EFFECT OF PERSONALIZED LEARNING ON MATHEMATICS PERFORMANCE AMONG SECONDARY SCHOOLS IN AWENDO SUB-COUNTY, KENYA

A Thesis Submitted to the

Department of Education

School of Education, Humanities and Social Sciences

University of Eastern Africa, Baraton

In Partial Fulfillment of the Requirements for the

Degree of Master of Education

(Curriculum and Teaching)

Peter Ogwari

April 2021

APPROVAL SHEET

This thesis entitled ***Effect of personalized learning on mathematics performance among secondary schools in Awendo Sub-county, Kenya,*** written and submitted by **Peter Ogwari** in partial fulfillment of the requirements for the degree of Master of Education (Curriculum and Teaching) is hereby accepted and approved.

Prof. Elizabeth Role
Supervisor

Date

Dr. Catherine Amimo
Supervisor

Date

Accepted in partial fulfillment of the requirements for the degree of Master of Education (Curriculum and Teaching).

Dr. Paul Wahonya
School Dean

Date

Dr. Moses Kibirango
Director of Graduate Studies and Research

Date

ABSTRACT

This study focused on the curriculum area of mathematics in secondary schools in Awendo sub-county, Migori county, Kenya. It explored the effects of PL on mathematics performance, gender effect, and the extent of implementation. Four research questions and two null hypotheses guided the study. The study centered on the social constructivism theory of learning. Purposive sampling technique was used to select one school with 40 forms one students taught by one teacher during term one of 2019. Data collection techniques included video recording, photos, observation schedules, questionnaires, and achievement examination. Data were analyzed using descriptive statistics and the Mann-Whitney U Test. The sub-scales of the questionnaire yielded Cronbach's alpha reliability coefficients ranging from .654 to .686. Findings revealed that equally the experimental and control group, with 20 students per group, had the same level of achievement before PL was implemented. The Posttest showed that the experimental class had a higher performance index than the control at 74.15% against 68.95%, however, with a p-value of 0.957 > 0.05, the difference is not significant. The p-value of 0.594 > 0.05, indicated that posttest scores of the learners in the experimental group are not significant. The implementation was generally good for Student Ownership and Reflection (M=3.21; SD= 0.49), areas of Targeted Instruction (M=2.92; SD= 0.69), Flexible Content Tools and Learning Environment (M= 2.86; SD= 0.65. However, inconsistency was observed mostly in the implementation of PL which focused on group work, student's interests, needs, skill level, and one on one support. The study recommends that Mathematics teachers should be inducted in PL particularly in the use of Flexible Content Tools and Learning Environment that factors in student's interests, needs, skill level, and support.

ACKNOWLEDGEMENT

The years taken for this study had been years of self-reflection, determination, and commitment. My sincere thanks to all who have supported me in my endeavors to complete my thesis. I would like to acknowledge the Principals, Mathematics Curriculum leaders, and mathematics teachers at the schools who participated, students, and focus groups. I am sincerely grateful for their willingness to share their time and for the honest accounts of their experiences. Many thanks to all the lecturers and staff in the Department of Education, School of Education, Humanities and Social Sciences. I am grateful to the West Kenya Union of Seventh-day Adventist Church for providing me with a study award which has allowed me to complete my Master in Education (Curriculum and Teaching). Special thanks to my wife Lillian and my children Rice and Barrack for their love and support throughout my studies. Finally, I would like to acknowledge and thank my principal supervisor, Prof. Elizabeth Role, Dr. Catherine Amimo, and Dr. Francis Juma Osonga of Binghamton, New York for making time to give me support, guidance, and constructive feedback. Their patience and encouragement had been invaluable to me.

DEDICATION

This thesis is dedicated to my loving and caring wife, Lillian, My children; The late Barak senior, Condoleeza, Barak Junior and Joe Biden. Finally, to all who prayed for the realization of this dream.

TABLE OF CONTENTS

ABSTRACT iii

ACKNOWLEDGEMENT iv

DEDICATION v

TABLE OF CONTENTS vi

LIST OF TABLES x

LIST OF FIGURES xi

ABBREVIATION AND ACRONYMS xii

CHAPTER ONE 1

INTRODUCTION 1

Background of the Study 1

Statement of the Problem 7

Research Questions 9

Hypotheses 9

Significance of the Study 9

Limitations of the Research 11

Justification of the Study 11

Theoretical Framework 14

Social Constructivism 14

Zone of Proximal Development 15

Conceptual Framework 17

Scope of the Study....18
Operational Definition of Terms....19
CHAPTER TWO....21
REVIEW OF RELATED LITERATURE AND STUDIES....21
Achievement in Mathematics....21
Effects of Personalized Learning on the Achievement of Students....25
Mathematics and Gender....28
Mathematics and Ability....30
Personalized Learning....32
Components of Personalized Learning....35
Student Choice....35
Student Engagement....37
Targeted instruction....39
Flexible Learning Environments....40
Personal Learning Paths....41
Implementation of PL and its Challenges....41
Summary of Literature Review....42
CHAPTER THREE....44
RESEARCH METHODOLOGY....44
Research Design....44
Population and Sampling Techniques....45

Sampling Technique....46
Research Instruments....46
The validity of Research Instruments....50
Reliability of the Questionnaire....52
Data Gathering Procedures....53
Statistical Treatment of Data....55
Ethical Considerations....56
CHAPTER FOUR....59
PRESENTATION OF FINDINGS, ANALYSIS, AND INTERPRETATION....59
Background Information....59
Gender of the Participants....59
Level of Achievement in Mathematics before Personalized Learning Picked Up....60
Comparison of Pre-test Scores....61
Comparison of Post-test Scores....62
Comparison of Achievement of Male and Female Students....67
Implementation of Personalized Learning....69
Flexible Content and Tools and Learning Environment....69
Targeted Instruction....72
Student Reflection and Ownership....75
Students Undergoing Personalized Learning....78
CHAPTER FIVE....83

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS.....83

Summary of the Study.....83

Summary of Findings.....84

Conclusions.....85

REFERENCES.....88

APPENDICES.....105

APPENDIX 1: Achievement Test.....105

APPENDIX 2: Sample Lesson Plan for Control Group.....110

APPENDIX 3: Sample Lesson Plan for Experimental Group.....112

APPENDIX 4: Classroom Observation Schedule and Coding Schemes.....114

APPENDIX 5: Questionnaire.....115

APPENDIX 6: Table of Specification.....118

APPENDIX 7: Reliability Analysis.....119

APPENDIX 8: Ethical Clearence.....122

APPENDIX 9: Permission from Ranen Adventist Secondary School.....123

APPENDIX 10: Authorization from NACOSTI.....124

APPENDIX 11: Authorization from County Commisoner.....125

APPENDIX 12: Permit.....126

APPENDIX 13: Authorization from County Education Director.....128

APPENDIX 14: Authorization from Sub County Education Director.....129

APPENDIX 15: Curriculum Vitae.....130

LIST OF TABLES

Table 1: Mathematics Mean Score in KCSE Alt B (2013-2017) 6

Table 2: Overall National Grade Count Summary for 2017.....12

Table 3: Cronbach's Alpha Reliability Coefficients.....55

Table 4: Students Assigned Groups of Similar Characteristics.....57

Table 5: Gender Distribution of Respondents.....62

Table 6: Level of Achievement before Personalized Learning (Pre-test)……63

Table 7: Mann-Whitney pret-test analysis.....64

Table 8: Comparison Between the Mathematics Achievement of Students in Experimental and Control Groups……65

Table 9: Pre and Post-test Scores of the Experimental Class…….68

Table 10: Pre and Post-Test Scores of the Control Class…….69

Table 11: Difference in Achievement of Male and Female Students in the Experimental Group…….70

Table 12: Experimental Class Standard Deviations…….71

Table 13: Flexible Content and Tools and Learning Environment……..73

Table 14 :Targeted instruction…….76

Table 15 :Student Reflection and Ownership……..78

LIST OF FIGURES

Figure 1: Zone of proximal development (ZPD) 16

Figure 2: Conceptual framework of the study 17

Figure 3: Students Consulting Among Themselves..... 80

Figure 4: Students under guided discussion..... 81

Figure 5: Personalized Learning session..... 82

Figure 6: Teacher in a Personalized Learning Class..... 83

ABBREVIATION AND ACRONYMS

AIR - American Institutes of Research

CEMESTEA - Center for Mathematics, Science and Technology Education in Africa

ECE - Early Childhood Education

ITS - Intelligent Tutoring Systems

KCPE - Kenya Certificate of Primary Education

KCSE - Kenya Certificate of Secondary Education

KNEC - Kenya National Examination Council

NACOSTI - National Commission for Science, Technology, and Innovation

PL - Personalized Learning

TIMSS - Trends in International Mathematics and Science Study

SMASSE - Strengthening of Mathematics and Science in Secondary Education

TOS -Table of Specification

UEAB - University of Eastern Africa Baraton

ZPD - Zone of Proximal Development

CHAPTER ONE

INTRODUCTION

Background of the Study

A personalized System of Instruction is an approach that customizes learning for each student, taping on students' goals, interests, needs, and abilities concerning the curriculum. It addresses values and fosters logical thinking skills particularly in science and mathematics (De Freitas &Yapp, 2005). It relies on proper identification of students' responses to a given problem and making necessary alterations while specifying contingencies/ misconceptions between the responses and the expected feedback. According to Pane, Steiner, Baird, Hamilton, and Pane (2017, p. 2),

> Personalized learning prioritizes a clear understanding of the needs and goals of each student and the tailoring of instruction to address the needs and goals. These needs and goals, and progress towards meeting them are highly visible and easily assessable to teachers as well as students and their families, are frequently discussed among these parties, and are updated accordingly.

Personalized learning is characterized by learners learning at different stations and setting with little intervention from the teacher. Learners are allowed to move from one station to the next upon mastering the work at hand or rather the unit in question (Deakin, 2007).

Personalized learning should not be confused with individualized learning. Whereas individualized learning places the focus on the teacher planning tasks for individuals who in turn work as individual elements on the assigned tasks, personalized learning involves the teacher focusing on what different individuals can

contribute to effective learning for the whole class. Several studies show that such initiatives in personalized learning result in better test scores and outcomes for students. What is perhaps most exciting and equally daunting/overwhelming is the possibility for PL to evolve what it means to be a good methodology (De Freitas & Yapp, 2015).

Educationists tend to turn away from the traditional setting of the classroom to the new dynamic culture of classrooms and relevant in the 21st century. Instructions that are personalized are among these initiatives which are referred to as the school effort considering each student based on needs and characteristics as the environment for learning has more flexible instructions. Teachers who are determined to personalized instruction help fellow scholars in developing plans for personalized learning, do diagnosis for faults and mental strength and other forms of characteristics which help in adapting to the environment of educational instruction, desires to the learners, their interest and impart experiences that are reflective and authentic to them (Demski, 2012).

Personalized learning encompasses a variety of programs that aim at addressing different learning needs and interests of students from diverse backgrounds. Concurrently, the students' quest for having an understanding stimulates their healthier learning process. Aggressive students would like to know more on a particular topic, idea, or the whole subject thus increasing recognition in research, inquiries, and consultations in the class and have more independent study. Therefore, learning and teaching elements progression should be flexible and to be made more interactive in an environment for learning that is more constructive (Bolstad, McDowell, Bull, Boyd, & Hipkins, 2012). A survey done to bring the strategy of personalized learning in Australian secondary schools revealed that there

was a marked improvement in as much as ongoing challenges were facing the implementation of personalized learning such as time factor, resources, and evaluation procedures. The surveys were done in regional secondary schools (Prain & Peter, 2013).

In a 2016 report by the National High School Center which is funded by the government of US, department of Education, entitled "Emerging Evidence on Improving High School Student Achievement and Graduation Rates: The Effects of Four Popular Improvement Programs," investigators identified prospective for the arrangement of learning that is personalized for improving results of students. Furthermore, it was noted in the report that grounded on an indication from the evaluation models for reform of high schools making the environment of orderly and personalized learning an area having successful interventions which are contributed by the outcome of students that is improved specifically in big high schools (Herlihy & Quint, 2006).

A study that analyzed performance data from 36,000 United States of America students that used personalized learning in the school year 2016-2017 shows strong growth in reading, math, and other academic measures. Students were noted to have achieved a remarkable 130% in reading and 122% in math on the NWEA MAP exam. It was seen that over half of those students exceeded the reading progress target while 61% exceeded the math growth target. Additionally, ninety-two percent of district leaders said teachers were more effective in using the personalized learning approach, while 70% of teachers were confident that personalized learning has a positive effect on teaching and learning (Osadebe & Nwabeze, 2018).

In India, the use of the cloud-based application Mindspark in learning math and language has been adopted by tens of thousands of students -this is a learning tool that is powered by artificial intelligence and curates a path for learning of students depending on the information that has been obtained from the student's activities and answers to questions. There is then adjustment of content to be delivered and activity based on the needs of the student such as learning pace and style. The dynamic nature of the platform culls customized and relevance to form more than a billion points of data delivering content like questions, videos, activities, games testing and providing explanations, feedbacks, and inputs of learning useful to both teachers and students. The major difference between Mindspark and other online test presentations is the use of big data and machine learning to categorize patterns in the manner students answer questions. If the software picks weaknesses, it endorses corrective exercises (Rajendran & Muralidharan, 2013).

Many learners in unindustrialized countries can access quality educational media outside of the teaching space. This is made possible with the use of Cheaper mobile devices together with the flourishing educational app (Papadakis & Kalogiannakis, 2017). Increased use of technology (particularly in Nigeria and South Africa) has aided educational technology, making learning accessible to students everywhere. Locally, there is the sharing of knowledge and the development of stronger frameworks in education between parents, teachers, and learners through technology. Mobile devices do streamline and improve education administration and communication among stakeholders (Traxler & Leach, cited in Traxler, 2016).

Similarly, the ed-tech entrepreneur Rapelang Rabana's ReKindle Learning has helped improve education in Africa through technology. The knowledge of ReKindle was developed as a tool for adaptive learning which gives assuring that learning is strengthened in the vast aspects of learning in academics (Lionesses of Africa, n.d.).

Another effective technological learning venture is Rethink Education. It has an app that supports Mathematics and Science by allowing learners to go through the entire curriculum of high school Mathematics and Science. Instructors too can also do customization to frameworks of the current application to meet the needs of institutions of education (Criticos, 2000).

The education system needs to be addressed again. Nowadays, there are many issues that the schools face such as; insufficient teachers who are passionate and skilled, the curriculum that is outlawed, facilities that are ill-equipped housing students in excess. In Nigeria, for, example, there is evidence of failure in education where 70% of students who are tertiary institution graduates do not have employment (Fafunwa, 2018). In-spite of students' trending approaches to personalized learning using modern technology like the case in India, Nigeria, and even Kenya, most teachers are stuck with teacher-centered methods- which do not support the learning of Mathematics (Rajendran & Muralidharan, 2013; Traxlar, 2016).

While the Kenya Vision 2030 (keen on changing Kenya into an industrialized, economy) focuses on technology-related subjects such as mathematics (GoK, 2007), persistent failures in the subject have remained a major concern (Yara & Otieno, 2010). Learners continue to manifest weak understanding of Mathematical theories, skills generalization, among others, not only in external examinations but also in classroom exercises (Bot, cited in Babayemi & Olagunjo, 2015). This view is supported by the Kenya National Examination Council report of the year 2017 on the

Kenya Certificate of Secondary Education (KCSE, 2017) where a very low percentage passes were recorded in Mathematics where 50% of the candidates got a despicable score of "E".

Table 1

Mathematics Mean Score in KCSE Alt B (2013-2017)

Year	2013	2014	2015	2016	2017
Mean Score	17.29%	24.76%	16.58%	17.18%	20.20%

Adopted from KNEC (2017)

From table 1 it is noted that the mean score of mathematics across the five-year period from 2013 to 2017 is below 25%. This clearly indicates that majority of the students got a mean grade of "E". The least grade being recorded in the year 2016 as 17.18% and the highest recorded in the year 2014 as 24.76%. Because mathematics is considered an area of learning that is of importance to students targeted to drive societal technological and economic development and transformation, it is important to promote the subject for the development of mankind.

As observed by Littky and Allen (1999), "one size fits it all " approach does not work for better achievement. Therefore, it is to adopt relationships and structure that help in discovering the passion and strength of scholars. The change in students' culture is clear currently in the environment of learning. This has unconsciously impacted on the achievements of students. However, having a learning environment in the 21st century gives the students opportunity of using the content and becoming the experts with the guidance from the teacher.

Educators all over, mathematics not spared, have resorted to technological advances for personalized programs for learning in supporting students on curriculum. Personalized learning gives the students opportunity to have control of their learning

process makes students take control of their own learning. They thus own/ be in charge of their style of learning, gets motivated and engaged for personal achievement.

This study expounds on the delivery of modern creativity in an active environment in the classroom. It targets learner's history, their styles of learning, and the philosophy of education collegiality environment. It gives the following; environment for learning that is constructive, arrangement for learning that is corporate, discussion in small groups, learning that is active, schedule that is paced and flexible, authentic based assessment, collaborative learning which are alternative modes of instruction but are subsets of personalized learning (Jenkins & Keefe, 2005).

Personalizing learning dares teachers and educationists to contemplate new resources needed for effective access to learning by learners. It gives learners chances of working independently. It is against this background that the study becomes inevitable.

Statement of the Problem

Mathematics is among the mandatory subjects in the curriculum of secondary school. Marketable career opportunities rate mathematics as a core subject. As such it is needful to have a better understanding of its concepts by the majority if not all students. Despite the efforts made by the Center for Mathematics, Science and Technology Education in Africa (CEMASTEA) and Strengthening Mathematics and Science in Secondary Education (SMASSE) in the provision of professional development that is continuous to the teachers of mathematics to provide delivery that is effective of curricular quality and related services to students, performance has remained low, especially among female students (Muthemi, 2014).

Numerous issues influence the learning and performance of secondary school Mathematics. A case of performance in Mathematics in Awendo Sub County of Migori for the last ten years shows has been growing steadily but still the Sub County lags as compared to the other sub-counties of Migori County. This is evidenced by the posted results of the Kenya Certificate of Secondary Education from 2010 - 2019. Thus, igniting the need to find out what makes the sub-county have low performance in this subject. Therefore, this research sought to explore in detail the effect of Personalized Learning (PL) on the performance of mathematics.

