Research has demonstrated that mathematics performance among pupils in early years of schooling is influenced by numerous factors such as instructional materials, home back ground, teacher qualification, parental support and learner characteristics (Woldehanna & Gebremedhin, 2016; Mueni, 2019; Owan, 2012; Banerjee & Lamb 2016; Meremikwu & Obinna, Enukola, 2010). Despite the efforts that have been made to improve learning of mathematical skills in primary schools, a significant improvement is yet to be realized. In Kenya, Digital Literacy Program was initiated in primary schools to enhance pedagogy and improve learning outcomes. This initiative was part of the Tusome Early Grade Reading Activity that targeted learners in grade 1-3. The objective was to improve literacy outcomes and nurture the development of ICT skills from the early years of schooling. However, these efforts have not realized significant improvement on the learning outcomes of children. A substantial number of primary school pupils continue to score below average grades in achievement tests (Wamalwa, Mugasia & Sugut, 2019; Uwezo Report, 2016).

Uwezo Report (2016) revealed a worrying trend about mathematics learning in primary schools. It was found that 5.5% of class eight pupils were unable to do a class 2 mathematics question. The report revealed a deteriorating quality of education in Kajiado County. The numeracy levels among children in private schools were higher compared to those of children in public schools. A significant number of pupils in class

three were found to be unable to correctly answer a class two mathematics question. This problem seems to continue even to upper classes because mathematics performance in KCPE examinations has been below average for the last three years as indicated in Table 1.1.

Table 1

KCPE mathematics mean scores in Kajiado County

Year	2018	2017	2016
Maths mean score	41.5	45.3	38.4

Source: Kajiado County Education Office (2019)

As indicated in Table 1.1 Kajiado County has been registering below average performance in mathematics in KCPE examinations. The trend in mathematics performance is the same in all administrative units. This worrying trend raises concerns to all stakeholders but there is a scarcity of empirical literature that can inform the policy makers and all other stakeholders on the variables that can be manipulated to improve learning and performance in mathematics in the county. To address this gap, this study sought to find out the effects of computer tutor on children's academic performance in the concept of subtraction of mathematics activities in preschools of Ildamat ward in Kajiado County.

1.2.Statement of the Problem

The problem to be addressed by this study is the declining performance in mathematics among primary school pupils in Kajiado County. The below average performance in mathematics is evidenced by the KCPE results in the year 2016, 2017 and 2018 with

mean scores of 38.4, 45.3 and 41.5 respectively. Mathematics performance in Kajiado County has been found to be contributing to the overall poor performance. Research that has been carried out to investigate the factors associated with below average performance indicate that the problem is linked to a number of factors such as socio economic factors, school factors, learner factors and teacher factors (Wamalwa, Mugasia & Sugut, 2019).

With the paradigm shift in pedagogy to integrate modern technology in teaching and learning, little is known on how this new approach influence mathematics performance among primary school pupils in the county. There are many different traditional methods that have used in schools but the schools in Kajiado County are registering below average mean scores. This therefore, indicates that there is need to find out the impact of instructional method on mathematics performance in an effort to provide empirical evidence that may be used to address this problem.

1.3.The purpose of the Study

The purpose of the study was to investigate the effects of computer tutor on children's academic performance in the concept of subtraction of mathematics activities in preschools of Ildamat ward in Kajiado County

1.4.Objectives of the Study

The study aimed at fulfilling the following objectives;

1. To determine the effects of teacher's computer literacy on children's performance of subtraction concepts in early childhood education.
2. To assess the effects of access to computer tutor on child's performance of subtraction concepts in early childhood education.

3. To examine the effect of gender difference on how computer tutor affect their performance in subtraction.

1.5.Research Questions

The study was guided by the following research questions:

1. How does teacher's computer literacy impact on children's performance of subtraction concepts in early childhood education? Computer tutor
2. To what extent does access to computer tutor s influence the performance of subtraction concepts in early childhood education?
3. How does gender mediate the effect of computer tutor on performance in Subtraction?

1.6.Significance of the Study

The study is quite significant to various stakeholders directly or indirectly involved in the education of pre-scholars in Kenya. These include the school teachers, the children and parents. The study may be beneficial to scholars' innovators, entrepreneurs and curriculum implementers and all leaders who take Kenya to the realization of vision 2030 as well as the millennium development goals. This improve the study because it seeks to establish the impact of computers in learning of mathematical concepts in early childhood education.

1.7.Limitations of the Study.

Some of the schools were located in the interior where sometimes roads became impassable especially being a rainy season and the findings could be biased since they don't portray the true findings which would be minimized by including related research

and ensuring that the respondent's identity would not be disclosed for fear of being criticized.

1.8.Delimitation of the Study

The study be delimited to public (nursery schools?) In Ildamatt ward, Kajiado Central zone in Kajiado County. The results may not be generalized to other areas without caution.

1.9.Basic Assumptions of the study

The study assumed that all the pre-schools in Kajiado County have a conducive learning environment. It also assumes that teachers and pupils gave truthful information during data collection which has been used to make conclusions in this study.

1.10. Definition of the Key Terms

Academic performance refers to the scores a student obtains in class a test.

Computer Tutor refers to the mathematics computer software called Mathwhizz used to teach mathematics concepts

Collaborative Learning refers to an instruction method in which students at various performance levels work together in small group towards a common goal

Collaborative Learning refers to an instruction method in which students work in groups towards a common academic goal

Computer Access refers to availability and use of a computer by learner at classroom or at school.

Efficiency refers to delivering of experiences in a manner that helps learners obtain the information, concepts or skills in a more rapid and timely manner.

Early Childhood Education refers to the formal teaching of young children by people outside the family or in setting outside the home.

Early childhood refers to the early stage of growth and development.

Early childhood development is a process through which the young children grow and thrive physically, mentally, emotionally and morally.

Instructional resources refers to a variety of resources which influences the child's learning and the teachers teaching; this includes, charts, picture, real objects, models improvised or commercially bought.

Individual Learning refers to an instruction method in which students work individually at their own level and rate towards academic goal

Performance refers to a forward or onward improvement of learners during learning period.

Pre-school refers to schools going children aged between 3-6 years.

Parent or Teacher Computer Literacy refers to the knowledge and ability of teachers or parents to utilize computer and related technology efficiently.

Resources refer to books, pens, equipment, materials, and recreational facilities within a pre-school set up.

Software refers to any set of instructions that tells the hardware what to do like web browsers and games.

Visual resources are instructional materials that apply the sense of sight

1.11. Organization of the Study.

The study was organized into five chapters. Chapter one explores the background of the study, statement of the problem, the purpose of the study, the objectives of the study, the research questions, significance of the study, limitation of the study, delimitations of the study, basic assumptions of the study and definition of key terms. Chapter two comprises of; related literature review, theoretical framework and the conceptual framework. Chapter three covers the research methodology to be employed in the study, the study closely looks at the research design employed the target population, sample and sample size, data collection methods, data collection instruments used, their validity and reliability and finally the procedure for data collection and data analysis. Chapter four consists of data analysis and discussions of findings while chapter five provides summary, conclusions and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0.Introduction

The literature presented in this chapter is captured from primary sources and from secondary sources. The empirical review covers; computer tutoror subtraction in mathematics activity, Access to Computers and mathematics performance in early childhood development, Learning of Mathematics in Early Childhood, Teachers Computer Literacy, theoretical framework and the conceptual framework.

2.1.Computer tutor on subtraction in mathematics activity

A recent review (Tamim, Borokhovski, Pickup, & Bernard, 2015) found 11 national tablet initiatives under way, suggesting wide interest in large-scale educational tablet and laptop programs. Pouezevara and colleagues (2013) characterized the drivers of these one-to-one device large-scale distribution programs along four key motivations: political, social, economic, and educational transformation. Yet evidence is scarce as to whether the introduction of one-to-one technology can achieve these broad objectives. The Kenyan government's statements about its Digital Literacy Program reveal economic and pedagogical aspirations (ICT Authority, 2016). By introducing tablets loaded with curricular materials and instructional content, the government hopes to "radically change teaching and learning in schools" while triggering economic growth and improved infrastructure. The Digital Literacy Program includes local assembly of the devices (ICT Authority, 2016). 1 Relevant resource include: South Korea—Jang, Yi, & Shin (2016); Kenya—ICT Authority (2016).

The Kenyan Ministry of Education (MoE) introduced the National Tablets Program on behalf of coaches who support teachers implementing a new numeracy initiative. The use of tablets for instructional support began with a pilot in 2013; by 2017 it had become a critical part of the interventions under the MoE's Tusome Early Grade Reading Activity.2 The National Tablets Program integrates ICT to support the goal of improving literacy in grades 1–3.

The tablets are equipped with model teaching videos and a software application to support letter sound knowledge, as a way to help teachers improve their instruction (Piper, Zuilkowski, Kwayumba, & Strigel, 2016). The purpose of the software installed on the tablet is to assist the coaches to more effectively offer instructional support to teachers during their visits. Data from the coaches' use of the tablets is provided to county- and national-level leaders for accountability purposes. This effort is, to our knowledge, the first program focused on improving instructional support on a national scale in a developing country through the use of ICT. Thus, evidence of its added value is important to compare to the recent spate of negative results from large-scale laptop and tablet programs,

Kenya National Tablets Program fits into the broader evidence base of ICT applied to supporting educational outcomes on a large scale in developing countries, the impact of ICT targeted at student use in The tablets program received funding starting in 2013, through the National Tablets Programme (2013– 2015, British Department for International Development [DFID]/Kenya); the Primary Math and Reading (PRIMR) Initiative (2011–2014, the United States Agency for International Development [USAID] and DFID); and the Tusome ("Let Us Read") Early Grade Reading Activity (2014–2019, USAID and DFID). 3 In Kenya, low-cost private schools are found in peri-

urban or slum areas; they are also known as Alternative Provision of Basic Education and Training (APBET) institutions. Some examples of ICT in the classroom have shown statistically significant effects on student outcomes or even enrollment, repetition, and dropout rates (Christia, Cserwonko, & Garofalo, 2011), and fewer still have shown cost-effective impacts (Bando, Gallego, Gertler, & Romero, 2016; McEwan, 2015; Ortiz & Christia, 2014). Whether classroom technology has an impact depends on factors beyond just the presence of technology. The literature has pointed to positive outcomes associated with total instructional time on the device, including out-of-school use (Bebell & Kay, 2010; Texas Center for Educational Research [TCER], 2008); whether it was applied to a specific instructional challenge or subject area (Cramer & Smith, 2002; McEwan, 2015; Ortiz & Christia, 2014; Silvernail, Pinkham, Wintle, Walker, & Bartlett, 2011); and whether it helped teachers tailor teaching to student needs through adaptive instruction (Evans & Popova, 2015). While the studies cited above primarily involved wealthy countries, there has been some recent research of ICT interventions in Africa. A tablet-based math tutoring program in Malawi showed significant positive effects for Grade 3 students (Pitchford, 2015). This software is now being tested at larger scale in Tanzania under the global learning XPRIZE competition, examining how this program's effectiveness compares to that of others in rural Tanzania. A computer-based early phonics game used in Grade 1 in Zambia resulted in significant positive improvements when students or teachers used the program. There was an additional impact on outcomes when both students and teachers used the software (Jere-Folotiya et al., 2014). In Kenya, a small-scale program that provided e-readers for students, carried out under the Primary Math and Reading (PRIMR) Initiative in Kenya, showed statistically significant effects (Piper, Zuilkowski et al.,

2016). The instructional program that underpinned the ICT program, however, potentially had a greater impact than the hardware and software on which it was delivered. The findings of the PRIMR study informed the Kenyan government in implementing the National Tablets Program presented here. Evidence is emerging regarding the impact of ICT in the hands of students, and whether or how it improves learning outcomes, as described above; but few examples have described large-scale or national-scale programs that invested in ICT for students in classrooms. The results of large-scale implementation programs utilizing laptops or tablets provided to students in Portugal (Trucano, 2012), Peru (Beuermann et al., 2012), Uruguay (Pittaluga & Rivoir, 2012), and Honduras (Bando et al., 2016) have not consistently been able to attribute significant positive learning outcomes to the technology. On the other hand, a tablet program in Maine (USA) saw some improvements in learning outcomes (Silvernail et al., 2011). Impact of ICT for Teachers on Learning Outcomes There remains limited positive evidence on whether and how ICT directed at teachers has 60 IJEDICT Similarly, Bando and colleagues (2016) reviewed evaluations of large-scale book provision and concluded that "neither laptop nor book provision alone has an effect on student learning. Computers and books seem to require mediation by teachers or parents to enhance learning" (p. 8). Other studies have investigated whether ICT can improve student learning by improving teachers' instructional delivery. Coaching has been singled out as an effective form of teacher support, when implemented well (Bruns, Costa & Cunha, 2017; Kraft, Blazar, & Hogan, 2016; Piper & Zuilkowski 2015).

The impact of PRIMR was larger in Grade 2 than in Grade 1, with somewhat larger impacts on a procedural index of numeracy outcomes than a conceptual index (Piper, Ralaingita, Akach, & King, 2016). This program was scaled up nationally through the

Primary Education Development (PRIEDE) program (2015–2019), funded by the Global Partnership for Education. The fact that the impacts of PRIMR were larger in Grade 2 than in Grade 1 is interesting, but somewhat discouraging for the potential impact of Tayari on ECDE numeracy outcomes. Similarly, the PRIMR results informed Tayari's emphasis on conceptual skills rather than simple procedural impacts on computation, but suggested that the challenge for Tayari would be substantial. ECDE Background in Kenya Kenya's Basic Education Act (Republic of Kenya, 2013) established that basic education in Kenya would include two years of preprimary education. The Kenyan government's curriculum 60 Global Education Review 5(3) and education framework includes an expectation for all children to have access to preprimary education. The Kenyan constitution (Republic of Kenya, 2010) gave counties in Kenya the mandate to manage preprimary education. County governments manage preprimary education by hiring teachers, providing educational materials, and making capital investments in the preprimary subsector. On the other hand, Kenya's national government oversees preprimary education policy, particularly through the recently created ECDE directorate. Counties are mandated to adapt the existing ECDE policy to suit their local situation, although research suggests that this is relatively difficult for counties to do without the necessary technical expertise required to do so (Piper, Merseth, & Ngaruiya, 2018).

Computer covers any products that store retrieve, manipulate, transmit or receive information electronically in a digital form like personal computers, digital television, emails and robots. So, computer is concerned with the storage, retrieval, manipulation, transmission or receipts of digital data. It is also concerned with the way these different uses can work with each other Riley, (2012 online what is html).

According to Gecci (2009), ICT has been emerging from the concept of IT, meaning basically computers and communication technology, digital data networks as the latest phase of development, but also TV, satellites and phone. Due to a trend of merging different technologies there was a reason to start speaking of ICT as opposed to IT. ICT captures all the latest technologies and data storage. However, wat is in discussion is talk of computers, which includes desktops, laptops and servers that are needed in schools.

According to Bridget, (1998) computers have been used to solve two different problems in education. Computer based learning and teaching was developed to make learning more efficient and more interesting for learning. This addresses problem of quality of education. A longer tradition of distance education exists. It began with very tangible communication technologies like letters, then, it moved to audio visual materials, TVs and radio and finally email and web based learning. It solved the problem of accessibility to education. It brought education to people. Many aspirations for quality teaching with information technology are synonymous with those for the curriculum as a whole. But, the argument is that they are promoted and facilitated by new information and communication technologies and therefore can more easily become a reality in everyday classroom practice.