While a personalized system would seem to offer solutions to the poor performance of Mathematics in Kenya, as it caters to different learner characteristics, research reveals that this approach to teaching is underutilized and under-researched (Powel, 2011). This study sought to experiment with the personalized learning concept; particularly investigating the more often overlooked factors such as gender variances and the extent of its implementation to help uplift the performance in mathematics. The study centered in Awendo as no study is known that has been done in Awendo. The effectiveness of the method was established by comparing the scores for the post and pre-tests.

Notable ways to improve the performance of mathematics include proper learning resources, learner-centered teaching approaches, and adequate teaching aids (Miheso, 2012). It is, therefore, prudent and crucial to come up with a well-blended, value-adding academic and learning method to ensure that the performance in mathematics transcends above average. This study sought personalized learning approaches to help mitigate and uplift mathematics performance.

Research Questions

This study was guided by the following four research questions:

1. What is the level of Mathematics achievement of control and experimental groups before personalized learning picks up?
2. Is there a significant difference between the mathematics achievement of control and experimental groups of the student?
3. Does the mathematics achievement of students taught using personalized learning differ significantly for male and female students?
4. To what extent is personalized learning implemented in the experimental group?

Hypotheses

This study aimed at testing two main null hypotheses as follows:

1. There is no significant difference between the mathematics achievement of control and experimental groups before personalized learning picks up.
2. The mathematics achievement of those taught using personalized learning does not differ significantly for male and female students.

Significance of the Study

Individualized learning is important to increase positive learning transitions. Students must be subjected to numerous quantifiable tests, problems, and workouts in the learning of mathematics to master the required skills. The educational interventions should be performed in a positive learning atmosphere to master these skills.

This research is the most important to encourage students to establish constructive approaches to mathematics academic achievement. The results of this research are anticipated to provide appreciated feedback on personalized learning instructional delivery, which can advance overall student achievement. It also provides bases for the communication strategy to be established responsive to the need for “more penetrating theories of mathematical thinking and learning in science” (Benbow, 2012). The cognitively-oriented science of thought and dynamic learning must therefore be harmonized with the different teaching/learning mechanism interaction theories and discourses.

Teachers should never remain to be the delivery agents of knowledge. They need to charge students to take ownership of their learning (Gillard, Gillard, & Pratt, 2015, p. 3). This study will help the secondary school teachers in the Sub-County in growing as educationists, identifying the needs of the learners thus help them reach their desired goals. Students will benefit from this study due to the degree of autonomy and engagement in their learning experience and so they get empowered and grow academically. Quality assurance standards officers in the Sub-County also will benefit by identifying best teaching methodologies and strategies for its implementation for quality math grade and enhancement of Competence-Based Curriculum -which focuses on what a learner can do as opposed to what he can remember. These findings can also educate school leaders who set up new schools so that strategies that regularly track student performance, results, and transparency as part of the evaluation process can be developed. Moreover, the results and advice may be of interest to secondary schools that have observed a decrease in mathematical student achievement, "When we teach our children as we did yesterday, we are stolen from the future" as quoted by the American philosopher and educator Dewey.

Limitations of the Research

Researchers are required or faced with minimal challenges. The limitations of this project are time and potential costs. After the initial session on personalized learning philosophy, teachers had to commit to content area professional learning experiences and meetings with an instructional coach. There was a cost for guest teachers for the days where teachers were out of the classroom. It is important to note that the normality of distribution could not be assumed because the sample size per group was less than 30 (Central Limit Theorem justifies the use of normal distribution for sample size greater than 30). This was because the available mixed schools within the study area had less than fifty students and are single streamed. The researcher, therefore, had to split the single-stream into halves. This study also lasted six weeks as the students had to break for end term exams. The researcher made sure that this short duration never affected the study by having some makeup lessons to help compensate for the short duration. Further, the forty minutes allocated for the lesson could not be enough to personalize learning to all students. The researcher, therefore, had to organize some evening classes to help meet the set objectives. It was assumed that the respondents were honest in filling the questionnaire.

Justification of the Study

Personalized learning is a critical building block of any education system. "Even though personalized learning offers potential for student-focused learning and meeting the needs of individual learners, there is limited knowledge of its application in the educational environment" (Basham et al., 2016, p. 126). Initial data pointed to inconsistent implementation amongst secondary teachers in the five elements of personalized learning: knowing your learners, student voice and choice, flexible groupings, and space. The teachers' methods of teaching directly influence the

learning outcomes of the students specifically in Mathematics. Mathematics teachers vary methods when teaching. Their duty when instructing is to develop methods or ways of teaching that will enrich students and make them successful. Modern methods of quality mathematical instruction include the use of graphics, connection, formative evaluation, and teaching of strategic thought (Collins, Brown, & Newman, 2016).

Further, it entails adjusting the style of instruction, materials used to help motivate students and teach them to persevere whenever challenges arise. Whereas the mathematics and science teachers' association bodies such as CEMASTEA and SMASSE which areas of equal importance as personalized learning have been in place to strengthen mathematics and science to tailor it to individual student need, less has been achieved. This is because the majority of the teachers have remained deeply rooted in traditional methods of teaching such as the lecture method followed by assignments with little interest in individual growth. This has led to a low level of performance in mathematics (KCSE, 2017).

The report (KCSE 2017) further indicated that boys perform better than girls. This issue has an intense national debate with many expressing fears that society is favoring girl children to the disadvantage of the boy child in almost all aspects of life.

Table 2

Overall National Grade Count Summary for 2017

GENDER	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E
FEMALE	61	901	2748	4890	7754	12032	18968	29834	42925	66978	91341	17191
MALE	81	1813	4596	7738	11631	15828	21506	31206	45522	68572	88040	18345

Adopted from KNEC (2017)

From the table above it is noted that the majority of the male students got quality grades than female students right from grade A to C+, the highest margin of close to 4000 is in the grade of B-.

This, therefore, justifies the need to determine the effects of personalized learning on the performance of Mathematics. This study was to look at the extent to which personalized is implemented in Mathematics through experimentation. It was to shed light on the challenges of personalized learning which when overcome, could improve the performance of Mathematics in Secondary schools.

In a study done by Wiley (2012) to evaluate the instructional use of learning objects, he showed that there are many ways in which computers and technology can be used to enhance teaching and learning practices by various training instruments. Psotka, Massey, and Mutter (2011) in their study on lessons learned from intelligent tutoring systems discussed how unique smart tutoring systems, computer systems, are capable of providing learners with instant, personalized feedback. Kulik, Bangert, and Williams (2013), in their study on the effects of computer-based teaching on secondary school students, concluded that computers have not been fully utilized in personalized learning of Mathematics. However, they found out that information technology has been used in learning other subjects and has improved the achievement of students (Kulik et al., 2013). From these studies, the use of educational tools is capable of improving teaching and learning practices with the provision of feedback to learners. These studies were not focused on personalized learning as a tool to improve performance of Mathematics and hence creating a gap for a study focusing on personalized learning as a tool to improve performance in Mathematics. This study, therefore, was focused on filling this gap by determining the

effects of personalized learning on the performance of Mathematics in Secondary schools.

Theoretical Framework

This study was centered on the social and cognitive constructivism theory of learning. It was also guided by the zone of proximal development (ZPD) a model coined by psychologist Vygotsky (1978). Social constructivism is applied in learning mathematics.

Social Constructivism

Social constructivism is a variety of cognitive constructivism that emphasizes how much learning is cooperative. Post-revolutionary Soviet psychologist Lev Vygotsky founded social constructivism. Vygotsky was cognitivist but refused the cognitivist's presumption that learning should be isolated from his social background, as Piaget and Perry had claimed. He argued that all cognitive functions emerge from the experiences of society and that education does not simply consist of learners' assimilation and adaptation of new knowledge; it was the mechanism that incorporated students into a knowledge group (Vygotsky, 1978).

The learning process requires that the student engages actively in innovative activities and self-organization. Learning is more likely when initiated and only encouraged. Teachers should encourage their students to ask their questions, to make their ideas, and to test them for viability. Instead of reducing or eliminating errors, teachers should facilitate errors arising from learner ideas. Students should also be challenged to carry out open-ended experiments and solve problems in practical and useful contexts by their teachers. This activity helps students to discuss and recognize ways to help or conflict.

Martin and Sugarman (2011) assert that learners must utilize the input of others and the teacher should only facilitate learning but not provide the knowledge. This theory allows for the integration and sharing of information among learners. The Zone of Proximal Development, which distinguishes between real and potential development stages of children, is the 'healthy learning.' According to Vygotsky.

Zone of Proximal Development

The Proximal Development Area is described by Vygotsky as “the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers” (Schunk, 2012). The ZPD is a student that reflects the amount of learning that a student will learn under acceptable educational conditions, according to Puntambekar & Hübscher (2005, cited by Schunk, 2012).

The principal reason Vygotsky was not happy with two practical problems in the field of educational psychology was to incorporate the idea of ZPD (Turuk, 2008). The first is the measurement of children's intellectual capabilities and the second is the assessment of educational activities. He assumes that research should not be based on the present level of success of a child, but that the future growth of a child should also be included (Verenikina, 2010). He claimed that the actual level of development which is considered as the level of independent performance does not sufficiently describe development. It rather indicates “what is already developed or achieved, it is a ‘yesterday of development’. The level of assisted performance indicates what a person can achieve shortly, what is developing (potential level, ‘tomorrow of development’, what a person ‘can be’)” (Verenikina, 2010). ZPD can therefore be

defined as the distance from or without help between an individual (illustrated in figure 1).

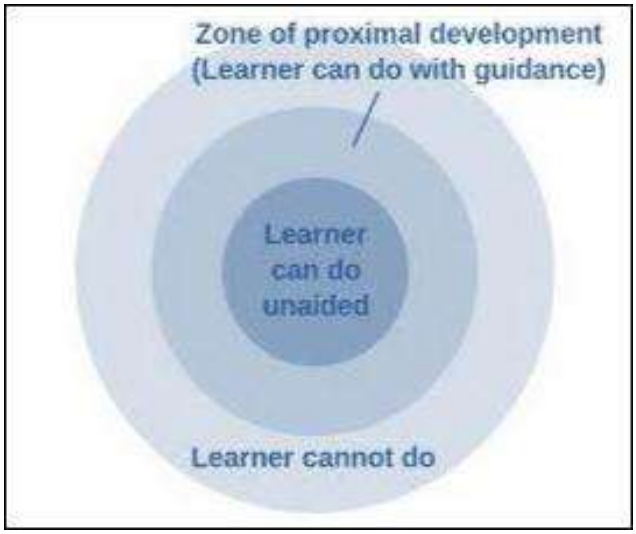


Figure 1. Zone of proximal development (ZPD).

Source: http://www.archemedx.com/blog/zones-proximal-learning-development/#.Wa7l3LpuL4g

ZPD is defined by Vygotsky as “the difference between the actual level of development as determined by independent problem solving and the higher level of potential development as determined through problem-solving under guidance or in collaboration with more capable peers” (Verenikina, 2010). The word 'proximal' means 'nearby' and, according to Cole and Cole (quoted by Verenikina, 2010, it says, the assistance given goes slightly beyond learners' complementing existing knowledge and enhancing existing skills. It is largely a measure of the willingness or intellectuality of a student in a particular domain and demonstrates how learning and growth are interrelated (Schunk, 2012).

The ZPD works together with an instructor and learner to a job that the student does not carry out separately due to the amount of trouble. This also illustrates the principle of group tasks, where those who know more or are more experienced share

their information and the capacity to execute their mission with those who have less knowledge, according to Bruner (1984, cited by Schunk, 2012). Rogoff (1986, quoted by Shunk, 2012) suggests that there needs a lot of guided engagement while working in the ZPD and students learn to understand and build meanings through their relational incorporation into the understanding. Therefore, this principle allows teachers to choose particular classes, to choose materials, and to adapt the content to fit the level of students.

The learners according to this theory are free to choose what methods, contents, and procedures to reach the target without necessarily considering the laid down processes as the result are what matters. The theory also stresses improving the current student/learner ability by providing them with the tools they need to succeed. Self-motivated students work hard and are focused to do their work right.

Conceptual Framework

As educators are given, various models of education have flourished. Initiatives aimed primarily at designing and/or redesigning academic learning structures to provide a more encouraging student-friendly learning environment. Ardelt (2011) argues the active need for this kind of learning Information building by social interaction, reflection community, Cooperation, and customization.

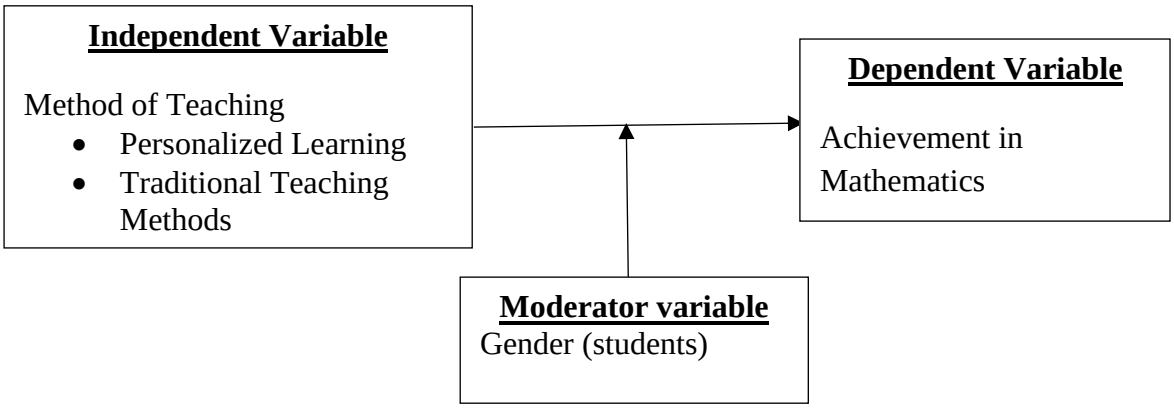


Figure 2. Conceptual framework of the study.

The first feedback for this analysis is to evaluate student learning background by examining and interpreting the learning styles and the atmosphere of collegiality in the mathematical learning environment. In response to the call to respond to the need and essence of the lesson-learning process. The separate variable was the teaching methods (personalized and traditional). Success in mathematics was the dependent/outcome variable. The instructional initiatives of the teacher have been revamped, to include the students actively in the creation, cooperation, experimentation, and reflection of what they learn in the popular culture of cooperative study. The dependent variable was performance/ achievement in mathematics. Gender as one of the factors affecting the achievement in mathematics was looked into. This helped determine the effect of gender on performance. The achievement in Mathematics was measured by the grades obtained by the student in the post-test examination. Further, the performance was also categorized in terms of gender.

Scope of the Study

This study was restricted to a private mixed secondary school. A mixed school was preferred because both boys and girls study under the same atmosphere and condition, hence the ease with which their progress could be monitored on gender roots. A group of 40 students participated in the study. The study ran for the second half of term one (six weeks) and the following units (natural numbers, factors, divisibility test, GCD, LCM, Integers) out of ten units meant for term one were covered. The experimental design was used to measure the effects of the independent variable (method of teaching) on the dependent variable (performance in Mathematics).

Operational Definition of Terms

The following are the definition of terms for the study:

Class: Consist of a group of students attending a Mathematics lesson.

Control Group: Refers to participants or pupils who received instructions using the traditional or regular teaching method (lecture method, question and answer method, individual seatwork, problem set).

Experimental Group: Refers to participants who were taught Mathematics using personalized learning strategies such as flipping the classrooms, helping students to set short and long term goals, followed by tracking their progress according to how they have prioritized their work. The focus is on what individuals can contribute to effective learning.

Mathematics: This is the science of structure, order, and relationship, which has developed from elementary counting, measuring, and defining objects' types. In this study, it refers to the subject taught in the Secondary School curriculum in Kenya involving manipulation of numbers.

Mathematics Achievement: Refers to gains in cognitive learning made after a teaching process. In this case, it refers to gains in post-test scores

Personalized Learning: The following were included: constructive atmosphere, collaboration learning structure, small-group discussion, active learning, flexible scheduling & speed, Authentic (regular) evaluation. In this research, lectures were centered on the learning needs and the unique interest of various teachers.

Traditional Method: This is referred to as the teacher-centered teaching of knowledge to student students. It includes the following: lecture method, question and answer method, individual seatwork, problem set.

Secondary Schools: This is the second level of schooling in Kenya in the 8-4-4 system of **education which normally takes four years.**

Flexible grouping: Learning spaces are created based on the needs of the student for the current learning task, including individual and group work opportunities

Student engagement: Active student participation in the learning process.

CHAPTER TWO

REVIEW OF RELATED LITERATURE AND STUDIES

In this chapter, the researcher reviews literature from various sources on personalized learning in secondary schools. The main themes which were reviewed are achievement in mathematics both locally and globally, history of personalized learning and its effects on student's achievement, gender and achievement in mathematics, mathematics and ability and personalized learning, its components and implementation.

Achievement in Mathematics

In the present world which is competitive, students have no option but to become knowledgeable in the field of mathematics, which means that they must know how to evaluate, understand and interact effectively and in a range of cases, ask for, address, and understand mathematical problems (OECD, 2004).

Many scholars have tried hard to research on mathematical skills, but the facts go beyond the cognitive factors. Students participate strongly in metacognitive factors such as understanding of their cognitive resources and reasoning, and the capacity for self-regulation (Zan 2010) as well as non-cognitive factors such as actions and acceptance of stimuli to make use of their information and the willingness to incorporate it if necessary (D'Amore, 2010). Mathematical knowledge cannot be taught; rather the learning process is a long-term goal. However, knowledge of the mixology, must be stressed to be equally essential as it requires declarative-proposal (knowledge) and procedure (skill). Given a problem, information helps one to grasp and evaluate the required theoretical findings, reasons and context that require theoretical approaches that can help solve the problem to be formulated and validated.

Without procedural competencies, knowledge is inadequate. The above results in concrete theoretical claims and practical consequences. Meanwhile, knowledge-less abilities can lead to proper procedures being applied in incorrect contexts resulting to false conclusions. For students to improve their self-regulation, a new approach is needed to upgrade their environment of learning (Azevedo, Cromley, Winters, Moos, & Greene, 2015).