The computer is not new innovation. Computers have been used many years in a variety of applications. They were initially devised to perform extensive computations such as mathematical manipulation with great speed and accuracy. Colin, (1984).

According to Telly (1984), Computers can assist even very young children to develop mathematical ideas, provided teachers are able to choose and use proper software tools

to explore mathematical concepts and relationships in a way that scaffolds and extends young children's thinking in particular, their higher order thinking by allowing children to create, change, save and retrieve ideas, promoting reflection and engagement, connecting ideas from different areas.

According to Kalas (2010), children are curious and ask questions. They like to tell and listen to stories about themselves, other people and things. They like to draw houses, animals, trees, their parents etc. they like to make something. They like to play and interact with others people and animals. Computers can help children do many of the things mentioned. Computers can deliver content and activities that originate and support strong and productive emotions for children. Eventually they can serve as the environment and the tools for development of a child. Computer tools are technical tools which children should be encouraged to apply in their learning of mathematical concepts in different forms of numeration and counting.

2.2.Access to Computers and Mathematics Performance

The National Tablets Program in Kenya was designed as a tablet-based instructional support program for coaches using ICT. The program design was guided by the findings from a PRIMR randomized controlled trial (RCT) examining the effectiveness and cost-effectiveness of applying technology to different levels of the educational system (Piper, Jepkemei, Kwayumba, & Kibukho, 2016; Piper, Zuilkowski et al., 2016),

The national government has been expanding its role in creating the policy environment for effective ECDE interventions in the country. The new ECDE directorate has managed the development of a new ECDE policy, which awaits an official launch by the government after the rollout of a new preprimary and primary curriculum in early

2018. This policy ensure that the key ministries that are assigned to various ECDE functions are familiar with their role in ECDE and reduce overlap of provision of services. The policy also guide counties in the specific aspects of preprimary education service delivery (Ministry of Education [MOE], 2017). Recent statistics have shown that the demand in Kenya for preprimary education has grown to one of the highest rates in sub-Saharan Africa. The overall gross enrollment ratio for early childhood education increased from 69.4% in 2012 to 76.6% in 2016, while the net enrollment ratio increased from 66.9% in 2013 to 74.9% in 2016 (Republic of Kenya, 2017).

Tondeour (2010) reported that the fast development of information and communication technology has brought about profound change in the way we live and work, creating what is referred to as a knowledge based society. Computer allow us to create, collect, store and use knowledge and information. It enables us to connect with people and resources all over the world, to collaborate in the creation of knowledge and to distribute and benefit from knowledge products. These changes clearly offer further opportunities, but also a number of risks. Many people do not have access to computer, resulting in a new form of exclusion often thought of as the digital divide. Considerable academic attention has addresses the division between those who have access to computer and those who do not.

Tondeour (2010) cited that individuals enter the educational system with different levels of cultural capital and cultural know-how, based on their social background. Students from more disadvantaged social economic backgrounds have more difficulties adjusting to a school situation, creating an increased chance of failure students from more advantaged backgrounds; on the other hand, have the same cultural experience at home as they encounter at school. They are already acquainted with the general culture,

linguistic skills, knowledge of the educational system. Teachers too easily and often wrongly assume that everybody has internet access and show little understanding for students with low computer competencies Maulic (2008).

Information communication technology enhances the way we think, the way we live and the environment in which we live. In developing counties, computers are available only on a very limited scale, and this raises doubts about developing countries ability to participate in the current ICT induced global knowledge economy. Social – economic background seems to have influence in students' access or exposure to computer and internet.

According to Jerry (2008) the use of technology is a trend in U.S education system. However in order to use technology as an accelerator to improve teaching and learning efficiently, technology must be applied appropriately that blindly introduced into classrooms. Social economic status does not affect student's access to institutional resources, but also affects their opportunities to use technology. It is inconclusive whether is going to affect students' academic performance in all subjects but research found out that at least mathematics and science are positively linked to technology usage.

While computers continues to advance in Western and Asian countries, African countries still experience a lag in its implementation, and that continues to widen the digital and knowledge divides. In a recent study by Kiptalamet all (2010), observed that access to computer facilities is a major challenges facing most African countries with a ratio of one computer to 150 students against the ratio 1:15 students in the developed countries. Whereas computer has penetrated too many sectors including banking,

transportation, communications and medical service, the Kenyan education system seems to lag behind. Further recent report by the National Council of Science and Technology (2010) indicated that computer us in Kenyan classroom is still in its early phases and concluded that the perceptions and experiences at teachers and administrators do play an important role in the use of computers in Kenyan classrooms.

According to Kiptalam (2010) there is lack of qualifies to teach computer in schools. The demand for Computer learning has been tremendous and the number of teachers who are trained to teach ICT cannot meet the demand. There are more students ing to be taught computing skills that there are teachers to transfer the skills. Computers are still very expensive and despite spirited efforts by the government agencies, NGOs corporate organizations and individuals to donate computers to as many schools as possible, there still remains a big percentage of the schools unable to purchase computers for use by their pupils.

Many students are still no connected to electricity. Kenya being a developing country, the government has not been able to connect to all parts of the country to the national electricity grid. Consequently those schools that fall under such areas are left handicapped and may not be able to offer computer studies. Computers are still expensive in Kenya, in a country with a G.D.P of $1600, majority of the individuals and schools cannot afford to buy a computer and consider it as a luxury item more expensive than a T.V. most schools are not connected to the World Wide Web due to the high cost involved in the connectivity. In average, it nay cost $120 per month to connect to about 15 computers on bandwidth of 128/64kbps. This is considered as very expensive for a very slow speed.

Mungai, (2011) explains that unless computer becomes part of both the delivery and content of education the disadvantage deepen and development suffer. But the failure to use computer is itself a result of the digital and knowledge divide that exist, and their causes are deeply embedded in the complex historical and social cultural context of the country. Fortunately with the vision 2030 goals the Kenyan government has begun to implement strategies that address these paradoxes Mungai, (2011).

According to Nehemiah, (2013), challenges such as equipment installation, lack power supply, lack of funds for initial capital investment, operation and maintenance, affordable coverage, lack of technical support and computer repair facilities, multiple players in ICT design and implementation can be very inhibitive Nehemiah, (2013). Rural areas also have a multiple of problems that create barriers to people owning and using computer, Mavetera, (2013). These are not limited to illiteracy, cultural barriers, lack of computer skills, technological knowhow and access to computer networks, internet access, and usage opportunities Nehemiah, (2013).

According to Tonny (2009) computer adoption in African and Asia-Pacific has serious barriers to their use in education and social economic development, such as issues of infrastructure support, access to the computers. The implementation of computers is occurring in the context where the cultural and institutional barriers are not well addressed. The assumption often made is that if one just purchases a few computers and modems, a post-industrial society can magically result. Developing African and Asia-Pacific without using the new technologies, their future generations further lag behind and find themselves further impoverished. If they use technologies without addressing some of the concerns and needs of their societies they could be placing their carts before their horses. Students in low social economic areas do not have the same

computer access use, or skill level as those living in middle or upper social economic areas. Bridging the technology, education gap for students in rural or low social economic areas requires determination on the part of educators in these areas. Those educators in the field must develop and keep strong voice for their students- a voice that is loud and clear in the admonition that the students must be provided with up- to date technology education that allows them to compete in a world market Dianne, (2008).

2.3.Learning of Mathematics Using Computers in Early Childhood.

According to Tandi (2008) computer graphics allow learners to share mental images of structures, patterns and working systems that have hitherto been hidden away inside each individual's mind. So the dominance of print as the defining factor of 'proper' mathematics is at last, being challenged in the class room. The support that the computer gives to these internal mental visualizations encourages their development. We need to ask whether learners who study mathematics in a computer-rich environment actually learn something different to the concept being learned. It is hard to define what it is that students learn with or without computers. Rather, there is continuum, with a lot of overlap.

According to Ontario (2011) it has been found out that early mathematics has revealed that children bring more mathematics knowledge and experience to school than previously believed. According to Ontario, children's thinking is not limited to the concrete and mechanical.

It is often complex and abstract. Growing evidence also indicate that early mathematics plays a significant role in later education. Ontario, (2011) found out that early

mathematics skills are more powerful predictors of later academic achievements in both mathematics and reading than social emotional or reading skills. The difference in mathematical experiences that children receive in their early years has long lasting implications for later school achievements.

Ontario (2011) states that before the onset of formal schooling young children do not only memorize and they do not only employ mechanical skills. They do not operate only on a concrete level. Instead, we can say fairly that young children are splendid little mathematicians. They deal spontaneously and sometimes joyfully with mathematical ideas. This is what real mathematicians do. Mathematization is a critical learning process which involves re-describing, re-organizing, abstracting, generalizing, reflecting upon and giving language to that which is first understood as an intuitive on informal level.

According to Ontario (2011), when children first come to school, they bring inquisitiveness, energy, a wide range of social, intellectual and emotional experiences. This is not surprising since studies have shown that mathematical ability is evident in humans as early as infancy when points enables educators to build on students' mathematical knowledge with an inquiry-based approach developing purposeful and meaningful mathematical experiences in the classroom. Good teachers interpret what the child is doing and thinking and attempt to see the situation from the child's point of view.

Computer manipulative can sometimes be more powerful than concrete manipulative. Effective integrating technology into the curriculum demands effort, time commitment and sometimes even a change in one's beliefs. Ontario Ministry of Education (2010).

According to Berger (2013) when we think about math we often think about numbers. Mathematical thinking for young children has a completely different meaning. Children naturally use an array of concepts and skills that enable them to see, as well as to process and organize relationships and connections among different elements in the world. Mathematical concepts such as comparing, measuring and patterning help children understand phenomenon, solve real life problems, appreciate design and make predictions about the future. In this context, math should definitely be something that is enjoyed by young children. Early on children learn about math intuitively by using their senses and body to make senses of their social and physical environment. For example, they experience small and big when they cuddle in their mother's lap Berger (2013). Such experience prepares them for their understanding and naming of math vocabulary – small, medium, big and mathematical concepts such as sequencing. From ages three through six, children move from an intuitive to a more organized formal mathematical thinking. During this time children need more amount or time from a few objects to many. Patterning a form of ordering that contains an element of repetition. Extend children's thinking by asking to predict how the pattern evolve.

As teacher should we try to take imaginative approach in our teaching and keep ourselves informed about how the present situation is changing? Children today have the world in their living rooms through the medium of television.

2.4.Teachers Computer Literacy

Bradford Brown et.al. (2000) posit that a number of lectures of new technologies are constant with principles of the science of learning and hold promise for improving education. They content that new information and communication technologies (ICT)

can bring existing curricula based on real word problems into the classroom and provides scaffolds and tools to enhance learning. The interactivity of technologies is sited as the key features that enable students to receive feedback on their performance. Test and reflect on the ideas and revise their understanding. However Bradford Brown and cocking (2000) caution that positive impact of technology does not come automatically much depends on how teachers use I.C.T in their classes.

According to Lani (2004), the choice to use or not to use, the choice of when and how to use the computer should become and remain the responsibility of the teacher. The computer revolution has initiated a demand for computer literacy to be added to the list of basics. It is important to make the distinction between computer awareness and computer literacy. These are two terms which have been the centre of considerable discussion. Computer awareness usually means becoming aware of the extent to which computers are part of our lives and the society in which we live. It might include a study of history of computers, how a computer works, what computers do, where they are used, the impact they are likely to have on society and perhaps the moral and ethical questions raised by the increase use of computers in everyday life.

The term computer literacy is derived from a wider use of term literacy for example in language or mathematics. Literacy in language refers to the ability to read and write, that is, does something with language, similarly, literacy in mathematics, to do essential arithmetic, solve algebraic equations and so on. Computer literacy therefore implies the ability to do computing not merely to be aware of facts about computers and computing. Such computer literacy can be achieved by hands on experience and practice at computing. Teachers in all areas therefore need to know about how the computer can be used as learning environment for their particular pupils, for their particular subject

discipline. They need themselves to be literate in all possible uses of computers in education. For this to take place the teacher must have some level of understanding of computer technology and perhaps some understanding and experience of computer programming.

Although teachers of science and mathematics are generally more comfortable with these issues, such awareness and experience is limited among the teaching profession at the present time. Of course very few teachers be directly involved with development of computer based learning materials but they find it desirable to understand the process involved. Over the next few years many teachers actively participate in such developments while others wish at least to understand and perhaps modify for a teacher to have enough programming experience to be able to read programs and interact with those producing programs for their particular needs. If experienced programmers are to produce software for effective use in schools, answers to questions concerning relevance, pedagogy, sequence, level etc. can only come from the classroom teacher.

Hagarty (2004) found out that micro-computers are becoming widely available in schools even if the number in any one school is still small. An immediate task is to provide the necessary vehicle for school staff development in these areas to match this increased availability. The lack of teacher time is the largest obstacle to any effective program of staff development. It is unlikely that traditional models of in-service education suffice for the task of training in computer skills and alternative models with need to be explored if any significant progress is to be made. Teachers should not have to spend out of school time to become computer literate. If the goal of computer literate teaching force is to be met, it is suggested that an on-going in-service education course should be offered from within the school. Each school should consider using their own

computer experts. The majority of the time should be spent on hands-on experience. This would give teachers almost instant programming concepts through graphics and the teacher later be able to apply these skills in more conventional programming problems. The training of teachers across all subjects' areas in the curriculum to use the micro-computers effectively in the teaching of their subjects represents one of the largest problem areas and is essential if micro-computers are to achieve their considerable potential in schools.

Florian (2004) explain that a teacher is able to sense and probe a pupil's learning difficulties and then to try a succession of different strategies, either singly or in combination, in an attempt to overcome the problem. The teacher can also learn from his previous encounter with pupils and the subject's material and so evolve new methods of presentation. However, while teachers are the most effective all round teaching devices, they do have some drawbacks to offset their many virtues. Because of their high cost, their availability is limited, so that it is not usually possible to have just a few pupils for each teacher. The teachers ability to adjust his teaching to the needs of individual pupils and hence his effectiveness, can be seriously diluted in large classes. The problem is compounded by the administrative board which inevitably falls on teachers and reduces the time that they can devote to the pupils. This may be alleviated by using the computer to assist with the management of meaning. Although the teacher is very adaptable, by himself he can only impart information to his pupils by speech and gestures. This makes it difficult for him to explain visual phenomena or the functioning of dynamic systems, unless he makes use of other media to support these parts of the course. The introduction of new technology has frequently led to predictions that they revolutionize education. According to Hegarty and Lani (2004) computer use in general

use in general reported a growing suspicion that teachers would transfer old instructional techniques on to new media and thus not fully exploit their potential. To avoid this happening with virtual environments, educators must take a proactive stance that has often been taken to educational technology development in the past. If educators want environments, educators in the past. If educators want environments to meet learning needs, especially of those pupils who have unusual leaning needs, they must play an active role in the development of applications, offering to developers their unique understanding of learning styles and good teaching practices.