Personalized learning has positive consequences for learning aftermaths, improvements in the conduct of learning (Underwood, 2009), and motivation and commitment (Wright, 2010). Further research on the use of technology such as iPad in literacy education has shown that iPads can be easily incorporated in the lecture room (Hutchison, Beschorner, & Schmidt-Crawford, 2012). They found that students learned to use the iPad easily and worked together to solve problems. The specificity of available applications and ease of access to iPads in the situation in the classroom allowed individual students to dynamically and effectively distinguish their learning. It will also appear that applications in the secondary mathematics classroom can be used in such a complex way.

Research has shown how the use of mathematics apps has positively affected student learning (Carr, 2012) by promoting optimistic mathematical learning attitudes and offering high encouragement through a variety of contexts and ages. Students are constantly engaged and inspired, often as an instructional medium, by the visual and interactive features of apps (Carr, 2012). Nevertheless, improved learning was seen to be dependent on the applications chosen, their intent, and, in particular, their pedagogical processes (Calder, 2015). Research also showed that the instructor can single learning for people or groups through mobile devices, and promote independent learning (Hutchison et al., 2012). However, teachers need to engage in pedagogical

processes that allow them to leverage applications in an age-appropriate and conceptual way to support learning intentions and meet the needs of their students (O'Malley, Jenkins, Wesley, Donehower, Rabuck, &Lewis, 2013). Although applications to encourage mathematical education to exist, Larkin (2013) admits that their efficient use depends on the teacher's expertise and inclination.

Mathematics education is a cognitive undertaking. Its success, as with other fields of cognition, plays an important role in student decisions as to how much mathematics they need in the future, and how they approach the studied mathematical material. The developments in International Mathematics and Science Research (TIMSS) have helped to achieve global achievement in mathematics (Jurdak, 2014). TIMSS is a broad evaluation body that advises educational policymakers and practitioners through international views of mathematics and science teaching and learning.

In addition to a selected community of European countries, students from East Asia (Mullis et al., 2012) have developed a worldwide reputation in fourth and eighth grades in mathematics, science, and reading. TIMSS offers overtime patterns and tests success in the fourth and eighth grades since 1995 in these subjects every four years.

Mathematics is one of the disciplines which helps people lay a solid foundation on which to survive. It is a requirement for science and technology. Mathematics is a basic human endeavor – a means of interpreting the universe (Ginsburg, 2002). Fapohunda (2002) considers mathematics as a central method in an educated man's training.

Due to its significance, in the primary and secondary school curriculums, Kenya made mathematics mandatory (Otiende, Bogonko, Wamahiu, & Karugu, 1992) to provide a strong base for scientific and reflective thinking and to prepare students

for the next education level. It is appreciative and without its knowledge there is shallowness in other fields, mainly in science. However, many students do not know enough about mathematics, mathematical principles, and skills (KNEC, 2000).

Accordingly, data released in 2014 on 31st December by the Ministry of Education, of the 839,759 class eight pupils taking the 2013 KCPE as the one-start exam, 467,353 scored below the average of 250 out of 500 possible scores. Uwezo Kenya's 2012 study showed few improvements in the cognitive ability of children (KCSE, 2015).

In some of the prestigious courses such as medicine, architecture, and engineering, mathematics is used as a basic entry criterion. While mathematics plays an important role in a society, Kenyan national tests have shown poor performance in mathematics (Aduda, 2003). The low results, could be attributed to the poor teaching methods (Harbour-peters, 2001), poor interest in mathematics and lack of suitable teaching materials at all levels of education (Gambari, 2010). Several studies have found other signs that could influence the mathematical output of pupils. In their rural education research in the US, Stringfield and Teddie (1991) demonstrated that the schools are distinct both from classrooms and from schools. Okoyeocha (2005) in a comparative analysis of public and private schools found that public schools were better prepared than their private counterparts.

A 2011 TIMSS study on results analysis in mathematics showed that in some Member States, achievements in mathematics increased over the years. In fourth and eighth grades, the number of high and low-level students has grown. Many governments fail to understand how they can better provide their students with mathematics education. The study notes that over school years, students' mathematics performance has declined (as a student grows older, math competencies decrease).

The bimodal distribution of mathematical achievement shows a high performance and low-performance peaks as was shown by a nation like China's Taipei. This means that schooling or services are not provided fairly to all students (Ker, 2013).

Early Childhood Education (ECE), Primary and Secondary Education is the current system of education in Kenya. After primary school, the Kenya National Examination Commission prepares KCPE (Kenya Certificate of Primary Education). Success in KCPE decides who is admitted in high schools. A candidate must engage in five fields – English, Mathematics, Kiswahili, Social Studies, and Science.

Identifying issues at a young age can avoid the creation of misconceptions that can be barriers to learning on a long-term basis (Walker et al., 2011). Early intervention can also battle anxiety that can become an important factor for elderly people (Dowker, 2004). It can in most cases be assumed that a solution will be identified if intervention begins early and clear vulnerabilities are discussed (Dowker, 2009). In TIMSS, Zan and Maartino (2007) announced that 4th Grade mathematics students had a much more optimistic attitude, thus making a great success.

In their paper, Gathier et al. (2004) stated that junior years are a significant transitional and increasing period for student mathematics. According to the study, the content, complexity, abstraction, and student proficiency standards evolve at this time. There is also a step towards abstract thinking. Junior students start researching more and more nuanced theories, thus building on their ability to manage more formal concepts.

Effects of Personalized Learning on the Achievement of Students

In the last 100 years, the world has changed dramatically, and education must also be changed to ensure that our children are adequately prepared for a world we could not imagine when we grew up. Training in one-size-fits-all may have been

enough years ago. Now it isn't. A customized learning approach using technology in a school is now accessible for both teachers and learners to match the needs of students and adapt learning to their interests (Kulik, Kulik, & Bangert-Drowns, 2010).

Students in the 21st century do not receive passively or reiterate knowledge, but personalize and actively contribute to their learning environments (Kulik, Kulik, & Bangert-Drowns, 2010). They can collaborate and work with teachers to set their own learning goals and can work towards them by integrating teacher experiences with the use of education technologies. Technology also helps students to look for opportunities beyond the reach of the schools independently. The output of custom learning demonstrates how the custom model of learning fosters interest, achievement and allows students and teachers to maximize their efforts for further success in education (Zhang, Zhao, Zhou, & Nunamaker, 2014).

Several research studies have shown the diversity and effectiveness of the combined models and have shown modest increases in student achievement in most studies, including broad meta-analyses (Staker & Horn, 2012). However, the power of these tools is unleashed with new emerging models built from the start for personalized learning. The profile of Spring City Elementary Hybrid Learning School in Pennsylvania demonstrates unprecedented progress with state test results in all grades and subjects in a mixed study conducted in April 2015 by the Evergreen Education Association and Clayton Christensen Institute for Disorderly Innovation (Clayton Christensen Institute for Disruptive Innovation and Evergreen Education Group, 2015). Between 2013 and 2014 the percentage of students who scored on the PSSA read scores at 'technical' or 'advanced' levels grew by 19 points to 82.9%; the number of mathematics scores increased by 24 points to 85.4%, and science scores increased by 27 points to 90% (Clayton Christensen Institute for Disruptive

Innovation and Evergreen Education Group, 2015). Excellent teachers contribute to excellent results and in customized classrooms, this remains true. The results from blended learning experts demonstrate the value of choosing an assisted method for transition with ongoing professional development resources based on teaching techniques for tailored student learning.

Several scholars and educators praise PL for affecting students positively in areas such as curiosity and motivation. "Most students are encouraged and driven to work hard," states Staker (2012), who adds that personalization encourages and retains treatment. To promote positive attitudes, personalization is especially successful.

Most evidence suggests that personalization of word problems can be an important strategy for teaching mathematical word problems and recognizing them. However, some study data indicate caution if word problems are customized. The findings are always positive.

The research in Wright and Wright (2010) showed that there were no major changes in student achievement in customized word problems even though the students preferred more often than not suitable solution strategies for customized problems. As reported, the study showed significant differences in two-step but not one-step customizations.

Ku and Sullivan (2012) customized issues in their analysis using the most common artifacts as decided by a completed student interest survey. Students achieved higher scores with individual problems both on the exam and on the test (i.e., before and after instruction). The interim 53-minute guidance and analysis used either personalized problems or problems that were not personalized. Students who customized problems were much better at handling personalized and un personalized

problems than those who were not trained individually, indicating that learning was shifted from personalized problems to non-personalized ones. Different advocates of personalized learning, collaborative teaching, and constructivism argue that the active exchange of ideas among small groups increases interest between group members and also encourages critical thinking and academic achievement.

As quoted by Bautista (2012), Petilos did find that cooperative teams reach a higher level of thinking and maintain knowledge longer than students who work as individuals alone. The shared learning during the discussion in small groups provides the students with an opportunity to speak, take responsibility for their learning, thus becoming critical thinkers. Small groups also contribute to more think because students participate in events, debates, and discussions where students are responsible for defending, explaining, justifying, and expressing their ideas to others.

Mathematics and Gender

The Millennium Objectives recommended equality in education and the promotion of African women to study mathematics and to take part in scientific and technical careers. While when girls and boys enter school there are no major disparities, the gender gaps in mathematics achievement and participation exist, as does the low representation of women from basic education to tertiary jobs (Robinson and Lubienski, 2011). Education has been severely affected by poverty in Africa. In the educational process of girls, history, religion, and culture forms the basis. The socio-cultural challenges to science, technology, and vocational training are the most pronounced and tragic in their negative impact on mathematics participation (Spaull, 2013).

The low mathematical participation of girls also depends on other factors. The UNESCO Institute of Statistics (September 2010) suggested that adult literacy is

71.6% for men in Sub-Saharan Africa and 53.6% for women and 76.7% and 58.1% for women in North Africa respectively. The net enrolment ratio for girls is 52.3 percent against boys, 60.7 percent, for children in the primary age population of sub-Saharan African countries, except in very few countries where almost all girls of primary school age are enrolled (Dickerson, McIntosh, & Valente, 2015).

Girls in secondary schools are experience a major drop-out because of socio-cultural (early marriage), financial factors, institutional obstacles, and poor results. In high school, only about 17% of students registered in Sub-Saharan Africa are girls, so that few have the chance to enroll in any science class; very few of those people choose mathematics. The best percentage for girls in mathematics at this level is around 30%, which is decreasing with the level of grade. It is around 10 percent at the tertiary level (Lindberg, Hyde, Petersen, & Linn, 2016).

Concerning accomplishments, 68% to 90% of African boys and girls at the age of eight have struggled to meet a lower international mathematical benchmark, and sadly no substantial improvement has been made in TIMSS 2007 or TIMSS 2011. (Mullis, Martin, González, & Chrostowski, 2004). Many studies show that girls and boys are at par as they join the kindergarten concerning mathematical ability. However, girls fall behind their male counterparts by the end of the fifth grade. For example, in TIMSS 2011, girls in Tunisia and boys performed equally until the fourth grade, but the gender difference favored boys by the eighth grade (Reddy et al., 2015).

The negative socio-cultural attitudes, the requisite household tasks, a gender-based curriculum, poor educational materials, lack of sponsorships, poor motivation, unqualified teachers, lack of encouraging and parental financial assistance, lack of trust, poor examination work, and attitudes of parents towards the sexes, among others, are factors that have led to gender differences.

In light of this special strategies were therefore initiated to encourage African girls to be more interested in science, mathematics, and technology and to encourage African women to embrace scientific and technical careers. The UNESCO, the African Union, the World Bank, NEPAD, and others have initiated these programs. The proportion of women who are teaching mathematics at the tertiary level remains very poor, and in francophone sub-Saharan countries, the proportion of African women who hold PhDs in mathematics is about 17%. It is higher, but not more than 30% for North African countries (Mullis, Martin, Foy, & Arora, 2012).

Mathematics and Ability

Ability in mathematics refers to the capacity to manipulate numbers in the administrative, science, and clerical fields. It is the capacity to grasp and work with numbers in numerical ideas. Schau (cited in Rosli, Maat, & Rosli, 2017) endorsed the belief that mathematical abilities help predict statistics. Similarly, Perin (2018) found that there is no substantial association of gender and mathematical skill and achievement. This means that the accomplishments of students in practical and physical mathematics are not differentiated together in gender and numerical capacity.

Classroom learning has many limitations in exposing the students to mathematical principles. The teachers are seen as not flexible in relating mathematical principles and daily lives (Hill & Dalton, 2013). Similarly, students have nothing to do with mathematics when studying the true artifacts of everyday life. The ability to link the various problems related to mathematics is the connection ability of students (Boaler, 2013). The relations between mathematics and non-mathematical stuff are included in Algebra-included topics with the Geometry concepts. Mathematical analysis should establish a link between mathematics and external mathematics (Blum & Niss, 2011). Since mathematics is a science that includes many ties between

concepts such as the concept of connection to the concept of function, additional operations with numerical multiplication, the concept of the derivative function with the concept of economic benefit and loss, and the concept of exponential bacterial growth. The mathematical skills of students are important in daily learning. Personalized learning is learning that includes these properties (Furner & Kumar, 2007).

Confidence in student's skill in mathematics in particular may have long-term consequences. Girls are frequently socialized and involved in linking science professions with men in adolescence (Cheryan, 2012), which is confirmed by several people (Else-Quest et al., 2013). Girls are more negatively conscious of their mathematical potential than young people, with implications for their future career choices (Correll, 2001). These negative self-evaluations seem to be a reaction to the above-mentioned sex-like comparisons (Cheryan & Plaut, 2010), popular in many developed countries. Experimental social scientists have found that in daunting mathematical environments threatening girls and women are frequently stereotyped (Good et al., 2003).

For those who have a certain view of mathematics rather than development, the adverse impact of these stereotypes can be exacerbated (Dweck, 2006). Indeed, when girls and boys have more positive mathematical orientations, including perceived mathematical capabilities and development, they are more likely to declare mathematical masters (Perez-Felkner et al., 2012). Even during college, optimistic perceptions about men's mathematical ability are connected to the continuation of major studies in mathematics and related fields (Sex et al., 2015).

Personalized Learning

In every corner of life, personalization is becoming more and more necessary. As one of these corners Personalization has been used to make schooling more authentic. Personalization can be defined as the incorporation of past experiences and interests of students in education content and context. As mentioned, personalization was a way of creating a connection between new knowledge and existing ones using familiar people and backgrounds from past experiences. The personalization of learning includes the use of multiple instructional methods to scaffold students' learning, the enhancement of student skills, changes in time, location, and speed in which students are to learn, the involvement of students in the formation of learning pathways, and the use of technology to control and record the learning process and their access. Usually, homework work includes conventional teaching and learning of core subjects, such as algebra, using problem sets or questions from textbooks. Since the introduction and usage of personal computers both in homes and in schools, computers have been developed for use as teaching and learning supplements in educational media (in other words education software, and, recently, message boards, Web-sites, blogs, and other web-based tools) (Wiley, 2012).

However, the most popular approaches to teaching and learning are a 'one-size-all' approach. Similarly, instructional software and problem sets did not recognize individual learners' needs. Adaptive mechanisms have begun to evolve for these reasons. As several educational tools, computers and technology have been used efficiently to enhance teaching and learning activities (Wiley, 2012).

Individual learning was used even in the 1920s when Helen Parkhurst developed the Dalton Plan that was intended to balance child talent and the needs of the community (Lombardi, 2015). Their first aim, in particular, was to adjust the

curriculum of each student to their needs, preferences, and abilities (Lombardi 2015) and to encourage each child of school to freely select a variety of activities already planned by the teacher so that academic, social and moral development can be completely improved (Ndume, Tilya, & Twaakyondo 2014). Those were theoretical ideas and practices which required no technology, not even mechanization. Practices that were mechanized with earlier technology to acquire expertise based on the past of the learner's responses were used in the 1930s (Lombardi, 2015). By the 1960s, scientists had already moved beyond systems that had predetermined instruction using some form of technology. These types of systems have been deemed adaptive and adapted to the needs of learners to move towards a lesson-centered approach (Hwang, Sung, Hung, Huang, & Tsai, 2012). It was only in the 1970s that Victor Garcia Hoz introduced and invented the word "personalization" in the sense of educational science (Hoz, 2012).

Technology had a problem, as the human contact and responsiveness of human teacher was missing on computers. Moreover, as technologies evolve and immersive experience with immediate feedback, machines became more complex. Relevant Smart Tutor Significant steps were taken to improve student achievement in mathematics by ensuring that teachers were supported and received training based on digitalization techniques in early secondary grades. These main areas were important to ensuring personalized learning and to ensure that the learning will contribute to positive student results, with particular references to mathematics. But how do we support the diversity and needs of individual students in a very multicultural world? With time, the main areas centered on how the process can be accelerated (Leadbeater, 2004):

- The transition from primary school to secondary school.

- New teaching and learning high school technique.
- Personalized learning supporting ICT.
- Topic education success.
- A diverse program in high school.

System (ITSs) containing animated conversational agents that communicate in natural language that express human-like communication (Fu, 2014) provided immediate and personalized feedback to learners (Psotka, Massey, & Mutter), provided user-input feedback, and recommended immediately based on user answers.

Sleeman and Brown (1982) coined the term "intelligent tutoring system" to describe a computer-aided education system that focused on learning by representing learner knowledge. An ITS offered a customized learning environment because its response to appointments and evaluations suggested that the delivery of education materials was tailored to the needs of the learner. The ability of ITS to provide individual learners with tailored learning support and feedback to enhance their learning performance based on their data, profiles, or portfolios was critical for learning (Walonoski & Heffernan, 2006). ITS has been the most commonly recognized type of adaptive learning resource which has provided individual students with a personalized learning experience that helps them enhance their learning performance through responses or learning portfolios.