Lani (2004) sees computers as just one more useful facility in general remedial framework that is available but advice that they are not there to replace human teachers, just to provide them with additional teaching aid. Although computers are highly motivating Hergarty (2004) caution against the naïve belief that unguided interaction can effectively exploit their educational potential. Interaction can be guided through the environment of human tutor and through incorporating tutoring functions in the software

2.5.Theoretical Framework

The study adapt constructivists learning theory which maintains that knowledge is not obtained from outside, but that learner construct knowledge in the mind and as such the learner makes interpretations of the real word. Piaget's theory of constructivism impacts learning curriculum because teachers have to make a curriculum plan which enhances their students' logical and conceptual growth. Teacher must put emphasis on the significant role that experiences-or connections with the adjoining atmosphere-play in student education. For example, teachers must bear in mind the role those fundamental

concepts, such as the permanence of objects, plays when it comes to establishing cognitive structures.

Piaget's theory of constructivism argues that people produce knowledge and form meaning based upon their experiences. Piaget's theory covered learning theories, teaching methods, and education reform. Two of the key components which create the construction of an individual's new knowledge are accommodation and assimilation. Assimilating causes an individual to incorporate new experiences into the old experiences. This causes the individual to develop new outlooks, rethink what were once misunderstandings, and evaluate what is important, ultimately altering their perceptions. Accommodation, on the other hand, is reframing the world and new experiences into the mental capacity already present. Individuals conceive a particular fashion in which the world operates. When things do not operate within that context, they must accommodate and reframing the expectations with the outcomes.

Apart from learning theories, Piaget's theory of constructivism addresses how learning actually occurs, not focusing on what influences learning. The role of teachers is very important. Instead of giving a lecture the teachers in this theory function as facilitators whose role is to aid the student when it comes to their own understanding. This takes away focus from the teacher and lecture and puts it upon the student and their learning. The resources and lesson plans that must be initiated for this learning theory take a very different approach toward traditional learning as well. Instead of telling, the teacher must begin asking. Instead of answering questions that only align with their curriculum, the facilitator in this case must make it so that the student comes to the conclusions on their own instead of being told. Also, teachers are continually in conversation with the

students, creating the learning experience that is open to new directions depending upon the needs of the student as the learning progresses. Teachers following Piaget's theory of constructivism must challenge the student by making them effective critical thinkers and not being merely a "teacher" but also a mentor, a consultant, and a coach.Some strategies for teacher include having students working together and aiding to answer one another's questions. Another strategy includes designating one student as the "expert" on a subject and having them teach the class. Finally, allowing students to work in groups or pairs and research.

Alessi (2001) Vygotsky introduced the social aspect of learning into constructivism. Dewey advocated for contended that knowledge and ideas only emerged from a situation in which the learners had to draw them out of experiences that had meaning and importance to them. Piaget called for teachers to understand the steps in the development of the child's mind. He cited stages in the development of children and felt that children develop through each of these stages until he or she can reason logically Jean Piaget and his followers has been concerned with how human beings construct the world around them through personal meaning rather than simply through the accumulation of knowledge and facts or the development of skills. Constructivists postulate that there is not reality independent of human being. Reality is always constructed by the human being and exists thus only subjectively in his or her brain. Piaget also advanced the notion that human beings pass through a number of stages from the use of basic sense to more sophisticated ones. Piaget saw cognitive development as essentially a process of maturation within which genetics and experience interact. The development mind is viewed as constantly seeking equilibration. Equilibration is a balance between what is known and what is currently

being experienced. This is accomplished by the complementary process of assimilation and accommodation. Assimilation is the process by which incoming information is changed or modified in our minds so that we can fit it in with what we already know. Accommodation or the other hand is the process by which we modify what we already know to take into account new information. Working in conjunction, these two processes contribute to what Piaget term the central process of cognitive adaptation.

2.6.Conceptual Framework.

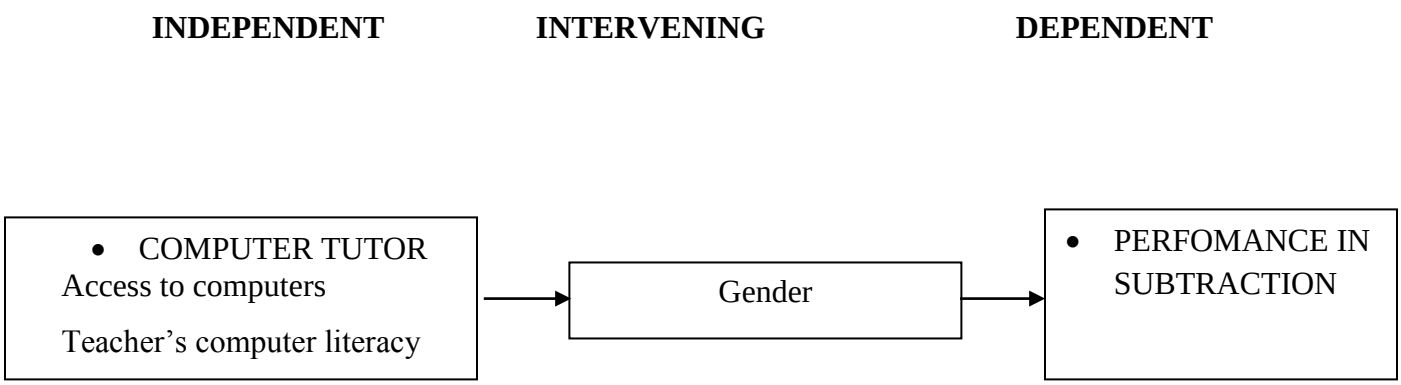

Figure 1; *Effect of Computer Tutor on Performance in Mathematics*

Conceptual framework explains either graphically or in a narrative for the main concepts or variables as well as their presumed relationship with each other (Miles and Huber man, 1994). This is a set of coherent ideas and concepts organized in a manner that makes them easy to communicate. Ravith (2011) states that, conceptual framework is both a process and a framework that helps to direct and ground researchers as they work through research challenges.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0.Introduction

This chapter describes the research methodology used to carry out the study. It covers the following areas; research design, target population, sampling techniques and sample size, data collection instruments, data collection methods, reliability and validity of instruments, data analysis and ethical considerations.

3.1.Research Design

Kumar (2005) defines a research design as a plan, structure, and strategy of investigation to obtain answers to research questions or problems, while Kothari (2004) defines it as the blueprint for collection, measurement and analysis of data. This study employed a quasi-experimental approach of the pre-test – posttest type. According to Kumar (2005) a pre-test – post test design is the most appropriate design for measuring the impact or effectiveness of a program, where one group is treated and the other is not. The quasi-experimental approach of the pre-test – post test design was suitable for this study because the performance in mathematics of the group of children taught through computer tutor (experimental group) was compared to the performance in subtraction activities of the group taught without tablets (control group). In both groups a pre-test and a post- test was used to determine the performance of the groups before and after treatment. Student Achievement Tests (SAT) were used to test learners' performance in subtraction activities. The use or non use of computer tutor in teaching was done without affecting the classroom set up so that the learners were not aware of their involvement in the study. However, to minimize the Hawthorne Effect, an equal

number of schools for the control and experimental groups were not pre- tested, but all groups.

3.2.Target Population

Target population or universe of a study is all the members or objects involved in the study (Kothari, 2004). The target population of the study was all public pre-primary schools in Ildamat Ward in Kajiado County. Mugenda and Mugenda (2003) assert that the target population is the population to which a researcher wants to generalize the results of a study. The target population for this study was 16 preschool teachers and 316 pre-school children. There are 10 pre-school centers in Ildamat ward.

3.3.Sampling Techniques and Sample Size

Purposive sampling was used to select two schools which were randomly assigned into experimental and control groups. Therefore each pre-primary school was considered as one intact group. The sample size for this study was drawn from two schools and it consisted of 44 pupils and 4 teachers drawn from the target population of 316 preschool children. The sample of schools selected represented 20%, pupils 14% and teachers 25%. Mugenda and Mugenda (2003) recommend that a sample of 10% -30% is considered representative.The sample size consisted of four teachers and 44 pupils who were categorized into two groups; experimental group 20 pupils and two teachers and control group 24 pupils and two teachers.