Computer instruction has shown the ability to deliver comparable or better training results than conventional face-to-face instruction, according to Tucker (2007). Educators, scientists, corporations, coaches, and psychologists have pursued computer systems to meet the needs of students and optimize the learning experience (Bartley & Golek, 2004). Each student had to complete a set of skills to demonstrate mastery of a subject. The performance of these computer-based programs depends on

the willingness of learners to acquire new skills, adaptability to technology, improved productivity, cost, and efficiency (Hategekimana, 2008). This comes back to the 'one-size-fits-all approach,' where all students conducted similar or equivalent tasks in a class. Examples of problems included sets, tests, and quizzes. To better understand these problems, student expectations have been analyzed, learners' needs, learning styles, and speeds at which students have been encountered (Hwang et al., 2012). Teachers and course designers proposed that the learners' personalities should be given specific consideration and interventions adapted accordingly (Coffield, Moseley, Hall, & Ecclestone 2012). Personalized learning was used to adapt to these learning needs, using adaptive learning to adapt curricula and instruction. Personalized learning content is one of the most significant characteristics of education systems (Tseng, Chu, Hwang, & Tsai, 2008). Personalized learning experiences are gained through a range of approaches, and one of the most common is inverted training.

Components of Personalized Learning

Personalized learning can entail a variety of curricular and physical changes to schools. However, the effects of personal learning demonstrate that this approach to education can have a powerful effect on student success. To test the impact of personalized learning on students and school performance, the following components were considered: student's selection, student participation, flexible study environments, and individual learning paths: (McLeskey, Rosenberg, & Westling, 2017).

Student Choice

This refers to giving students the possibility to choose what they study to strengthen their commitment and motivation in the classroom (Perks, 2010). By

growing the commitment of students, teachers expect to influence student success and to produce successful results (Perks, 2010). Investigation indicates that this strategy is successful, suggesting that students can increase both academic performance and their participation in school by having a degree of autonomy in their learning experience.

It has a positive impact on student motivation as it helps students to determine how to tackle their homework (Patall, Cooper, & Wynn, 2010). Teachers randomly allocated students to one of two groups: choice of homework or no choice of homework. Those in the former could choose for two tasks, while students in the latter had no choice in their tasks (Patall et al., 2010). The findings of the study indicated a greater interest, pleasure, and competence in homework for pupils with a preference in their homework. Besides, the choice had a measurable effect on student success, because students conducted end-of-unit tests and homework better (Patall et al., 2010). One possible flaw in the study is the longer time it takes teachers to design, distribute, collect, and grade a variety of tasks (Patall et al., 2010).

It was found that a variety of factors – including motivation, effort, success at assignments, competence, learning, and challenge preferences – has positive consequences in the meta-analysis of student choice (Patall, Cooper & Robinson, 2008). They attributed increased motivation to a greater sense of autonomy and competence when students can select freely (Patall, Cooper, & Robinson, 2008). The results of such analysis indicate that as opposed to choices affecting schooling, activities, and task options, educationally irrelevant choices have the greatest effect on the motivation of the students (Patall, Cooper, & Robinson, 2008).

Promoting Student Choice

While using tic-tac-toe choices boards for instance, students may make several decisions about which tasks they wish to accomplish. Similarly, students who work on

summative assignments have the option of the subjects to be studied or explored. Another approach to student choices is skill-based learning of their learning experience. The Next Generation Learning Challenges encourages students to move at their best and get credit for the mastery of the curriculum, an organization that is committed to improving college readiness and works through innovating technology (Vogt, 2014). The company reviewed its grant recipients to record the approaches to master's studies in the program based on the two basic strategies (Vogt, 2014).

In certain schools, students move beyond narrowly defined boundaries at their own pace, within a particular task, in a classroom, or even in a grade level. The limits form a beginning and a stopping point for self-interest by a clear curriculum expectation. Students are honored to advance within the restricted set of skills. Students tend to pass without limits in other schools at their own pace. There are no school levels, learning assignments and master's content are guided by projects, or students can opt for ways to show mastery beyond any particular curriculum. Before they can move to students must comply with national requirements and prove a predestined degree of mastership. Some schools have minimum self-pacing conditions such that a student who has no history cannot escape the subject but must continue taking it as he advances in master's degree, for example (Gauci, Dantas, Williams, & Kemm, 2009).

Student Engagement

This is the degree of attention, curiosity, interest, and optimism in education, and passion which students display when they learn or are taught, further it refers to the level of motivation they need to learn and progress in their education (Cranton, 2006). Students take the initiative "to make progress from lack of knowledge, lack of understanding, lack of competence, and failure, to know to understand and acquire

ability" (Reeve, 2013). The participation of students is essential in preventing academic error, promoting skills, and influencing a variety of results for students (Li & Lerner, 2013). Researchers often point to dedication as a significant predictor of academic success (Dotterer & Lowe, 2011). Student participation, however, is not a specific entity. Research into student participation has progressed from a unilateral to a multidimensional one over the last 10 years (Li & Lerner, 2013).

Research shows that the dedication of schools is good for the academic results of students. Chase, Hilliard, Geldhof, Warren, and Lerner (2014) determined that there is a two-way, reciprocal link between school involvement and academic achievement in their high school research (Chase et al., 2014). In other words, levels of commitment will predict the academic success of a learner. Inversely (measured by grade point average) student achievement will predict the level of participation of a student in the school (Chase et al., 2014). Evidence from their analysis indicates the cognitive, behavioral, and emotional of the three forms of interaction. Comportment is the best indicator of academic success in high-school students (Chase et al., 2014). They observed in particular that while students are engaged cognitively if students consider the school to be relevant, academia cannot succeed if they do not know the best way in which they should participate in schoolwork (Chase et al., 2014).

Changes in one form of commitment, however, can affect other types of commitment as well. Research by Lerner and Li suggests that there are feedback loops between the various interaction styles (Li & Lerner, 2013). Researchers find, for example, an essential positive relationship between emotional involvement in grades 9 and compartmental involvement in grades 10. Emotional activity at 10th grade also forecasts cognitive commitment at 11th grade (Li & Lerner, 2013). Further research is

required to understand how the connections between the different types of commitment are interrelated (Li & Lerner, 2013).

Studies carried out by Li, Lerner, Chase, and others have shown that the degree and background of the classroom will affect the type of commitment the students require. Although the study of Connor is small in its sample size, its existence at the cross-grade level indicates that the advancement of students from elementary school (Conner, 2011). The effect of the classroom context on student participation has been studied by Dotterer and Lowe (2011).

Targeted Instruction

This refers to Specific instruction a teacher gives in response to individual needs Teaching is limited number of students and based on their specific goals. Teacher assesses data for each student for recognition of education requirements. He groups students in homogeneous or heterogeneous formats on a competency basis, and adjust teaching resources based on student needs for each group.

Standard teaching in the classroom focused on group-wide methods to facilitate student academic development has not done well due to diverse learning needs. Students' academic performance has since deteriorated. Instruction focuses on the middle class and never responds to the unique needs of students who are behind or ahead of the average class. The goal of targeted instruction is to break down the whole community structure of classrooms so that the needs of all the students can better be met. Targeted teaching gives teacher's flexibility in both what they teach and when they teach, rather than following a predetermined curricle or timeline guide, to promote student development. Goal group curriculum differs depending on students' different needs. For example, a teacher may concentrate on multiplication by one group of students and complex with another.

Targeted instruction in this way provides opportunities for teachers to use data to provide direct instruction that students need. Besides, targeted instruction gives students more possibilities for exchanging opinions and voicing concerns while interacting together with teachers and peers who have similar requirements. Teachers also stated that they will listen, tutor, and develop closer relationships with their students in small groups, as well (Richburg-Burgess, 2012).

Flexible Learning Environments

To build an efficient learning environment management must subscribe to practice theory and connect it to sensitive startups (Lippman, 2010). The theory of practice explains how learners communicate with the environment, while sensitive commissioning discusses the essence of the interaction between the social and physical dimensions of the learning environment (Lippman, 2010). In other words, to develop a successful atmosphere for learning it is not only important to consider how students operate in a classroom but also how students communicate in the classroom. Modern learning contexts are seen as environments where students participate in self-directed and cooperative learning practices in terms of how they engage with personalized learning; thus, the learning environment plays a direct role in personalized learning (Lippman, 2010).

Some research after monitoring of the potential mediating factors, suggests, that certain physical environments are positively correlated to student achievement. One such research examined the influence of four design aspects on student achievement to assess the impact of the environment on learning. The study found positive associations between academic achievement and the environment (Tanner, 2008). The study analyzed socioeconomic status and found that while socioeconomic

status is negatively linked to student performance, the overall environment is associated with better student performance.

The incorporation of new technologies such as laptops, tablets, and SMART panels is one way of making the learning experience more versatile and adaptable. A recent study by American Research Institutes (AIR) notes that blended learning environments are one way to make classroom versatile (Tanenbaum, Le Floch, Boyle, Laine, & Newberger, 2013).

Personal Learning Paths

A personal learning path, or plan, is a plan prepared for short- to long-term learning purposes by students, with teachers, counselors, and parents. Usually based on the conviction that schools provide students with a greater understanding of their choices (Vogt, 2014). There is minimal longitudinal research that explores specifically the effect of student success and changing personal learning routes.

But the research findings of a seminal study conducted in 1992 on the position of student self-efficiency and the setting of personal objectives suggest that the self-efficacy and the goals of the students are interlinked, more efficient, and further that more goals are identified by the students upon review (Zimmerman, Bandura, & Martinez-Pons, 1992). Self-efficacy not only affect the determination of academic goals by students but also their achievement (Zimmerman et al., 1992). The researchers also recommend that students be supported by teachers, in three key ways: supporting organizational autonomy, supporting procedural self-governance, and supporting cognitive autonomy (Stefanou, Perencevich, DiCintio, & Turner, 2014).

Implementation of Personalized Learning and its Challenges

Personalized learning demands that professors become "apprentices" and incorporate unique methods of teaching and evaluation (Basham et al., 2016). They

need the training to promote interest, build trust and provide opportunities for learning to share with other learners (Tlhoaele et al., 2014). Critical characteristics include a highly autonomous environment; open, continuous, and workable data; ongoing input and weekly meetings; incorporation of voice for students; and numerous means for mastery of learning standards (Basham et al., 2016).

Challenges occur when PL is introduced as "students question the degree of control and choice offered and whether the learning experience is personalized to students" (Prain et al., 2013, p. 668). The lack of access to an exemplary individual learning model creates an obstacle for classroom teachers to incorporate this teaching method (Basham et al., 2016). Teachers who are to provide students with customized learning experiences, need, expertise, time, resources and coordination' to establish a scalable program that is sufficiently organized in content, learning activities and adaptable classroom practices to address contrasting needs.

Summary of Literature Review

From the reviewed literature on the effects of personalized learning that have been carried out globally and locally there has been little experimentation on the effects of personalized learning on mathematics performance in Kenyan Secondary schools. In addition to a selected number of European countries, global achievement in mathematics shows that students from East Asia outperform their colleagues in mathematics, science, and reading students worldwide. Standard eight students, who took the 2013 KCPE, won the mastery of science and technology, which is a product of little improvement in children's education skills and mathematics, according to the Ministry of Education. This is because mathematics performs badly, including bad teaching techniques, poor math’s interest, and lack of educational content across all stages of education. In 2011 the TIMSS report on mathematics showed that the

success of mathematics is improving over time in the many Member States, but Kenya is not one. Moving from the group method of teaching to the personalized method is poised to rescue the Kenyan case. This study therefore has been set to bridge this gap of using personalized learning as a tool to improve performance in Mathematics by experimentally examining the effects of personalized learning on the performance of mathematics in secondary schools.

Having reviewed the literature relevant to personalized learning, it is noted that even though some research has been done with regards to personalized learning, its implementation has remained a challenge in a mathematics classroom due to the time requirement by a teacher for individual student concentration and attendance. Further, not a single of the research studies on personalized learning on mathematics achievement has been exhaustive.

Utilizing innovative instructional methods such as personalized learning to increase student engagement, teachers are better able to design learning opportunities for students that emphasize current learning and solicit interests I and potential career goals (Tlhoaele et al., 2014).

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter is a representation of how the research was conducted. The chapter focuses on research architecture, the field of analysis, population target, samples and sampling methods, instruments for investigation, instrument validity, reliability of instruments, processes for data collection, statistical data processing, and ethics.

Research Design

A quantitative approach has been used in this research to measure the problem by producing numeric information that can be converted into functional statistics. The standard experimental technology in most scientific disciplines is the quantitative testing method (Shuttleworth, 2008).

Specifically, the researcher used a design known as quasi-experimental that involves the use of pretest-posttest control groups (Mertler & Charles, 2008). This provided the basis for the causal influence of the independent variable to a dependent variable on experimental and control groups. When clustered according to their genders, the influence of customized training on students' academic achievement in mathematics was shone out. Before the implementation of the treatment, members in the double groups were as identical as possible on the following variables; mean entry mark, boy-girl ratio, participants per class and most importantly being taught by one teacher. The experimental group was taught using personalized learning strategies such as flipping the classrooms and helping students to set short and long-term goals which were followed by tracking their progress according to how they have prioritized their work. This group was allowed to have learned of the content at their

own determined pace even as they reflect on what they had learned. The control group was taught using traditional patterns/customary instruction whereby they listened to lectures, took notes, quizzes, and tests. For the experimental community, the class session was reduced to pave the way for its speed.

The given pre-test helped ensure that the participants are at par as the learning process begins. The quasi-experimental was more applicable because the participants involved could not be selected at random (no random assignment) and controlling all the conditions was not possible especially when dealing with human beings.

Furthermore, in this design, the researcher had to use naturally formed groups/ intact groups available to the researcher (for example, a classroom, an organization, a family unit). It also indicates the cause-effect more convincingly than other research designs. The researcher briefed the participants on the research study to avoid misconceptions.

Population and Sampling Techniques

The population in this study comprised of approximately 4000 form one students in Awendo Sub-county who were drawn from both schools that are private and public, this is for convenience. The four thousand students were from the available 35 schools in the sub-county. Twenty-five of the schools were public with a total population of 3500 form ones while ten were private with a total population of 500 form ones. The form one class of 40 (representing 10% of form ones in the population) students in a private mixed secondary school with a total population of 240 students were purposively selected because the foundation for secondary mathematics is laid at this level, and the topics of experimentation were derived from Form one syllabus. It is also believed that at this level (form ones) the student is

capable of manipulating ideas, think creatively, and use abstract reasoning. Moreover, it is a class that is under no pressure for any national Examination.

Sampling Technique

This refers to coming up with a representative of a population from a given population. The experiment was done in one school with one stream of a total population of forty students during the first term within Awendo-Sub County. Form I of forty was selected from the school purposively because the topics of experimentation were derived from form one syllabus. This is supported by Mugenda (2003) stating that purposive sampling is selecting samples based on a set of criteria that is picking samples that have the needed characteristics for the study. The form one students of forty were divided into two of twenty classes by randomization of their entry behavior. This the researcher managed to do with the help of the Principal and mathematics Head of the Department. The KCPE scores were arranged in descending order and then distribution was done with no biasness (ensuring that the distribution is uniform in terms of entry behavior). This helped prevent the undue advantage of one class over the other. The simple tossing of a coin helped in assigning one class to be experimental and the other control group. The researcher took time with the teacher giving him a thorough orientation on how to carry himself through the whole exercise of personalized learning. Class sessions were done to help verify if the teacher had grasped the concept.

Research Instruments

Research instruments used in the study included: lesson plan analysis guide, achievement examinations, a questionnaire, and a classroom observation schedule. A lesson plan was the tutor’s comprehensive account of the course of instruction for a lesson. It was developed daily to guide the teacher's in-class learning. Details in the

lesson plan (appendix 2 and 3) varied depending on the objectives, preference of the teacher, teacher's teaching method, the topic being covered, and the needs of the students. It was divided into four main parts namely the introduction, lesson development, conclusion, and evaluation.

Achievement examination (Appendix 1) which was given to students contained validated twenty (20) teacher-made questions derived from the topics that were covered during the experimentation period. The validation and refinement were conducted at the department of mathematics of UEAB and reliability was obtained to ascertain that the test is consistent and that a single unidimensional latent structure was measured by several objects. The questions ranged from simple to complex ones bearing in mind Bloom 's taxonomy and were guided by the table of specification (ToS) (appendix 6).

From the ToS, topic 6 attracted the most (that is, 5) of the six subjects and the topics (2 and 4) the least of the six (that is 2). For goals, there were 7 elements with the highest degree of awareness and comprehension. The minimum level of was the application. The distribution of the number of items in each cell (this is the priority and value that the instructor assigns to these areas for each purpose and topic level) expressed the emphasis attached to each subject. The instructor then created the test items or questions guided with a table of specifications. The questions were derived from natural numbers, factors, divisibility test, greatest common divisor, least common divisor, and integers. The test was used for both the post-test and pre-test.

The questionnaire (appendix 5) was used to measure the extent of the implementation of the elements of personalized learning and collect data from the students. It had the first section giving the demographic details of the respondents. Gender perspective was taken into consideration here. Part two dealt with issues

relating to flexible content and tools and the learning environment, it ensured that the environment was adjusted depending on the set objective. Part three checked on whether the instruction was targeted, this helped ensure that individual students were treated independently. Finally, the last bit was concerned with whether the student was allowed to own the lesson and make personal choices on areas to be covered. The questionnaire was the self-developed instrument used for data collection purposes. The questionnaire was used since a large sample could achieved within a limited period by the researcher.

The researcher delivered the questionnaire with the aid of a research assistant. Its reliability was tested using Cronbach's Alpha. A four-point scale of (4), Agree (3) Tend to agree (2) Tend to disagree (1) Disagree were used. This rating scale of four points is acceptable. According to Nunnaly (cited in Schutt, 2017), "research suggests that you should use somewhere from 4 to 11 points on a rating scale" (p. 201). Further, "research suggests that omitting the middle alternative (e. g. neutral, about, the same, average, no difference), which is the case in this study, does not appreciably affect the overall pattern of results (Schuman & Presser, cited in Schutt, 2017, p. 202). It was administered before the treatment (pre-test) and after the treatment (post-test) (Boone & Boone, 2012).

The last tool which was used in this study was the classroom observational schedule (appendix 4) which guided the teacher/researcher in monitoring the progress of the lesson. It was composed of the following:

a) Learning activity - here the researcher had to identify the activity to be covered each time. It enabled the researcher to have targeted learning activities with set objectives.

b) Time allocated for each activity - this was to help prevent over-concentration on a given activity. An observational protocol checklist, which can be found in Appendix 4, was used to gather classroom data during personalized learning opportunities from teacher participants. The use of an observational protocol document including questions and space for field notes was used to focus the observation on the needs of the study. The researcher had to contend with the set time of every activity and record whether make-ups would be necessary.

c) Frequency of the activity - this guided the researcher on how often an activity was to be revisited and reflected on the lesson This was necessary for feedback and evaluation as to whether an activity was well taken or further consideration was of value. A group of 40 students participated in the study.

The teacher helped in providing the information regarding the learners' participation in both the control and experimental class. In the experimental class, the teacher managed the resources and offered support that students needed, when they needed them, to reach mastery. The teacher adjusted instructions daily-sometimes even more frequently based on identified individual needs, strengths, and interests instead of creating highly structured lesson plans days in advance. The teacher facilitated the transition to student ownership through projects and activities that help students understand and assess their skills and learning targets. The teacher did all these under the researcher's guidance. He however carried on with the traditional teaching method while in the control class. The study ran for the second half of term one and the following six units (natural numbers, factors, divisibility test, GCD, LCM, integers) out of ten units meant for term one were covered.

It is in this context that the teacher's role in aiding learning is meaningfully desirable because an educator who is aware of his role in the teaching-learning process does not only hang on the printed media. Rather, he designs his activities and auxiliary materials. He is expected to prepare his students with instructional resources that encompass the most effective and productive ways to improve skills and augment their learning.

Validity of Research Instruments

According to Mutch (2015), validity ensures that a study measures what it is set out to measure. Kimberlin and Winterstein (2012) recognized that if a piece of work is invalid then it is valueless. For research to be effective it must be valid. To determine the content validity of the instruments, they were presented for expert validation with the assistance of the supervisors from the department of education in UEAB who are conversant with the use of such instruments. The experts confirmed the overall suitability/validity of all the stated instruments.

The validity of the research instrument refers to the validity of the findings within the research study. It is primarily concerned with controlling the extraneous variables and outside influences that may impact the outcome. Validity is critical because this study was to determine a causal relationship. Therefore, the researcher controlled and or eliminated the influence of moderator variables to be confident when making conclusions about the relationship between personalized learning and mathematics performance. Validity is the degree to which the evaluations or judgment we make as teachers about our students can be trusted based on the quality of evidence we gathered (Golafshani, 2003). Validity is what the test is supposed to measure or predict. Content validity helped reveal what the test measures while face validity assesses whether the test "looks valid" to the examinees who take it, the

administrative personnel who decide on its use, and other technically untrained observers.

The validity of contents was verified by recognized subject matter experts. It helps to know whether test items represented the expertise needed in a given field. Face and content validation of the questionnaire was done by experts from the school of education, UEAB. Apart from face validity being checked by leading experts in the field it also underwent an examination of lay people who were sampled so that a potential effect of literacy of comprehension reading can be controlled. Necessary adjustments were done.

There are vital principles that should be observed and guide the researcher as he makes an achievement quiz. It should measure the approved learning objectives that have been taught. It should be intended as an operational regulator to guide the learning order and practice and be in agreement with the instructional aims. It ought to cover all education tasks that are most suitable for a specific objective to check on learner attainment.

To ensure that the assessment was valid, the researcher used a specification table, TOS. The Kibler Table of Requirements (TOS) (1998) ensures the appropriate sampling by the test items of the subject matter material and course purpose. A guideline for the construction of the test was required, which took into account the relative value of every aspect and level of the cognitive domain of the curriculum. It is a blue-test print that helps teachers balance goals, education, and evaluation. To provide material sampling and validity of products, TOS should be performed before testing. These allow the researcher to coordinate and align teaching and learning in many ways (Alade & Igbinosa, 2014). The output test was built against this backdrop.

Reliability of the Questionnaire

Whereas validity is connected to qualitative research design, reliability is majorly applied in quantitative designs. The success of a good experiment is to ensure that the results are as reliable as possible if it's repeated elsewhere. Aiken, (2010), observes that for one to make a causal assessment there must be repeatable and reliable measures. Reliability refers to the consistency of research instrument measurement. The researcher ensured that the instrument is reliable by piloting and testing in a private mixed secondary school in Rongo Sub- County before carrying out the main study. The school had similar characteristics as the school identified for the study. The analysis was done to verify if those who were involved in the pilot study had the same characteristics as the study participants. The process assisted in revealing the suitability of the questionnaires. The researcher considered a Cronbach's alpha value of 0.60 as the cut-off point. Table 3 shows the reliability coefficient for each construct. Flexible content and tools and learning environment with.654, Targeted instruction with.686 and Student reflection and ownership (student choice) with .656

Table 3

Cronbach's Alpha Reliability Coefficients

Subscale	**Cronbach's Alpha**	**Number of items**
Flexible content and tools and learning environment	0.654	10
Targeted instruction	0.686	6
Student reflection and ownership (student choice)	0.656	8

Data Gathering Procedures

This involved seeking permission from the various authorities. A letter of clearance was obtained from the Ethics Committee of the University of Eastern Africa Baraton together with the introductory letter from the Director of Graduate Studies and Research enabled the researcher to apply for the permit to carry out the research which is provided by the National Commission for Science, Technology, and Innovation (NACOSTI). The researcher used these documents in introducing himself to the Sub- County Director of Education seeking permission to research in Sub County.

The researcher then visited the school and met the Principal for consent. Further, the Principal of the school introduced the researcher to the department of mathematics. Thereafter, the arrangement was made with the help of a mathematics teacher on how the research was to be conducted. This involved having a list of all the form ones of the year 2019 with their entry marks and arranging them in descending order. The students were then divided into two streams of similar traits (table 4). The participants in the two groups had to be as identical as possible on a certain variable (mean entry mark, boy-girl ratio) before the implementation of the treatment. The research design being a two-group pretest-posttest experimental design, a pre-test was administered to the two streams given that examination was the major mode of data gathering.

There was one teacher involved in teaching the two classes. This helped control the teacher effect, however, the work was too much so the researcher had to lend a hand. The researcher trained the teacher on how to carry out personalized learning with the experimental class. This involved providing and going through the materials and demonstrations of how to conduct personalized learning. Schemes of

Table 4

Students Assigned Groups of Similar Characteristics

EXPERIMENTAL GROUP			CONTROL GROUP		
STUDENT#	GENDER	ENTRY MARK	STUDENT#	GENDER	ENTRY MARK
1	M	277	1	M	344
2	F	296	2	F	306
3	M	381	3	F	267
4	M	253	4	M	294
5	M	341	5	M	298
6	F	296	6	F	269
7	M	344	7	M	264
8	M	271	8	M	289
9	F	262	9	M	307
10	M	345	10	M	258
11	F	305	11	F	251
12	F	327	12	F	251
13	M	275	13	F	295
14	F	271	14	F	260
15	M	308	15	M	371
16	M	244	16	F	278
17	F	247	17	M	312
18	F	234	18	F	233
19	M	207	19	M	298
20	F	264	20	M	300
MEAN MARK		287.25	MEAN MARK		287.40

Work covering the topics for the remaining part of the second half of the term was also prepared from the syllabus. Further, the researcher gave a thorough orientation about the design of the experiment, and teaching material was provided which included a teacher guidebook and a model of the personalized learning lesson

plan. The list of the topics to be covered was given to the teacher before work would begin. The researcher kept on monitoring the lessons and on some occasions took photos and videos of the lessons as they progressed. To avoid unnecessary anxiety during videotaping, the researcher did expose the learners to several online video lessons and further explained to them the necessity of having such lessons. Several videos were done outside the lesson to help them get used to the system. Further, rehearsals were done to help check if the concentration of the learners was stable for lessons to run unaffected.

The study went on smoothly as the researcher's role was monitoring, making observations, and guiding the teacher on the new model for the experimental class. By the end of the term, the two groups obtained a post-test exam and an experimental class questionnaire. The questionnaire was used to allow a large sample to be reached in a short period. The survey was conducted by the Research Assistant to students. The students' questionnaire was used to gather information about the degree to which customized learning on flexible content and resources, tailored teaching, reflection on students, and ownership was carried out. The quantitative data obtained after the experiment was used for statistical treatment.

Statistical Treatment of Data

Data analysis is the mechanism by which information collected can be organized, structured, and displayed meaningfully (Mugenda, 2003). The study used descriptive statistics to define the degree of achievement in mathematics (the question of research 1) and the implementation of PL (research question 4). Descriptive statistics measure uniform statistics, for example, average, standard deviation, lowest, and highest numeric variables for enhanced comparison and shown in a single table.

Besides comparability of the two groups in their entry marks as shown in table 4, the pre-test scores being considered in research question 1 were also compared. This was done using Mann-Whitney U-test.

To address research questions 2 and 3, the Mann-Whitney U test which is a non-parametric test that is used to test the null hypothesis and does not have any assumptions related to the distribution of scores was used (where data do not satisfy the distributional requirements of parametric methods). The researcher employed Mann –Whitney because the sample size per group was less than 30. It compared two sample means that came from the same population and used to test whether the two sample means were equal or not. It was applied in the analysis of alternatives to a t-test as the data were not distributed normally. It enables the researchers to infer differently about the data that rely on the assumptions made, unlike in t-test. These results can vary from the fact that both populations differ in the determination of differences in medians between groups. The response to questions one, two, and three regarding discrepancies in rank helped in dealing with research issue 4, which was reviewed before embarking on coding, tabling and evaluating data for completeness of the questionnaire. To profile sample characteristics and significant trends from the data provided in tables, classification statistics and percentages have been used. The SPSS version 23 was used for all analyzes.

Ethical Considerations

Researchers having human or animal as their subjects must take into account the conduct of research and discuss the ethical problems involved in their research (Kombo & Tromp, 2006). Despite the high importance of science-based information, knowledge cannot be sought at the cost of human integrity. A researcher needs to

demonstrate how he or she guarantees respect for ethical demands in the research (Oso & Onen, 2009).

To ensure the aforesaid, consent was sought from the study participants by the researcher who were majorly students. This involved informing their parents through the Principal since they were still at the age of 14 to 15 and therefore could not make an independent decision. The students were also informed of the study objectives, methods, and their relevance. The principle of benevolence was applied (a regulatory declaration of a moral duty to behave to the good of others, to help them promote their major and valid interests, often by preventing or eliminating potential harm). It was both done verbally and documented for security purposes. This made both the teacher and the students allow the researcher to display their photos. They were assured of anonymity and confidentiality.

All personal information that was obtained from participants during the study was not revealed in the report and any publication. Moreover, the identity of the participants was not needed since the research tools had codes for identification. Confidentiality was maintained through data storage where the researcher stored soft copies of data safely in the computer with strong passwords that were only known to the researcher.

The hard copies of data were stored safely by the researcher and only the researcher accessed the stored data. They were told that the research was not dangerous and that nobody had to take part in the study. It also guaranteed that all involved and informants are handled in compliance with their privacy. This was done by using codes in the whole exercise.

Finally, after the study, the researcher combined the two groups and systematically explained to them the benefits of personalized learning over the traditional method and further encouraged them to embrace its tenets. This was done to help mitigate the negatively affected group (control group).

CHAPTER FOUR

PRESENTATION OF FINDINGS, ANALYSIS, AND INTERPRETATION

The outcome of the experiment, statistical research, and interpretation of quantitative and qualitative knowledge were discussed in this chapter. They focused on the study's objectives. The analysis of data was done both descriptively and inferentially and the presentation of findings was done with the help of tables. Analysis were carried out using the SPSS version 23 program. The findings were addressed in a table to help read and understand.

Background Information

Gender of the Participants

Table 5

Gender Distribution of Participants

	Experimental Group		Control Group	
	Frequency	Percent	Frequency	Percent
Male	11	55.0	11	55.0
Female	9	45.0	9	45.0
Total	20	100.0	20	100.0

From table 5 it is noted that there are only 20 students per group. 11 members, that is (55%) of the respondents were male while 9 members (45%) were female for both the control and experimental group.

Level of Achievement in Mathematics before Personalized Learning Picked Up

Research Question 1. What is the level of achievement in mathematics of the students in the experimental and control groups before personalized learning picks up?

To address this question, the scores of students were recorded before the administration of personalized learning. These are the pre-test scores. The level of achievement was measured on a scale of 0-100.

Table 6

Level of Achievement before Personalized Learning (Pre-test)

	Experimental grouping	N	Mean	Std. Deviation
Pretest scores	Experimental group	20	51.05	12.407
	Control group	20	50.10	15.771

Table 6 shows the descriptive statistics in terms of the standard deviation, mean, and the total number of participants who were in experimental and control groups. The achievement before personalized learning yielded a 51.05 mean and 12.407 standard deviations for the experimental group. The improvement before personalized learning yielded 50.10 mean and 15.771 standard deviations for the group that was controlled. For the experimental group, the maximum and minimum scores before personalized learning were 73 and 27 respectively. For the group that was controlled, the maximum and minimum scores before personalized learning were 73 and 15, respectively.

Comparison of Pre-test Scores

It was necessary to do the Mann-Whitney U test in comparing scores to prove comparability in pre-test scores. This is presented in table 7.

Table 7

Mann-Whitney Test Pre-test Analysis

Ranks

	Experimental grouping	N	Mean Rank	Sum of Ranks
Pretest scores	Experimental group	20	20.43	408.50
	Control group	20	20.58	411.50
	Total	40		

Test Statistics

	Pretest scores
Mann-Whitney U	198.500
Wilcoxon W	408.500
Z	-.041
Asymp. Sig. (2-tailed)	.968

From table 7, 0.968 which is the value of *p* is way greater than 0.05, which was the set level of significance. There is no substantial difference between the pre-test values of the study group and the control group. This was a key requirement in quasi-experimental research where the researcher was to dynamically influence the learning process to detect the consequences. The groups, therefore, had to be checked to ascertain whether the groups are different before the actual experiment. This is in line with the requirement of experimental research which requires that if a research project requires care, operations, or another form of experimental manipulation, a pre-test/post-test design may be considered in which identical subjects are assessed at different points of time by the variables of interest (Bonnell, Alatishe & Hofner, 2014).

In conclusion, the findings show that the levels of mathematics achievement of the Experimental and control classes before personalized learning picked up were not significantly different.

Comparison of Post-test Scores

Research Question 2: Is there a significant difference between the mathematics achievement of students in the experimental and control groups after the intervention?

From the comparison of pre-test scores, it is noted that the two groups are comparable. Since the number of participants per group is small, that is less than 30, it was to use the Mann-Whitney U test which is a test that is not a parametric statistical test for comparing scores.

Table 8

Comparison Between the Mathematics Achievement of Students in Experimental and Control Groups

	Experimental grouping	N	Mean	Std. Deviation
Posttest scores	Experimental group	20	74.15	12.713
	Control group	20	68.95	23.809

Mann-Whitney Test

Ranks

	Experimental grouping	N	Mean Rank	Sum of Ranks
Posttest scores	Experimental group	20	20.60	412.00
	Control group	20	20.40	408.00
	Total	40		

Test Statistics

	Posttest scores
Mann-Whitney U	198.000
Wilcoxon W	408.000
Z	-.054
Asymp. Sig. (2-tailed)	.957

Table 8 shows the mean scores of the experimental group's post-test. From the table, the mean score of the posttest of the experimental class (74.15) is numerically greater than that of the control class (68.95). In terms of its effect on the overall academic performance of the students, personalizing the education is better than the conventional model. The results from Gokhale (1995), Mevarech (1999), and Schafersman (1991) are confirmed by the findings that collective learning students have a better performance in critical thinking test than students who studied individually (Bautista, 2012). However, since the expected 0.05 p-value is less than the achieved 0.957, the degree of importance set is not important between the post-test results of the experimental group and the control group. This means that personalized learning has not made a significant difference in the mathematics achievement of the students in the experimental community. It could then be interpreted that there are other important variables such as student capacity and other classroom strategies, that could help explain the disparity in academic performance in both experimental and control groups of students in addition to the implementation of the modern learning approach, as teachers and learners seemed to be firmly embedded in conventional approaches. This according to the researcher may be due to the instructor – variables such as insufficient time to cope with curriculum requirements. The videos revealed that the teacher needed to balance the execution of the personal education components and the achievement of the goals set in the syllabus.

The variations according to Pane, Steiner, Baird, and Hamilton (2017), would likely be due to various samples of study. The teachers and also students were relatively new in the implementation of PL in this research, which meant that the full effects of PL were insignificant. The benefits indicated by two-year analyzes show more beneficial effects After at least a year of school implementation. Larger more

cohesive positive results will occur as the sector grows with a greater understanding of real PL methods and detailed packages (Benjamini & Hochberg, 1995; Steiner, Hamilton, Peet, & Pane, 2015).

Bates and Wiest (2004) also arguing out that there are potential explanations as to why students have not increased their achievement: a) alternatives offered by personalization could not be covered because the issue of wordings used could be overcome by students; b) students' age; c) procedures that did not include personalized teaching. Further, the bulk of the students could not properly understand the word problems as English was a barrier. This was seen in the post-test results of the two international students in the control class who dismally performed in the posttest exams. They were as well affected by absenteeism as a result of school fees shortage. Either the non-significant outcomes show that the effect of these treatments was the same in terms of resources such as operationalism, cost, manpower requirement, and time.

Descriptive Statistics for the Scores of Post and Pretest of the Control and Experimental Groups

For gaining a better understanding of how the two classes fared as far as their performance is concerned, tables 9 and 10 present the scores for the post-test and pre-test of the control and experimental groups.

Table 9 shows the marks which were obtained before and after the treatment by students in the experimental class. It is clear that there was a marked improvement in the test scores with a mean difference of 23.10

Table 9

Pre and Post-test Scores of the Experimental Group

STUDENT #	PRE-TEST SCORE	POST-TEST SCORE	GENDER
1	73	95	M
2	66	86	F
3	65	77	M
4	63	74	M
5	62	71	M
6	61	74	F
7	59	84	M
8	57	88	M
9	55	95	M
10	53	67	M
11	49	76	F
12	49	64	F
13	46	81	F
14	45	71	F
15	43	66	M
16	38	71	F
17	32	61	M
18	27	39	F
19	41	67	M
20	37	76	F
Mean	51.05	74.15	

Table 10 shows the marks which were obtained by the students in the control class in the pretest and posttest examination. It is noted that there was also improved with a mean difference of 18.85, which is numerically lower than the mean difference gained by the experimental class.