3.4.Data Collection Instruments

Data collection instruments are devices used to collect data such as: Paper questionnaires or computer assisted interviewing system (Census Bureau, 2010). Instruments in the general term that researchers use for a measurement device. To help

distinguish between instrument and instrumentation. Questionnaires and pupils competence tests (PCT) were be used to collect data.

3.5.Data Collection Instruments

These are instruments used to collect important information about the population. The items developed in the instruments should address to the specific objectives of the study. Data collection instrument also included questionnaires for preschool teachers and maths test.

3.6.Reliability and Validity of Instruments

3.6.1 Validity

The validity of a test is a measure of how well a test measures what it is supposed to measure. For this study, therefore supervisors, lectures and fellow students from the department of education examined the instruments individually and provided feedback necessary correction where made. Validity refers to the quality that a procedure or an instrument use in the research is accurate, correct, true, and meaningful and right (Enon, 1995). Therefore, the study is believed to be valid because it used respondents (teachers and pupils) who are practitioners in the field of learning and therefore were well informed about the study problem.

3.6.2 Reliability

4 Reliability refers to how consistent a research procedure or an instrument is. It therefore means, the degree of consistency demonstrated in a study (Enon, 1995).

Reliability is a measure of how consistent the result from a test over a number of repeated times (Kombo and Tromp, 2006). Thus it was expected that access that scores

obtained by each respondent on the first and second trail were close. The tests reliability was measured using Cronbach's Alpha, which looks at the internal consistency of the test items. This was done using the statistical package for social science (SPSS version 21.0). The test had Reliability of 0.882 using Cronbach's Alpha. Orodho (2005) noted that a correlation coefficient of about 0.8 should be considered high enough to judge the instruments as reliable for the study. The questionnaire used had a test retest reliability of 0.74

3.7 Data Analysis

The quantitative data were analyzed using frequencies, percentages, mean, standard deviation, independent samples t-test and Analysis of Covariance (ANCOVA). Why. Data was analyzed using statistical packages of social sciences (SPSS) version 21.0 and presented using tables. Show statistical technique for each objective.

3.8 Ethical Consideration

The research was carefully done to avoid causing physical or psychological harm to the respondents by asking embarrassing or irrelevant questions, threatening language or making respondent nervous. The purpose of this study was explained in details to the respondents and they were assured that the information gathered would be confidential.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATION

4.0.Introduction

This chapter presents the results of data analysis, interpretation and discussion of the results. It starts with the background information of the pupils and teachers and then the findings as per the study objectives. The data were analyzed using frequencies, percentages and inferential statistics and the findings presented using tables.

4.1.Background Information

This section presents the research instruments return rate, gender and age of the pupils, Teaching experience, academic qualification and computer literacy of the teachers, descriptive statistics for mathematics scores, Effect of Teacher's computer literacy on children's performance in subtraction, Effects of using computer tutor on child's performance in subtraction concepts and Effect of computer tutor on performance of pupils in subtraction based gender.

4.1.1. Return rate

A total of 48 questionnaires were administered to the sampled preschool teachers and pupils. The return rate for the questionnaires was 100% since the researcher conducted the pretest and posttest in person.

4.1.2. Gender and age of the pupils

Table 2 shows the gender of the pupils who were involved in the study.

Table 2

Gender of the pupils

	Control Group		Experimental group	
Gender	Frequency	Percent	Frequency	Percent
Girl	13	54.5	9	40.9
Boy	11	45.5	13	59.1
Total	24	100.0	22	100

As indicated in Table 2, in the control group 13 participants (54.5%) were girls while 11 participants (45.5%) were boys. In the experimental group, majority of the pupils representing 59.1% were boys while 40.9% of the participants were girls. The results show that there were almost an equal number of boys and girls who participated in the study Regarding the age of the pupils who were involved in the study, the results are presented in Table 3.

Table 3

Age of the pupils

	Control group		Experimental group	
Age (years)	Frequency	Percent	Frequency	Percent
4	19	81.8	17	72.7
5	5	18.2	2	18.2
6	0	0	1	9.1
Total	24	100.0	20	100.0

Table 3 shows that in the control group, 19 participants (81.8%) were aged four and 5 participants (18.2%) were five years old. In the experimental group, 17 participants representing 72.7% were four years old, 2 participants (18.2%) were five years old and only 1pupil (9.1%) were six years old. The results indicate that majority of the pupils selected from PP2 to participate in this study were four years old contrary to the ministry of education policy that pupils in PP2 should be five years.

4.1.3. Teaching experience, academic qualification and computer literacy of the teachers

The teaching experience, academic qualification and computer literacy of the teachers in the experimental and control groups are presented in Table 4 and Table 5 respectively.

Table 4

Teacher's Education, computer literacy and teaching experience in Experimental Group

Highest level of education	Percent	Computer literate	Percent	Teaching experience
Certificate	50	Yes	100	5 years
Diploma	50	No	0	20 years
Total	100.0		100	

As shown in Table 4, 50% of the respondents were certificate holders in ECDE while 50% were diploma holders. Concerning computer literacy, all the teachers in the experimental group were computer literate. The study established that with the teaching

experience of 5 and 20 years, the teachers had the capacity to provide reliable data. The parents were reported to be supporting the teachers in integrating technology in learning mathematics. The teachers also reported that they had access to computer technology in the school.

Table 5

Highest level of education, computer literacy and teaching experience of teachers in control group

Highest level of education	Percent	Computer literate	Percent	Teaching experience
Certificate	50	Yes	50	2 years
Diploma	50	No	50	10 years
Total	100.0		100	

The results in Table 5 reveal that 50% of the teachers were certificate holders while 50% were diploma holders. Similarly, half of the teachers were computer literate and the rest were computer illiterate. The teaching experience of 2 and 10 years imply that the teachers were fairly experienced. The teachers also revealed that parental involvement on computer games in learning mathematics was low. It was established that the school from which the control group was drawn did not have computers.

Descriptive statistics for mathematics scores

Table 6 presents the descriptive statistics for mathematics scores of the control group.

Table 6

Descriptives of Mathematics Scores for the Control Group

	N	Min.	Max.	Mean	Std. Dev.	Skewness
Pretest	22	1.00	4.00	2.50	.96	-.53
Posttest	22	2.0	5.0	3.64	1.40	-.19

The mathematics test consisted of five subtraction questions. Table 4.5 shows that the minimum score in the pretest was 1 while maximum score was 4. The mean score was 2.5 with a standard deviation of 0.96. The skewness coefficient of -0.53 indicates that the distribution of scores is nearly normal. The minimum score in the posttest was 2 while the maximum score was 5. The mean score was 3.64 with a standard deviation of 1.40. The skewness coefficient was – 0.19 indicating that the scores were near normal distribution. From the results, the pupils performed better in the posttest compared to the pretest.

Table 7 presents the descriptive of mathematics scores for the experimental group.

Table 7

Descriptives of mathematics scores for the experimental group

	N	Min.	Max.	Mean	Std. Dev.	Skewness
Pretest	22	1.00	5.00	3.05	1.05	-.098
Posttest	22	4.0	5.0	4.82	.39	-.77

Table 7 indicates that the minimum score in the pretest was 1 while the maximum score was 5. The mean score was 3.05 with standard deviation of 1.05. A coefficient of -0.098 indicates that scores in pretest were near normal distribution. In the posttest, the minimum score was 4 while the maximum score was 5. The mean score was 4.82 with a standard deviation of 0.39. The skewness coefficient was -0.77 implying that the scores

were near normal distribution. As indicated in the scores, the pupils performed better in the posttest compared to the pretest.