It could be concluded based on the results that the students in the experimental group improved their mean scores from 51.05 to 74.15 (an increase of 23.1) while the control group improved from 50.10 to 68.95 (an increase of 18.85) as shown in tables 9 and 10. This implies that although personalized learning seemed not to have impacted much on learning as shown by academic achievements differences in both groups of students being not statistically significant, the personalized teaching

strategy had a great potential in improving students' achievement in mathematics-since it yielded better test scores than the traditional methods.

Table 10

Pre and Post-Test Scores of the Control Class

STUDENT #	PRE-TEST SCORE	POST-TEST SCORE	GENDER
1	73	33	M
2	70	87	F
3	66	90	M
4	63	83	F
5	62	97	F
6	61	91	F
7	59	70	M
8	59	60	M
9	57	73	F
10	55	81	M
11	51	87	F
12	49	61	F
13	47	76	M
14	45	89	F
15	45	81	M
16	39	81	M
17	36	44	F
18	28	51	M
19	22	38	M
20	15	6	M
Mean	50.1	68.95	

In general, the study established that personalized learning yields better test scores than the traditional methods used in the control class. The results indicate that customized learning (PL) will enhance students' achievement, regardless of their entry level. Further, the advantages and its effects seem to be more positive after schools have had longer experience with its implementation.

Comparison of Achievement of Male and Female Students

Research question 3: Does the mathematics achievement of students taught using personalized learning differ significantly for male and female students?

Table 11

The difference in Achievement in Mathematics of Male and Female Students in the Experimental Group

	Gender of students	N	Mean	Std. Deviation
Posttest scores	Male	11	76.82	11.998
	Female	9	70.89	13.495

Mann-Whitney Test

Ranks

	Gender of students	N	Mean Rank	Sum of Ranks
Posttest scores	Male	11	11.14	122.50
	Female	9	9.72	87.50
	Total	20		

Test Statistics

	Posttest scores
Mann-Whitney U	42.500
Wilcoxon W	87.500
Z	-.533
Asymp. Sig. (2-tailed)	.594

From table 11, although the posttest means a score of the male students (76.82) is numerically higher than that of the female students (70.89) in the experimental group, the value of *p* which is 0.594 is greater than 0.05, which was the level of significance set by the researcher, thus the difference existing between the posttest scores of the female and male students who were in the experimental class is not significant. It implies that personalized learning implementation in the experimental group has presented no difference in the mathematics improvement of

the students. However, looking at the individual pretest achievements of the female students which seems to be much lower than the posttest scores compared with the male counterparts. A conclusion can therefore be made that individual female students did benefit from their male counterparts.

Table 5

Experimental Class Standard Deviations

Gender	Pre-test mean	Post-test mean	Deviation
Female	46.44	70.89	24.37
Male	54.81	76.82	22.01

Table 12 gives a comparison of the means and the standard deviation of both the male and females in the experimental class. A keen look at both table 9 and table 12 indicated that both boys and girls benefited equally from personalized learning and that achievement depended on an individual student and not gender.

This is in line with the study done by Bates and Wiest (2004), which found out that personalization did not affect achievement and there were no significant differences between the sexes, apart from the positive views of students. Also, Şimşek and Çakır (2009) found out that a significant difference does not exist between genders. The personalized strategy of teaching has a similar effect on both male and female students.

The findings indicated that both boys and girls benefited equally from personalized learning and that achievement depends on an individual student and not gender. It further suggests that PL is capable of improving the student's achievement regardless of gender.

Implementation of Personalized Learning

Research Question 4: To what extent is personalized learning implemented in the experimental group? This was done under the following headings:

(a) Flexible content and tools and learning environment

(b) Targeted instruction

(c) Student reflection and ownership (student choice)

When examining the extent of personalized learning implementation, the researcher asked participants to show how they agree on a level ranging on a scale. The scale (level of agreement) was interpreted in a range of 1-4 were 1.00 – 1.49 represented disagree and interpreted as low level, 1.50 – 2.49 represented tend to disagree and interpreted as below-average level, 2.50 – 3.49 represented tend to agree and interpreted as average level and 3.50 – 4.00 represented agree with which was interpreted as high level.

Flexible Content and Tools and Learning Environment

When examining the level of knowledge of students on personalized learning in terms of flexible content and tools and learning environment, the researcher asked participants to indicate how they agree on a four-point scale, with 1 representing disagree, 2 representing tend to disagree, 3 representing tend to agree and 4 representing agree.

As indicated in table 13, students agreed that they are allowed to do a lot of practice on their work (M=3.65; SD=.587). Students tended to agree that the teacher brought books and mathematical instruments that aided their learning (M=3.15; SD=1.309) and used their assignments result to inform and modify what to teach (M=3.25; SD=.910), that students are guided to learn at their pace (M=3.30;

Table 13

Flexible Content and Tools and Learning Environment

	Minimum	Maximum	Mean	Std. Deviation
The teacher brings books and mathematical instruments that aid my learning	1	4	3.15	1.309
The teacher organizes time for me to be in the library to do my studies	1	4	2.65	1.309
The teacher assigns me to revise specific topics based on my need	1	4	2.95	1.356
The teacher uses my assignment result to inform a modify what to teach	1	4	3.25	.910
The teacher frequently changes books and teaching instruments according to my needs and interest	1	4	2.40	1.465
The teacher uses different books to facilitate understanding and application of knowledge	1	4	2.05	1.356
I am guided to learn at my pace	1	4	3.30	1.218
I am allowed to do a lot of practice on my work	2	4	3.65	.587
The teacher keeps on changing the discussion groups per lesson	1	4	2.35	1.309
The teacher keeps on changing learning rooms(use of optional classes) for proper content delivery	1	4	2.80	1.508
FLEXIBLE CONTENT AND TOOLS AND LEARNING ENVIRONMENT	1.80	3.90	2.8550	.64520
N = 20				

SD=1.218), the teacher assigns them to revise specific topics based on their needs (M=2.95; SD=1.356), organizes time for them to be in the library to do their studies (M=2.65; SD=1.309), and keeps on changing learning rooms (use of optional classes) for proper content delivery (M=2.80; SD=1.508).On the other hand, students tended to disagree that the teacher frequently changed books and teaching instruments according to their needs and interest (M=2.40; SD=1.465), uses different books for

application and understanding of knowledge (M=2.05; SD=1.305), and keeps on changing the discussion groups per every lesson (M=2.35; SD=1.309).

All the questions had means ranging from 2.05 to 3.65. The results were 2.8550 by average and 0.65 standard deviation showing that most respondents agreed to personalized guidance. This means for flexible content and tools and a learning environment as a component of personalized learning was experienced. The implementation was good particularly, in the cases where the teacher used feedback on student's assignments to modify his teaching, let students work at their pace, and practice. Areas that needed much improvement were changing discussion groups, and the use of different textbooks for the application of knowledge and skills.

These results are in line with Lippman (2010), who says management needs to abound to the theory of realistic experience and to link it with responsive commissioning to create an efficient learning environment. Although he says that the theory of practice describes the relationship between learning and community, responsive commissioning examines social and physical dimensions of the learning environment and the essence of the interaction. In other words, managers need to consider not only the functioning of students in classrooms but also the relationship of students in this field with the teacher and others.

The results also support Tanner's study (2008), which noted that particular physical environments correlate positively with student success even after changes aimed at variables that can be mediated. The research showed positive associations between academic achievement and the surrounding conditions, large group gatherings, illumination, and training neighborhoods. He added that while the socio-economic status is damaging to student success, overall it is linked with marked improvement.

In line with the findings is the recent American Institutes for Research, AIR study, which point out that mixed learning environments are identified as a potential way to incorporate versatility into the teaching environment (Tanenbaum, Le Floch, Boyle, Laine, & Newberger, 2013).

It is, however, noted that some components were not well implemented resulting in high standard deviations as per the student's response. These could be attributed to the following:

a) Teacher frequently changes books and teaching instruments according to my needs and interest: -This could be attributed to the shortage of enough and a variety of the required textbook for curriculum implementation, ill-equipped math laboratory coupled with inadequate teaching models.

b) The teacher keeps on changing the discussion groups per every lesson: When time is not well managed the lesson planned could be ill implemented. The teacher was faulted on some occasions for not changing the groups as frequently as possible citing lethargy and time factor. The researcher kept on intervening on this variable. It was also noted that this was a new idea and the teacher was struggling to adopt it within the shortest time possible, this led to several lapses in its implementation.

Targeted Instruction

When examining the level of knowledge of students on personalized learning in terms of targeted instruction, the researcher asked participants to show how they agree on a scale of 1 to 4, with 1 representing disagree, 2 representing tend to disagree, 3 representing tend to agree and 4 representing agree.

Based on table 14, students agreed that the teacher reviews their assignments to identify their needs (M=3.60; SD=.940) and that the teacher adjusts teaching style for the classes of students according to their needs (M=3.60; SD=.940). Students tended to agree that teachers give direction on syllabus requirements M=3.05; SD=1.234) and students' work report is for creating students' groups according to their interest, needs, and level of skills (M=2.65; SD=1.089). Students tended to disagree that their discussion groups are changed with some frequency (M=2.35; SD=1.309) and their work is used as an integral part of daily interaction (M=2.25; SD=1.333).

Table 14

Targeted Instruction

	Minimum	Maximum	Mean	Std. Deviation
The teacher reviews my assignments to identify my needs	1	4	3.60	.940
The teacher adjusts teaching style for each group of students based on the student need	1	4	3.60	.940
Students work report is used to create students groups based on interest, needs and skill level	1	4	2.65	1.089
Our discussion groups are changed with some frequency	1	4	2.35	1.309
My work is used as an integral part of daily interaction	1	4	2.25	1.333
Teacher gives direction on syllabus requirements	1	4	3.05	1.234
TARGETED INSTRUCTION N = 20	1.50	4.00	2.9167	.69143

All the questions had a mean ranging from 2.25 to 3.60. The findings produced 2.92 as the mean and 0.69 as the standard deviation meaning most of the participants tended to agree that teachers target the instructional needs of an

individual learner. However, the high standard deviations noted on the items on student work report (M=2,65; SD=1.089), frequency of change of discussion groups (M=2.35; SD=1.309), daily interactions (M=2.25; SD=1.333), and syllabus requirements (M=3.05; SD=1.234) show that there was inconsistency in implementation. This could be attributed to time constraints and focus on curriculum content and standards.

In line with findings from Richburg (2012), the teacher analyzed the student data for student needs, grouped them in homogenous or heterogeneous formats, based on abilities, and adjusted delivery for each category of students based on learner need. This was done in compliance with results from Richburg (2012). To reach the students more efficiently, the central teaching would equally involve breaking downs the entire community structure seen in conventional schools. Instead of adhering to a fixed curriculum or guidance, targeted training provides teachers with versatile teaching to encourage the growth of students.

It could be noted that on some occasions the learning method was not fully implemented in the experimental class. The change of the groups could be attributed to time restraints, teachers deeply rooted in traditional methods, and lethargy developed by the teacher. Use of the student's work as an integral part of daily instruction became a challenge to the teacher as he took much of his time marking the books and not finding time to revise with them individually. The teacher also found it hard to fulfill the students' different needs when concentrating on curriculum material and expectations. These led to high standard deviations in the student work report, frequency of change of discussion groups, daily interactions, and syllabus requirements.

Student Reflection and Ownership

To examine the level of knowledge of students on personalized learning in terms of targeted instruction, the researcher asked participants to show how they agree on a scale of 1 to 4, with 1 representing disagree, 2 representing tend to disagree, 3 representing tend to agree and 4 representing agree.

Table 15

Student Reflection and Ownership

	Minimum	Maximum	Mean	Std. Deviation
The teacher guides me on revisiting my work	2	4	3.80	.523
The teacher meets with me individually to listen and develop a relationship with me	1	4	3.60	.940
The teacher provides me with some form of choice in assignment	1	4	3.00	1.076
The teacher provides me with choice in prioritization of tasks or path to complete assignments	1	4	3.05	1.146
I am allowed to create my daily priorities	1	4	3.00	1.076
I am allowed to make choices about the content guided by the syllabus	1	4	3.35	1.040
I am allowed to make choices on the structure of learning	2	4	3.55	.759
The teacher sets the time during the day for one-on-one academic support	1	4	2.35	1.309
STUDENT REFLECTION AND OWNERSHIP (STUDENT CHOICE)	2.13	4.00	3.2125	.49020
N = 20				

Students agreed that the teacher guides them on revisiting their work (M=3.80; SD=.523) and meets them personally for listening and developing a relationship with them (M=3.60; SD=.940) and they are allowed to make choices on the structure of learning (M=3.55; SD=.759). Students tended to agree that the teacher gives them assignments with choices (M=3.00; SD=1.076) and prioritize their choices concerning their path of completing the assignments (M=3.05; SD=1.146) and that they are allowed to create their daily priorities (M=3.00; SD=1.076) and to make choices about the content guided by the syllabus (M=3.35; SD=1.040). Students tended to disagree that the teacher sets time daily for one on one support concerning their academics (M=2.35; SD=1.309).

All the questions had a mean ranging from 2.35 to 3.80. The result had a mean of (3.2125) and a standard deviation of 0.49020 meaning the majority of the respondents tended to agree that students are allowed to reflect and own the learning process; this was also captured by the researcher during observation as shown in the picture in figure 3.

Figure 3. Students consulting among themselves.

The above students had time to reflect, own what they had learned, and make choices of what they learn. This is in line with what was videotaped showing how students freely interacted.

Students Undergoing Personalized Learning

Figure 4. Students under guided discussion.

The figure shows students under the teacher's guidance guided by the sub-theme targeted instruction. The students together with the teacher have some set targets. There was both an individual and group target. PL enhances individual targets.

Figure 5. Personalized learning session.

From figure 5, it could be seen that students here were allowed to think for themselves as the learning session progressed. The teacher was very flexible in meeting the set objective.

It is however noted that the teacher could not fully get time to implement areas that demand a lot of time including interaction on one on one basis with the learners, provision of choice to the students, matters of prioritization, and matters of choice

making. These could allude to extraneous circumstances such as time factors and congested curriculum resulting in a greater standard deviation.

Figure 6. Teacher in a personalized learning class

From figure 6, the learning session was seen to be more teacher-centered as opposed to learner-centered. More of the discussion was done by the teacher as the students were keen on taking notes. This challenge was also seen with the videos taken where the teacher experienced a lot of challenges in personalized learning. The

instructor found it hard while remaining true to curriculum content and expectations, to satisfy the different needs of the students. Some students did not care about the content, others were not ready for academics and 60-70 percent of the population was inactive. This could be observed from the videos and the figure 6 photo.

The instructor, as seen in Figure 5 and a corresponding video, battled to ensure that students were given all they wanted. The researcher noted that Implementing PL is time-consuming and requires a tremendous amount of upfront planning. Keeping the pace especially with those who move too quickly and those who move slowly was a great challenge to the teacher. He had to balance to help ensure that some students did not end up too far ahead or behind the class at the end of the term. The teacher also had to tame students who had a strong desire to adhere to expectations of their cultural upbringing (orientation from primary schools).

Some components were not fully implemented, according to the researcher's observation could be attributed to teacher commitment as he had to attend to other classes. The researcher also observed that the timetable was very rigid as there was no free lesson where the teacher could have some makeups. Further the school, being a mixed day and boarding, making it difficult even to attend to individual students as some had to leave earlier enough.

The choice of the student, according to Perks (2010), means allowing the students the opportunity to make choices as to what they learn in the classroom to encourage their interest and motivation. With increased participation of students, teachers aim to influence student achievement and to get positive results (Perks, 2010).

Patall et al. (2010) agree on the results of the study with a better performance, interest, enjoyment, and skills for learners who have the option of homework.

Besides, options have a quantifiable effect on student success as they perform best in final exams when alternatives for homework are provided (Patall et al., 2010). Next Generation Learning Challenges – an organization committed to improving the speed at university and career through technical advancement – encourages students options for optimum rate and mastery (Vogt, 2014).

Overall, there are suggestive signs that improved PL implementation results in more positive results; the results reveal which practices are most successful or which techniques must be as beneficial as possible. Also, it was clear that all the participants in their mathematics class could explain or define the strengths of PL. It was clear that all the participants suffered because teachers did not use this as a continuing approach to mathematical teaching while they understood the value of personalized learning.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

A description of the observations, conclusions, and recommendations is given in this chapter. There are also suggestions for further research. Based on the research questions of this report, the summary, conclusions, and recommendations are made.

Summary of the Study

This research was aimed at finding the effect of Personalized Learning on the performance of Mathematics in Secondary Schools. The researcher opted to undertake this study because of the recurrent poor performance in mathematics locally and globally. The researcher was determined to find out the effect of Personalized Learning on Mathematics Performance in Secondary Schools, specifically with regards to the student's choices and engagement, environment for learning, and personal learning paths. The academic achievements of both girls and boys who were taught using personalized learning and those not taught were compared to get the reality of the strategy. The researcher utilized Two Group Prettiest-treatment-posttest research design to determine the extent of the closeness among academic achievement ratings. This study examined the potential of personalized learning as a creative teaching tool.

The following null hypotheses were tested:

H_{01}: There is no significant difference between achievement in mathematics in both the control and experimental group of students.

H_{02}: The mathematics achievement of those taught using personalized learning does not differ significantly for male and female students

The study covered three units of form one mathematics class with a total of 40 students during the first term of the year 2019. One teacher taught both the experimental and control classes. The researcher observed two experimental class sessions and one control class session during the study period.

Summary of Findings

The study had the following major findings:

0. The experimental and control group had the same level of achievement before PL was implemented (51% and 50%, respectively).
1. The study showed that the experimental group had a numerically higher performance index than the control at 74.15% against 68.95%, however, with a p-value of 0.957, the difference is not statistically significant.
2. The study found that PL influence results positively on both boys and girls through achievement not significant. The null hypothesis is accepted
3. The study shows the implementation of Personalized Learning was generally good: Student Ownership and Reflection (M=3.21; SD= 0.49), Targeted Instruction (M=2.92; SD= 0.69), and Flexible Content Tools and Learning Environment (M= 2.86; SD= 0.64520). However, a deeper analysis of item by item SD indicates that there was inconsistency in implementation in areas of high SD such as frequency of changing books (M=2.40; SD=1.465), frequency of change of discussion groups (M=2.35; SD=1.309), use of students' work as an integral part of daily instruction (M=2.25; SD=1.333), one on one interaction with the students for academic support (M=2.35; SD=1.309), daily prioritization of activities (M=3.05; SD=1.146), and finally students making their own choices (M=3.35; SD=1.040). The findings suggest that PL challenges lie in teachers' difficulties in managing class size and time.