4.2. Effect of Teacher's Computer Literacy on Children's Performance in Subtraction

The findings on computer literacy of the teachers who participated in the study indicate that in the control group, 50% of the teachers were computer literate while the rest were computer illiterate. In the experimental group, all the teachers who were involved in the study were computer literate. Informed by these results, the researcher used independent samples *T*-test to establish if there was a significant mean difference in mathematics performance of the pupils taught by teachers who were computer literate and those who computer were illiterate. The posttest scores were used as the test variable and the grouping variable was categorized into two; control and experimental. The results are presented in Table 8

Table 8

Results of Independent samples T-test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	T	df	Sig. (2-tailed)	Mean Diff.	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	95.76	.000	-3.81	42	.000	-1.18	.30988	-1.81	-.56
Equal variances not assumed			-3.81	24.32	.001	-1.18	.31	-1.82	-.54

This study established that the mean of posttest scores for the control and experimental groups were significantly different, t (42) = -3.81, p = 0.001. The results imply that those pupils who were taught by teachers who were computer literate performed better in subtraction concepts than those taught by teachers who are computer illiterate. The results are consisted with the findings of Lani (2004) and Hergarty (2004) who established that teacher's computer knowledge and use and application of technology concepts in teaching and learning enhance learning outcomes. Educational researchers in Kenya have demonstrated that one of the constraints to the implementation of ICT in teaching and learning is lack of skills among the teachers. Maruti (2012) established that very few primary school teachers had sufficient skills in the use of ICT. The researcher attributed this problem to inadequate training in teacher training colleges and lack of ICT equipment in schools.

Since ICT integration in teaching and learning enhances creativity, problem solving and critical thinking, teachers equipped with ICT knowledge and skills use a variety of instructional approaches to bring on board all the learners during teaching and learning (Hergarty, 2004). Teachers with less ICT skills have been found to have a negative attitude towards the use of technology in teaching (Afshari et al., 2009). The negative attitude towards modern technology limits the scope and knowledge base of the teacher which negatively affects lesson delivery. Kzenek and Christensen (2008) notes that lack of computer literacy has a considerable effect on reflecting on new approaches to teaching as well as openness to new experiences to meet the demands of new era in education. Clearly the findings demonstrate that if preschool teachers are equipped with

skills on modern technology and how to integrate ICT in classroom instruction, then the learning objectives be effectively translated into learning experiences.

4.3.Effects of using computer tutor on child's performance in subtraction concepts

The second objective of this study was to investigate the effects of using computer tutor on child's performance in subtraction concepts. To achieve this, the collected data were subjected to Analysis of Covariance (ANCOVA) to establish if there was a significant mean difference in mathematics performance of the pupils taught using computer tutor and those taught using the traditional methods. In the two groups; control and experimental, data were collected in two phases. Phase one (pretest) the researcher collected data on the ability of the pupils to perform subtraction and the second phase (posttest) involved data collection after the pupils were taken through instruction on subtraction of numbers. The posttest scores were used as the dependent variable, the fixed factors were the two groups; control and experimental and the pretest scores were used as the covariates. The results are presented in Table 9.

Table 9

ANCOVA results for group pretest and posttest scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	18.309[a]	2	9.154	9.062	.001	.307
Intercept	60.000	1	60.000	59.394	.000	.592
Pretest	2.945	1	2.945	2.915	.095	.066
Group	11.007	1	11.007	10.896	.002	.210
Error	41.419	41	1.010			
Total	846.000	44				
Corrected Total	59.727	43				

a. R Squared = .307 (Adjusted R Squared = .273)

The results in Table 9 indicate that there was a statistically significant difference in the posttest scores for the control and experimental groups, $F(1, 41) = 10.896$, $P < 0.05$. As indicated in table 10, the difference in the mean score was in favour of the experimental group.

Table 10

Adjusted mean scores for control and experimental groups

Posttest Scores	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Control	3.708[a]	.218	3.267	4.149
Experimental	4.746[a]	.218	4.305	5.187

a. Covariates appearing in the model are evaluated at the following values: Pretest scores = 2.7727.

The results indicate that the pupils who were taught using computer tutor performed better in subtraction concepts than those taught using chalk and board method. The results are consistent with the findings of other scholars such as Piper, Zuilkowski, Kwayumba and Strigel (2016) and Bebell and Kay (2010) who found that ICT integration in teaching and learning significantly enhance learning outcomes. Anisha and Rani (2018) in their study on the use of ICT in teaching mathematics in primary and secondary schools reported that ICT integration in teaching and learning mathematics has a positive impact on critical thinking, problem solving skills and mathematics performance. The learners who were taught using computers performed better than those taught using traditional methods in all the three domains that were measured. A similar study in Kenya by Gachinu (2014) that investigated the impact of using ICT on

mathematics performance in secondary schools and reported that students who were taught using ICT performed better than those taught using traditional methods. The researcher recommended that to enhance learning outcomes in mathematics, teachers should embrace the use of technology in their instructional approaches. This is because the use of ICT enhances conceptualization of mathematics content.

4.4.Effect of computer tutor on performance of pupils in subtraction based gender

The third and last objective of this study was to investigate the effect of computer tutor on the performance of the pupils in subtraction based on gender. Table 11 shows the descriptive statistics for the posttest scores of the two groups.

Table 11

Descriptive statistics for posttest scores

Gender for experimental group	Mean	Std. Deviation	N
Girl	5.0000	.00000	9
Boy	4.6923	.48038	13
Total	4.8182	.39477	22

Table 11 shows that in the experimental group there were 13 girls and 9 boys. The mean score of the girls was 5 while that of boys was 4.6923. To establish if the difference in posttest mean score for boys and girls was statistically significant, the researcher subjected the collected data to ANCOVA. The posttest scores were the dependent variable, pretest scores were analyzed as the covariate and the fixed factor was gender of the pupils. The results are presented in Table 12

Table 12

ANCOVA results for experimental group pretest and posttest scores

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	.624[a]	2	.312	2.237	.134	.191
Intercept	52.902	1	52.902	379.448	.000	.952
Pretest	.120	1	.120	.863	.365	.043
Gender	.595	1	.595	4.265	.053	.183
Error	2.649	19	.139			
Total	514.000	22				
Corrected Total	3.273	21				

a. R Squared = .191 (Adjusted R Squared = .105), Dependent Variable: Experimental group posttest score

As indicated in Table 12, the mean score difference between boys and girls when taught using computer tutor was not statistically significant, $F(1, 19) = 4.265$, $P > 0.05$. Empirical evidence on gender differences in mathematics performance when ICT is used as an instructional tool is mixed. The findings of the present study contradict past research work which has demonstrated that ICT can be used to improve achievement better in boys than girls (Younger et al., 2005). Recent research evidence on harnessing technology in schools show that primary school teacher indicated that ICT has a positive effect on learning for both boys and girls but the effect was more in boys than girls (Kitchen et al., 2007). Boys were found to perform better in ICT related tasks while girls outperformed boys in paper and pen tasks. Concerning the use of different technologies and pupil's performance, there is a considerable difference between boys and girls. In the use of interactive whiteboards in teaching and learning in primary schools, it was established that there were gains for both boys and girls (Somekh et al.,

2007). The study did not find significant gender difference in learning. However, boys perform better than girls when handheld ICT devices are used in teaching and learning (Perry, 2005). In the project boys progressed by 3.79 grades in mathematics over a period of 2 years (3-5 years) while girls progressed by 3.36 grades. Ontario (2011) reported that children come to school with different mathematics experiences and knowledge. It was reported that difference in learning experiences between boys and girls was not significant. Tandi (2008) also revealed that it was difficult to define or quantify what boys and girls learn with or without computers.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0.Introduction

In this chapter, summary of the findings based on each objective are presented. It ends with conclusion and recommendations.