Conclusions

The following main conclusions could be drawn based on the findings:

1. Before the experiment, the findings of the experimental and control groups were similar.
2. Personalized learning as a teaching strategy has a great potential of improving mathematics achievement if given enough time and resources for implementation.
3. Personalized learning has an equal bearing on achievement in mathematics regardless of gender (male or female).
4. The implementation of PL in the experimental group was majorly affected by time, attitude, and deeply rooted culture on traditional method for the teacher suggesting that for the real and maximum benefit of personalized learning, it needs time and attitude change. Personalized learning can influence achievement in mathematics if the proper implementation is done and factors such as resources, manpower, time, and methodology) are given prime consideration.

Recommendations

The following were recommended based on the results:

1. The Ministry of Education, to sensitize teachers teaching mathematics on the usage of the personalized learning approach in mathematics in a secondary school based on the PL pedagogy.
2. School principals should explore the implementation of a personalized learning approach as it has the potential of leading to higher achievement in mathematics and better outcomes.

3. School leaders to implement strategies that provide a consistent evaluation of the student.
4. Success and results as well as transparency in the assessment process.
5. The secondary school mathematics teachers should:
    - Give equal attention to male and female students as both have the potential of doing well with PL approaches.
    - Build self-esteem among students to help them embrace personal responsibility through exposure to personalized guidance.
    - Create learning environments that best suit students' needs.
    - Exploit fully the PL components and ensure that the learners have a feel of the learning process.

Recommendations for Future Research

1. A similar study is done following the rigor of experimental research design with the following conditions: the adequate period of experimentation and allocating adequate time per lesson activity.
2. Future research to examine the differences in personalized learning experiences at the elementary level compared to the secondary level.
3. In a secondary school classroom, a multimedia survey of personalized learning should be conducted with the representatives of the Mathematical Association in Kenya.
4. The personalized learning strategy is extended to the other curriculum areas in secondary school and an experimental study is done.
5. A study is done on the integration of technology with personalized learning as a new approach to teaching.

6. Research being done in multiple sites, not just a single school to fully explore how PL implementation affects the achievement of students.

REFERENCES

Aduda, D. (2003). Kenya Certificate of Secondary Education, Examination results released by Minister of Education. *Daily Nation*. Nairobi: Nation Media Group Ltd.

Agenda, P., & Week, E. (2000). Reality check 2000. *Education Week*, *16*, S1-S8.

Aiken, L. R. (2010). Content validity and reliability of single items or questionnaires. *Educational and Psychological Measurement*, *40*(4), 955-959.

Alade, O. M., & Igbinosa, V. O. (2014). Table of specification and its relevance in educational development assessment. *European Journal of Educational and Development Psychology*, *2*(1), 1-17.

Ardelt, M. (2011). Intellectual versus wisdom-related knowledge: The case for a different kind of learning in the later years of life. *Educational Gerontology*, *26*(8), 771-789.

Azevedo, R., Cromley, J. G., Winters, F. I., Moos, D. C., & Greene, J. A. (2015). Adaptive human scaffolding facilitates adolescents' self-regulated learning with hypermedia. *Instructional Science*, *33*(5-6), 381-412.

Babayemi, J. O., & Olagunju, A. M. (2015). A survey of pre-service teachers' skills for improvising educational resources for effective instruction in basic science. *African Journal of Educational Research (AJER)*, *19*(1 & 2), 64-76.

Bartley, S. J., & Golek, J. H. (2004). Evaluating the cost effectiveness of online and face-to-face instruction. *Educational Technology & Society*, *7*(4), 167–175.

Basham, J. D., Hall, T. E., Carter Jr., R. A., & Stahl, W. M. (2016). An operationalized understanding of personalized learning. *Journal of Special Education Technology, 31*(3), 126-136.

Bates, E. T., & Wiest, L. R. (2004). Impact of personalization of mathematical word problems on student performance. *The Mathematics Educator*, *14*(2).

Bautista, R. G. (2012). The convergence of Mayer's model and constructivist model towards problem solving in physics. *Journal of Education and Practice, 3*(10), 31-41.

Benbow, C. P. (2012). Academic achievement in mathematics and science of students between ages 13 and 23: Are there differences among students in the top one percent of mathematical ability? *Journal of Educational Psychology*, *84*(1), 51.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal statistical society: Series B (Methodological)*, *57*(1), 289-300.

Blum, W., & Niss, M. (2011). Applied mathematical problem solving, modelling, applications, and links to other subjects—State, trends and issues in mathematics instruction. *Educational Studies in Mathematics*, *22*(1), 37-68.

Boaler, J. (2013). Ability and mathematics: The mindset revolution that is reshaping education. *Forum*, *55*(1), 143-152.

Bolstad, R., Gilbert, J., McDowall, S., Bull, A., Boyd, S., & Hipkins, R. (2012). *Supporting future oriented learning and teaching - a New Zealand perspective.* New Zealand: Ministry of Education.

Boone, H. N., & Boone, D. A. (2012). Analyzing likert data. *Journal of Extension*, *50*(2), 1-5.

Bonnell, W., Alatishe, Y. A., & Hofner, A. (2014). The effects of a changing culture on a child and adolescent psychiatric inpatient unit. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, *23*(1), 65.

Bulger, M. (2016). *Personalized learning: The conversations we're not having.* New York, NY: Data and Society Research Institute.

Calder, N. (2015). Apps: Appropriate, applicable, and appealing. In *Digital Games and Mathematics Learning* (pp. 233-250). Springer, Dordrecht.

Calder, N., & Campbell, A. (2016). Using mathematical apps with reluctant learners. *Digital Experiences in Mathematics Education*, *2*(1), 50-69.

Campbell, D. T., & Riecken, H. W. (2013). Quasi-experimental design. *International Encyclopedia of the Social Sciences*, *5*, 259-263.

Carr, J. M. (2012). Does math achievement h'APP'en when iPads and game-based learning are incorporated into fifth-grade mathematics instruction? *Journal of Information Technology Education Research*, *11*, 269-286.

Chase, P. A., Hilliard, L. J., Geldhof, G. J., Warren, D. J., & Lerner, R. M. (2014). Academic achievement in the high school years: The changing role of school engagement. *Journal of Youth and Adolescence*, *43*(6), 884-896.

Chen, S. M., & Lee, L. W. (2010). Fuzzy multiple attributes group decision-making based on the ranking values and the arithmetic operations of interval type-2 fuzzy sets. *Expert Systems with Applications*, *37*(1), 824-833.

Cheryan, S. (2012). Understanding the paradox in math-related fields: why do some gender gaps remain while others do not? *Sex Roles*, *66*, 184–190.

Cheryan, S., Plaut, V. C., Davies, P. G., & Steele, C. M. (2009). Ambient belonging: how stereotypical cues impact gender participation in computer science. *J. Pers. Soc. Psychol.*, *97*, 1045–1060.

Clayton Christensen Institute for Disruptive Innovation and Evergreen Education Group. (2015). *Proof points: Blended learning success in school districts Spring City Elementary Hybrid Learning School.* Retrieved from

https://www.christenseninstitute.org/wp-content/uploads/2015/04/Spring-City-Elementary-Hybrid-Learning-School.pdf

Coffield, F., Moseley, D., Hall, E., & Ecclestone, K. (2004). *Learning styles and pedagogy in post-16 learning: A systematic and critical review*. London: Learning and Skills Research Centre.

Collins, A., Brown, J. S., & Newman, S. E. (2016). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. *Knowing, Learning, and Instruction: Essays in Honor of Robert Glaser*, *18*, 32-42.

Conner, T. (2011). Academic engagement ratings and instructional preferences: comparing behavioral, cognitive, and emotional engagement among three school-age student cohort. *Review of Higher Education & Self-Learning*, *4*(13).

Correll, S. J. (2001). Gender and the career choice process: The role of biased self-assessments. *Am. J. Sociol., 106*, 1691–1730.

Cranton, P. (2006). *Authenticity in teaching*. San Francisco: Jossey-Bass.

Criticos, C. (2000). Experiential learning and social transformation for a post-apartheid learning future. In D. Boud, R. Cohen, & D. Walker (Eds.) *Using Experience for Learning* (pp. 159-165). Milton Keynes, England: SRHE.

D'Amore, B. (2010). La complessità dell'educazione e della costruzione dei saperi. *Riforma e didattica*, *4*, 35-40.

Dane, E. (2011). Paying attention to mindfulness and its effects on task performance in the workplace. *Journal of Management*, *37*(4), 997-1018.

Deakin Crick, R. (2007). Learning how to learn: The dynamic assessment of learning power. *The Curriculum Journal*, *18*(2), 135-153.

De Freitas, S., & Yapp, C. (Eds.). (2005). *Personalizing learning in the 21st century*. Stafford, UK: Network Educational Press.

Demski, J. (2012). This time it's personal. *THE Journal (Technological Horizons In Education)*, *39*(1), 32-36.

Dickerson, A., McIntosh, S., & Valente, C. (2015). Do the maths: An analysis of the gender gap in mathematics in Africa. *Economics of Education Review*, *46*, 1-22.

Doppelt, Y. (2003). Implementation and assessment of project-based learning in a flexible environment. *International Journal of Technology and Design Education*, *13*(3), 255-272.

Dotterer, A. M., & Lowe, K. (2011). Classroom context, school engagement, and academic achievement in early adolescence. *Journal of Youth and Adolescence*, *40*(12), 1649-1660.

Dowker, A. (2004). *What works for children with mathematical difficulties?* (Vol. 554). Nottingham: DfES Publications.

Dowker, A. (2009). Use of derived fact strategies by children with mathematical difficulties. *Cognitive Development*, *24*(4), 401-410.

Duckworth, A. L., & Yeager, D. S. (2015). Measurement matters: Assessing personal qualities other than cognitive ability for educational purposes. *Educational Researcher*, *44*(4), 237-251.

Dweck, C. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.

Else-Quest, N. M., Mineo, C. C., & Higgins, A. (2013). Math and science attitudes and achievement at the intersection of gender and ethnicity. *Psychol. Women Q.*, 37, 293–309.

Fafunwa, A. B. (2018). *History of education in Nigeria*. Oxfordshire, England: Routledge.

Fapohunda, T. M. (2010). Information technology and women education in Nigeria. *Multidisciplinary Journal of Research Development*, *15*(4), 1-8.

Furner, J. M., & Kumar, D. D. (2007). The mathematics and science integration argument: A stand for teacher education. *Eurasia Journal of Mathematics, Science & Technology Education*, *3*(3). 185-189.

Gambari, A. I. (2010). Effects of instructional models on the performance of junior secondary school students in geometry in Minna, Niger State. *DELSU Journal of Educational Research and Development, 9*(1), 54-61.

Garcia, H. V. (2012). *Educacion personalizada*. Madrid: Rialp.

Gauci, S. A., Dantas, A. M., Williams, D. A., & Kemm, R. E. (2009). Promoting student-centered active learning in lectures with a personal response system. *Advances in Physiology Education, 33*(1), 60-71.

Gillard, S., Gillard, S., & Pratt, D. (2015). A pedagogical study of intrinsic motivation in the classroom through autonomy, mastery, and purpose. *Contemporary Issues in Education Research, 8*(1), 1-6.

Ginsburg, H. P. (2002). *Little children, big mathematics: Learning and teaching in the pre-school.* Proceedings of the Annual Meeting of the International Group for the Psychology of Mathematics Education (26th, Norwich, England).

Githua, B. (2013). Secondary School Student's Perceptions Of Mathematics Formative Evaluation and The Perceptions Relationship to their Motivation. *Asian Journal of Social Sciences*, *2*(1), 174-173.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597-606.

Good, C., Aronson, J., and Inzlicht, M. (2003). Improving adolescents' standardized test performance: an intervention to reduce the effects of stereotype threat. *J. Appl. Dev. Psychol., 24*, 645–662.

Government of Kenya (GoK). (2007). *Kenya Vision 2030: The popular version.* Retrieved from http://vision2030.go.ke/inc/uploads/2018/05/Vision-2030-Popular-Version.pdf

Hambleton, R. K. (2012). Measurement and validity. In J. Arthur, M. Waring, R. Coe, & L. V. Hedges (Eds.), *Research methods and methodologies in education* (pp. 241-247). London: Sage.

Harbour-Peters, V. P. (2012). Aspects of further mathematics that present difficulties to graduating Senior Secondary Students ABACUS J. *Math. Assoc. Nig.*, *22*(1), 74-78.

Harlow, L. L., Burkholder, G. J., & Morrow, J. A. (2002). Evaluating attitudes, skill, and performance in a learning-enhanced quantitative methods course: A structural modeling approach. *Structural Equation Modeling*, *9*(3), 413-430.

Hategekimana, C. P. (2008). *Cognition and technology: Effectiveness of intelligent tutoring systems for software training* (Graduate Theses and Dissertations). Retrieved from https://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=2386&context=etd

Herlihy, C. M., & Quint, J. (2006). *Emerging evidence on improving high school student achievement and graduation rates: The effects of four popular improvement programs.* (National High School Center Research Brief). Retrieved from https://files.eric.ed.gov/fulltext/ED501076.pdf

Hill, J. G., & Dalton, B. (2013). Student math achievement and out-of-field teaching. *Educational Researcher*, *42*(7), 403-405.

Hutchison, A., Beschorner, B., & Schmidt-Crawford, D. (2012). Exploring the use of the iPad for literacy learning. *The Reading Teacher*, *66*(1), 15-23.

Hwang, G.-J., Sung, H.-Y., Hung, C.-M., Huang, I., & Tsai, C.-C. (2012). Development of a personalized educational computer game based on students' learning styles. *Educational Technology Research and Development*, *60*(4), 623–638.

Jenkins, J. M., & Keefe, J. W. (2005). *Personalized instruction*. Arlington, VA: Phi Delta Kappa Educational Foundation.

Jurdak, M. (2014). Socio-economic and cultural mediators of mathematics achievement and between-school equity in mathematics education at the global level. *ZDM*, *46*(7), 1025-1037.

Kenya National Examination Council-KNEC, (2000). *KCPE Examination Report 2000.* Nairobi: KNEC.

Kenya National Examination Council-KNEC, (2017). *KCPE Examination Report 2017.* Nairobi: KNEC.

Kibler, M. E. (1998). *Classroom assessment and learning*. New York: Longman.

Kombo, D. K., & Tromp, D. L. (2006). Proposal and thesis writing: An introduction. *Nairobi: Paulines Publications Africa*, *5*, 814-30.

Kulik, C. L. C., Kulik, J. A., & Bangert-Drowns, R. L. (2010). Effectiveness of mastery learning programs: A meta-analysis. *Review of Educational Research*, *60*(2), 265-299.

Kulik, J. A., Bangert, R. L., & Williams, G. W. (2013). Effects of computer-based teaching on secondary school students. *Journal of Educational Psychology*, *75*(1), 19.

Ku, H. Y., & Sullivan, H. J. (2012). Student performance and attitudes using personalized mathematics instruction. *Educational Technology Research and Development, 50*(1),21–34.

Li, Y., & Lerner, R. M. (2013). Interrelations of behavioral, emotional, and cognitive school engagement in high school students. *Journal of Youth and Adolescence, 42*(1), 20-32.

Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin*, *136*(6), 1123.

Lionesses of Africa. (n. d.). *Rapelang Rabana, founder of rekindle learning.* Retrieved from http://www.lionessesofafrica.com/lioness-rapelang-rabana

Lipman, P. (2010). Bringing out the best in them: The contribution of culturally relevant teachers to education. *Theory into Practice, 34*(3), 203–208.

Leadbeater, C. (2004). *Learning about personalisation: How can we put the learner at the heart of the education system?* Nottingham: Department for Education and Skills.

Lombardi, M. M. (2015). Authentic learning for the 21st century: An overview. *Educause learning initiative, 1*(2007), 1-12.

López, C. L., & Sullivan, H. J. (2012). Effect of personalization of instructional context on the achievement and attitudes of Hispanic students. *Educational Technology Research & Development, 40*(4), 5–13

.Loucks-Horsley, S., Stiles, K. E., Mundry, S., Love, N., & Hewson, P. W. (2009). *Designing professional development for teachers of science and mathematics*. Thousand Oaks, CA: Corwin Press.

Martin, J., & Sugarman, J. (2011). The social–cognitive construction of psychotherapeutic change: Bridging social constructionism and cognitive constructivism. *Review of General Psychology*, *1*(4), 375.

McLeskey, J. L., Rosenberg, M. S., & Westling, D. L. (2017). *Inclusion: Effective practices for all students*. London, UK: Pearson.

Mertler, C., & Charles, C. M. (2008). Analyzing research data and presenting findings. *Introduction to Educational Research, 14*, 167.

Miheso, K. M. (2012). *Factors affecting mathematics performance among secondary students in Nairobi* (Unpublished master's thesis). Nairobi, Kenya: Kenyatta University.

Mugenda, A. (2003). *Research methods: Quantitative and qualitative approaches.* Nairobi, Kenya: ACT.

Mullis, I. V., Martin, M. O., Foy, P., & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. Amsterdam, Netherlands: International Association for the Evaluation of Educational Achievement.

Mullis, I. V., Martin, M. O., Gonzalez, E. J., & Chrostowski, S. J. (2004). *TIMSS 2003 international mathematics report: Findings from IEA's trends in international mathematics and science study at the fourth and eighth grades*. Boston, MA: TIMSS & PIRLS International Study Center.

Mutch, C. (2015). *Doing educational research: A practitioners guide to getting started.* Wellington: NZCER Press

Muthemi, T. K. (2014). *The impact of SMASSE programme on teaching of mathematics performance in Kibwezi Division, Makueni District* (Unpublished master's project). Nairobi, Kenya: Kenyatta University.

Ndume, V., Tilya, F. N., & Twaakyondo, H. (2014). Challenges of adaptive elearning at higher learning institutions: A case study in Tanzania. *International Journal of Computing and ICT Research*, *2*(1), 47-59.

OECD. (2004). *PISA Learning for tomorrow's world: First results from PISA 2003.* Retrieved from https://www.oecd.org/education/school/programmeforinternationalstudentassessmentpisa/34002216.pdf

Okoyeocha, A. C. (2005). A comparative study of public and private secondary schools in the provision of quality education. *Nigerian Journal of Educational Administration and Planning*, *5*, 88-95.