5.1.Summary of the Findings

Summary of the findings on effects of teacher's computer literacy on child's performance in subtraction, effects of using computer tutor on child's performance in subtraction and effect of computer tutor on performance of children in subtraction based gender.

5.1.1.Effects of teacher's computer literacy on child's performance in subtraction

The researcher sought to find out if teacher's computer literacy influences the child's performance in subtraction. Data on the teachers' computer literacy was used to categorize the pupils into two groups; control and experimental. The results indicated that the teacher's computer literacy had a significant effect on the child's performance in subtraction. Those children who were taught by teachers who were computer literate performed better in the posttest than those children who were taught by teachers were not computer literate.

5.1.2.Effects of using computer tutor on child's performance in subtraction concepts

To establish the effects of using computer tutor on child's performance in subtraction the researcher subjected the data on pretest and posttest to analysis of covariance with experimental and control groups as the fixed factors. The findings revealed that there

was a statistically significant difference in the mean score of the two groups; control and experimental. The pupils who were taught using computer tutor (experimental group) performed better in subtraction than the control group. From the findings, the use of computer tutor in teaching mathematics enhanced learning outcomes.

5.1.3.Effect of computer tutor on performance of pupils in subtraction based gender

To establish the effect of computer tutor on performance of pupils in subtraction based on gender, the researcher focused on the experimental group. The findings indicated that girls performed slightly better than the boys in the posttest. When the data were subjected to analysis of covariance with gender of the pupils as a covariate, the results showed that the mean score difference between boys and girls was not statistically significant.

5.2.Conclusion

The findings showed that the teacher's computer skills significantly affect the performance of children in subtraction test. The better quipped the teachers are in terms of knowledge and skills in computer technology and its application in teaching and learning, the better the learning outcomes of the children. Teachers with insufficient computer skills find it difficult to integrate computer technology in their instructional approaches, a factor that negatively affects lesson delivery leading to dismal learning outcomes.

Concerning the effects of computer tutor on child's performance in subtraction, it was established that the use of computer tutors in teaching and learning enhance academic performance of children. The use of computer technology helps teachers to improve

instruction. The technology assists the children to develop mathematical ideas that broaden their thinking and knowledge.

In the last objective the researcher wanted to establish if there was gender difference in mathematics performance for pupils who were taught using computer tutor. In the results, the mean of girls was slightly higher than that of boys but when the data were subjected to inferential analysis it was revealed the difference was not statistically significant. The findings indicate that in the experimental group, the performance of boys and girls in the posttest was the same.

5.3.Policy Recommendations

Based on the findings of this study, the researcher makes the following recommendations to improve the quality of teaching, learning and learning outcomes among preschool children in Kajiado County and the country at large.

i. The national government should come up with a policy that guide ECDE training colleges on how to incorporate computer in education training in teacher training. This build ICT capacity of student teachers and equip them with skills they require to integrate ICT in education.

ii. The county government in collaboration with the national government should endeavor to provide computer technology to all preschools in an effort to improve the quality of early childhood education. This set a solid foundation for subsequent learning that focuses on skills development.

5.4.Recommendations for Further Research

i. Since the study was carried out in Ildamat Ward which is a small region, a similar study should be carried out in the entire Kajiado County to find out if the

use of computer tutor improves learning outcomes to enhance the generalizability of the findings.

ii. Similar studies should be carried using samples of children in lower primary to compare the results in an effort to inform the policy makers on the effectiveness of using computer technology to enhance learning across different classes.

iii. Since the study found out that the performance of boys and girls in mathematics did not differ significantly when taught using computers, a similar study is necessary using a sample of older children or even secondary school students to see if the same results be obtained.

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APPENDIX I: OBSERVATION CHECKLIST FOR CHILDREN

The purpose of this observation checklist for children is to solicit information concerning computer and performance of subtraction concepts in pre-schools in Kajiado County. The pre-school identity was be treated with strict confidentiality and information obtained was be used for academic purpose only.

Names of the pre-school……

Number of computers……

1. Frequency of participation

   High ☐

   Medium ☐

   Low ☐

2. Level of handling the computers:

   High ☐

   Medium ☐

Low ☐

3. Concept projected form the computer:

Space and shape ☐

Counting and naming numbers:

Counting by role ☐

Comparing ☐

Counting objects ☐

Measuring ☐

Recognizing numerals ☐

Classifying ☐

Ordering ☐

Boys ☐

4. Those mostly engaged in the computer:

Boys ☐

Girls ☐

5. Attitude portrayed:

   Positive ☐

   Negative ☐

6. The allocation to computer:

   Adequate ☐

   Inadequate ☐

7. Learning environment – Conducive?

   No ☐ Yes ☐

APPENDIX II: QUESTIONAIRE FOR TEACHERS

The purpose of this questionnaire is to solicit information concerning the computer and performance of subtraction concepts in pre-schools.

Kindly respond to all the items in all the sections. Your identity treated with strict confidentiality and the information gathered not be used for any other purpose than education.

Name of the pre-school:…….

1. How long have you been a teacher in this pre-school?

   Less than 2 years ☐ 2-5years ☐ not more than 5 years ☐

2. State your highest academic qualification:……

3. Your highest professional qualification…….

4. Are you a computer literate? Yes ☐ No ☐

5. State your teaching experience years:……..

6. Is there organized dialogue among you and parents of your pre-school learning of mathematical concepts and computer?

   Yes ☐ No ☐

   If yes, how often? 0-5times ☐ over 5 times ☐

7. How would you describe the level of involvement of parents on computer games and learning of mathematics?

High ☐

Medium ☐

Low ☐

8. State the number of computers in your school:…….

9. How often do children play computer games?

Once a day ☐

Thrice a day ☐

More than twice a day ☐

10. How would you describe the influence of computer on children's performance of subtraction concepts?

High ☐ Medium ☐ Low ☐

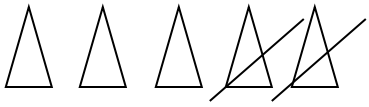
APPENDIX III: PRE-TEST

SUBTRACTION

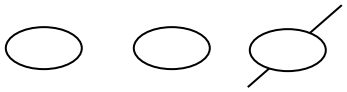
Write the missing number

1. 

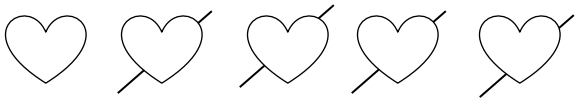
   4 take away 3 is ☐

2. 

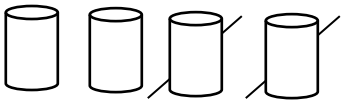
   5 take away 2 is ☐

3. 

   3 take away 1 is ☐

4. 

   5 take away 4 ☐

5. 

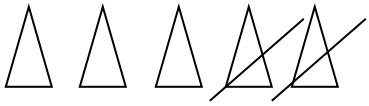
   4 take away 2 ☐

APPENDIX 1V: POST-TEST
SUBTRACTION

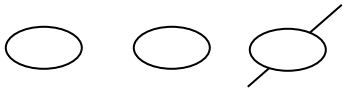
Write the missing number

1. 

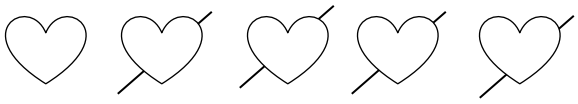
   4 take away 3 is ☐

2. 

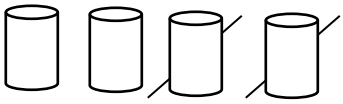
   5 take away 2 is ☐

3. 

   3 take away 1 is ☐

4. 

   5 take away 4 ☐

5. 

   4 take away 2 ☐