O'malley, P., Jenkins, S., Wesley, B., Donehower, C., Rabuck, D., & Lewis, M. E. B. (2013). *Effectiveness of using ipads to build math fluency.* Paper presented at the Council for Exceptional Children annual meeting (San Antonio, Texas, Apr 3-6, 2013).

Osadebe, P. U., & Nwabeze, C. P. (2018). Construction and validation of physics aptitude test as an assessment tool for senior secondary school students. *International Journal of Assessment Tools in Education*, *5*(3), 461-473.

Oso, W.Y., & Onen D. (2009). *Writing research proposal and report*. Nairobi, Kenya: Jomo Kenyatta Foundation.

Otiende, J. E., Bogonko, S. N., Wamahiu, S. P., & Karugu, A. M. (1992). *Education and development in Kenya: A historical perspective*. Oxford: University Press.

Pane, J. F., Steiner, E. D., Baird, M. D., & Hamilton, L. S. (2015). *Continued progress: Promises evidence on personalized learning.* Santa Monica, CA: RAND Corporation.

Pane, J. F., Steiner, E. D., Baird, M., Hamilton, L. S., & Pane, J. D. (2017, July). *Informing progress: Insights on personalized learning implementation and effects.* (RAND Corporation Research Report). Retrieved from https://www.rand.org/pubs/research_reports/RR2042.html

Papadakis, S., & Kalogiannakis, M. (2017). Mobile educational applications for children: what educators and parents need to know. *International Journal of Mobile Learning and Organisation*, *11*(3), 256-277.

Patall, E. A., Cooper, H., & Wynn, S. R. (2010). The effectiveness and relative importance of choice in the classroom. *Journal of Educational Psychology*, *102*, 896–915. doi:10.1037/a0019545

Perin, D. (2018). Teaching academically underprepared students in community colleges. In J. Levin & S. Kater (Eds.), *Understanding community colleges* (pp. 135-158). New York, NY: Routledge/ Taylor Francis.

Perks, K. (2010). Crafting effective choices to motivate students. *Adolescent Literacy in Perspective*, *2*, 2-15.

Powell, W., & Kusuma-Powell, O. (2011). *How to teach now: Five keys to personalized learning in the global classroom*. Alexandria, VA: ASCD.

Prain, V., Cox, P., Deed, C., Dorman, J., Edwards, D., Farrelly, C., . . . Yager, Z. (2013). Personalized learning lessons to be learnt. *British Educational Research Journal*, *39*(4), 654-676. https://doi.org/10.1080/01411926.2012.669747

Psotka, J., Massey, L. D., & Mutter, S. A. (2011). *Intelligent tutoring systems: Lessons learned*. London: Psychology Press.

Rajendran, R., & Muralidharan, A. (2013, December). *Impact of mindspark's adaptive logic on student learning*. Paper presented at IEEE Fifth International Conference on Technology for Education (T4E), Kharagpur, India.

Reddy, V., Zuze, T. L., Visser, M., Winnaar, L., Juan, A., Prinsloo, C. H., ... & Rogers, S. (2015). *Beyond benchmarks: What twenty years of TIMSS data tell us about South African education*. South Africa: HSRC Press.

Reeve, J. (2013). How students create motivationally supportive learning environments for themselves: The concept of agentic engagement. *Journal of Educational Psychology*, *105*(3), 579-595.

Richburg-Burgess, J. (2012). *Targeted instruction for struggling readers: It takes a team*. Dissertation available from ProQuest. https://repository.upenn.edu/dissertations/AAI3530073

Robinson, J. P., & Lubienski, S. T. (2011). The development of gender achievement gaps in mathematics and reading during elementary and middle school: Examining direct cognitive assessments and teacher ratings. *American Educational Research Journal*, *48*(2), 268-302.

Rosli, M. R., Maat, S. M., & Rosli, R. (2017). Students' attitude and anxiety toward statistics: A descriptive analysis. *Research on Education and Psychology, 1*(1), 47-56.

Sax, L. J., Kanny, M. A., Riggers-Piehl, T. A., Whang, H., & Paulson, L. N. (2015). But I'm not good at math: The changing salience of mathematical self-concept in shaping women's and men's STEM aspirations. *Res. High. Educ*., *56*, 813–842.

Schunk, D. H. (2012). *Learning theories an educational perspective sixth edition*. Pearson.

Schutt, R. K. (2017). *Understanding the social world: Research methods for the 21st century. Los Angeles, CA: Sage Publications.* Retrieved from https://www.sagepub.com/sites/default/files/upm-binaries/77685_Chapter_8.pdf

Shuttleworth, M. (2008). *Quantitative research design.* Retrieved from https://explorable.com/quantitative-research-design

Şimşek, N., & Çakır, Ö. (2009). Effect of personalization on students 'achievement and gender factor in mathematics education. *International Journal of Social Sciences, 4*(4), 278-282.

Sleeman, D., & Brown, J. S. (1982). *Intelligent tutoring systems*. New York, NY: Academic Press.

Spaull, N. (2013). Poverty & privilege: Primary school inequality in South Africa. *International Journal of Educational Development, 33*(5), 436-447.

Staker, H., & Horn, M. B. (2012). *Classifying K-12 blended learning*. Lexington, MA: Innosight Institute.

Stefanou, C. R., Perencevich, K. C., DiCintio, M., & Turner, J. C. (2014). Supporting autonomy in the classroom: Ways teachers encourage student decision making and ownership. *Educational Psychologist, 39*(2), 97-110.

Steiner, E. D., Hamilton, L. S., Peet, E. D., & Pane, J. D. (2015, November). *Continued progress: Promising evidence on personalized learning.* (RAND Corporation Research Report). Retrieved from https://www.rand.org/pubs/research_reports/RR1365z2.html

Stringfield, S. (1994). Outlier studies of school effectiveness. In D. Reynolds, B. Creemers, P. S. Nesselrodt, E. C. Shaffer, S. Stringfield, & C. Teddlie (Eds.),

Advances in school effectiveness research and practice (pp. 73-83). Oxford, UK: Pergamon Press.

Tanenbaum, C., Le Floch, K., & Boyle, A. (2013). *Are personalized learning environments the next wave of K-12 education reform*. (Education issue paper series). Retrieved from http://www. air. org/sites/default/files/AIR_Personalized_ Learning_Issue_Paper_2013. pdf.

Tanner, C. K. (2008). Explaining relationships among student outcomes and the school's physical environment. *Journal of Advanced Academics, 19*(3), 444-471.

The Kenya Certificate of Secondary Education (KCSE). (2015). *Examination essential statistics*. Retrieved from http://www.capitalfm.co.ke.

Tlhoaele, M., Hofman, A., Winnips, K., & Beetsma, Y. (2014). The impact of interactive engagement methods on students' academic achievement. *Higher Education Research and Development, 33*(5), 1020-1034.

Traxler, J. (2018). Learning with mobiles: The global south. *Research in Comparative & International Education, 13*(1), 152-175. DOI: 10.1177/1745499918761509

Tseng, J. C. R., Chu, H. C., Hwang, G. J., & Tsai, C. C. (2008). Development of an adaptive learning system with two sources of personalization information. *Computers & Education*, *51*(2), 776–786.

Tucker, B. (2007). *Handbook of technology-based training*. London: Ashgate Publishing Company.

Turuk, M. C. (2008). The relevance and implications of Vygotsky's sociocultural theory in the second language classroom. *Arecls*, *5*(1), 244-262.

U.S. Department of Education. (2008). *Foundations for Success: The Final Report of the National Mathematics Advisory Panel*. Washington D.C.: National Mathematics Advisory Panel.

Underwood, J. D. M. (2009). *The impact of digital technology: a review of the evidence of the impact of digital technologies on formal education*. Coventry, UK: Becta.

UNESCO Institute for Statistics. (2010). *Global education digest 2010: Comparing education statistics across the world*. Paris, France: UNESCO.

Verenikina, I. (2010). Vygotsky in Twenty-First-Century research. In J. Herrington & B. Hunter (Eds.), *Proceedings of world conference on educational multimedia, hypermedia and telecommunications* (pp. 16-25). Chesapeake, VA: AACE.

Vogt, K. (2017, January). When projects are personalized, learning is social. *Education Week*. Retrieved from http://blogs.edweek.org/edweek/learning_deeply/2017/01/when_projects_are_ personalize d_learning_is_social.html

Vygotsky, L. (1978). Interaction between learning and development. *Readings on the Development of Children*, *23*(3), 34-41.

Walker, S. P., Wachs, T. D., Grantham-McGregor, S., Black, M. M., Nelson, C. A., Huffman, S. L., ... & Gardner, J. M. M. (2011). Inequality in early childhood: risk and protective factors for early child development. *The Lancet*, *378*(9799), 1325-1338.

Walonoski, J. A., & Heffernan, N. T. (2006, June). *Detection and analysis of off-task gaming behavior in intelligent tutoring systems*. Proceedings of Intelligent Tutoring Systems, 8th International Conference, ITS 2006, Jhongli, Taiwan, June 26-30, 2006 (pp. 382-391).

Wiley, D. A. (2012). *The instructional use of learning objects* (Vol. 1). Bloomington, IN: Agency for Instructional Technology.

Worsley, D., Fox, E., Landzberg, J., & Papagiotas, A. (2013). *Changing systems to personalized learning: Teaching to each student.* Providence, RI: The Education Alliance at Brown University.

Wright, J. P., & Wright, C. D. (2010). Personalized verbal problems: An application of the language experience approach. *Journal of Educational Research, 79*(6), 358–362.

Wright, N. (2010). *e-Learning and implications for New Zealand schools: A literature review*. New Zealand: Ministry of Education.

Yara, P. O., & Otieno, K. O. (2010). Teaching/learning resources and academic performance in mathematics in secondary schools in Bondo district of Kenya. *Asian Social Science, 6*(12), 126-132. DOI: 10.5539/ass.v6n12p126

Zan, R. (2010). A metacognitive intervention in mathematics at university level. *International Journal of Mathematical Education in Science and Technology*, *31*(1), 143-150.

Zhang, D., Zhao, J. L., Zhou, L., & Nunamaker Jr, J. F. (2014). Can e-learning replace classroom learning?. *Communications of the ACM*, *47*(5), 75-79.

Zimmerman, B. J., Bandura, A., & Martinez-Pons, M. (1992). Self-motivation for academic attainment: The role of self-efficacy beliefs and personal goal setting. *American Educational Research Journal*, *29*(3), 663-676.

APPENDICES

APPENDIX 1: Achievement Test

CODE……

MATHEMATICS FORM 1 ACHIEVEMENT EXAM
TIME: 2HRS

ATTEMPT ALL THE QUESTIONS AND SHOW ALL YOUR WORKINGS

1) Simplify the following expressions;

a) $\frac{8 - 3.5 \div 0.7 + 2.85}{3}$ (3mks)

b) $\frac{7(2k+3) + 4k-3}{2(k+1) + 4k+7}$ (3mks)

2) Round off;
a) 468.3894 to two decimal places (1mk)

b) 43264 to the nearest on thousand (1mk)

3) What is the Greatest Common Divisor of 33, 121 and 143? (1mk)

4) Express the following numbers in terms of their prime factors;

i) 360 (2mks)

ii) 90 (2mks)

5) What is the place value and total value of digit 5 in 8950403? (2mks)

6) A farmer sold milk for all the day of the week. The table below shows the amount of milk the farmer sold for six of the seven day

Day	Mon	Tue	Wed.	Thurs.	Fri		Fri	Sat	Sun
Amount in Kg	410	315	400	410		300	420		

One kilogram of milk was sold at sh.18. If the mean sale per day was 380kg, how much more money did the farmer get from selling milk on Friday than on Tuesday? (4mks)

7) What is the value of $\frac{1¼ \times 2½}{3½ - 2¼}$ (2mks)

8) What is the LCM of 45, 12, and 9? (2mks)

9) Factorize the following expressions:

(i) 3px- py +3qx – qy (2mks)

(ii) $a^2 4p + a$ (2mks)

10) Four bells are set to ring at intervals of 6,8,10 and 15 minutes. If they ring together at 8.00 am, at what time will they ring together again. (3mks)

11) The L.C.M of two numbers is 180 and there GCD is 12.
(a) If the two numbers are 36 and x , find the value of x
` (2marks)

(b) Suppose the two numbers in part (a) and another number(y) have GCD of 6 and LCM of 900; Work the value of y. (2mks)

12. If 9 is added to a certain number, the result is 1 less than 3 times the number. what is the number. (3mks)

13. Write the following numbers in symbols.

a) Five hundred and ninety million, seven hundred thousand, five hundred. (1mk)

b) Sixty-five million, two hundred and ninety-two thousand, four hundred and forty four. (1mk)

14. Divide the following numbers by 11 and give the quotient only as the answer.

a) 6,493 (2mks)

b) 73,350 (2mks)

15. Use factor-tree to decompose 256 into prime factors. (4mks)

16. From the following set of numbers which are:
a) Odd [20, 18, 6, 7, 8, 21] (1mk)

b) Prime [14, 2, 10, 9, 3] (1mk)

17. Use a number line to perform the following operations.
a) (-10) -(-3) (1mk)

b) (-3) -(-4) (1mk)

c) (+1) -(-8) (1mk)

18. When a number is divided into by 8, 9, and 6 the remainders are 7, 8 and 5 respectively. Find the number. (6mks)

19. Determine whether the following numbers are divisible by 6:

a) 390 (2mks)

b) 441 (2mks)

c) 6732 (2mks)

d) 7544 (2mks)

e) 5310 (2mks)

20. Express the following numbers in powers of their prime factors:

a) 196 (2mks)

b) 72 (2mks)

c) 385 (2mks)

APPENDIX 2: Sample Lesson Plan for Control Group

LESSON PLAN FOR CONTROL GROUP

FORM	NUMBER OF STUDENTS	SUBJECT	TIME	DATE
1	20	MATHS	8:00AM-8:40AM	

TOPIC: NATURAL NUMBERS
SUB TOPIC: Place Value of Natural Numbers
REF: Secondary Mathematics Students Book 1 by KLB, pg. 1.
OBJECTIVE: By the end of the lesson, the learner should be able to

1. Identify, read and write natural numbers in symbols and in words

STAGE	**TIME**	**TEACHER ACTIVITY**	**STUDENT ACTIVITY**	**MATERIALS AND RESOURCES**	**REMARKS**
INTRODUCTION	5 min	A brief review on numbers 0-9	Students identify the numbers 0-9	Place value chart	
DEVELOPMENT	5 min	Grouping learners in groups of 4 or 5	Learners group themselves and identify the numbers and make 2-3 digits from the numbers		
	15 min	Organization of different groups and supplying them with a chart of numbers	Learners practice placement of numbers in the chart as directed by the teacher		
	10 min	Teachers guides the learners in seeing the relationship between place value and writing numbers in words	Learner take notes		
	5 min	Teacher summarizes and gives exercises	Note taking and listening		

DISCUSSION

Numbers	Thousands	Hundreds	Tens	Ones
3721	3	7	2	1

EVALUATION

Students book 1 Exercise 1.2 Numbers 1a and 1 b.

FEEDBACK

Teacher to mark and give a report in the next lesson.

APPENDIX 3: Sample Lesson Plan for Experimental Group

LESSON PLAN FOR EXPERIMENTAL GROUP
STUDENT CODE…….....

FORM	NUMBER OF STUDENTS	SUBJECT	TIME	DATE
1	20	MATHS	8:40AM-9:20AM	

TOPIC: NATURAL NUMBERS
SUB TOPIC: Place Value of Natural Numbers
REF: Secondary Mathematics Students Book 1 by KLB, pg. 1.
OBJECTIVE: By the end of the lesson, the learner should be able to

1. Identify, read and write natural numbers in symbols and in words

STAGE	TIME	TEACHER ACTIVITY	STDENT ACTIVITY	TEACHER LEARNING RESOURCES	REMARKS
INTRODUCTION	5 min	Teacher connect a video illustrating natural numbers	Learners keenly listen as they watch the video	Audio-visual, charts, CDs and projector Marbles with numbers inscribed on them Place value chart	
DEVELOPMENT	15 min	Teacher walks around the class to see those who have a problem with listening and seeing as he directs them to write the numbers on their books The teacher redesigns the class and come up with different groupings	Learners practice on their own how to write the numbers Learners form number games in their various groups		

	15 min	Teacher request learners to demonstrate what they have learnt on the chalk wall in terms of place value	Learners display the skills they have gathered on the chalk wall as others watch and contribute		
	5 min	Teacher summarizes by giving review of the video on place value and natural numbers.	Learners give their view on how the lesson was and express where they had challenges		

DISCUSSION

Numbers	**Thousands**	**Hundreds**	**Tens**	**Ones**
3721	3	7	2	1

EVALUATION

Students Book 1 Exercise 1.2 Numbers 1a and 1 b.

FEEDBACK

Teacher to mark and give a report in the next lesson.

FOR TEACHER USE ONLY

STUDENT PROFILE

CODE……

SKILLS

1. Strength
   ……
   ……
2. Ability
   ……
   ……
3. Weakness
   ……
   ……
4. Interest

……
……

APPENDIX 4: Classroom Observation Schedule and Coding Schemes

1-Very Poor 2-Poor 3-Average 4-Good 5-Very Good

FLEXIBLE CONTENT TOOLS AND LEARNING ENVIRONMENT

		1	**2**	**3**	**4**	**5**
1	Teacher select tools to meet learners needs					
2	Learning venue keeps on changing					
3	Learners do a lot of practice on their own					
4	Seating arrangements are altered frequently					
5	Use of multiple tools in the class					
6	Contents are frequently adjusted					

TARGETED INSTRUCTION

		1	2	3	4	5
1	Teacher reviews the students work					
2	Grouping of the students is done based on the skill level					
3	Delivery of instruction is based on learner needs					
4	Student report is used to learning groups					

STUDENT CHOICE

1	Teacher provides learners with some form of choice in assignment	1	2	3	4	5
2	Learners have a choice to prioritize or path to complete the assignment					
3	Learners come up with simple learning goals					
4	Students have a choice to monitor their own work					

STUDENT ENGAGEMENT

		1	2	3	4	5
1	Learners are in involved in class discussions					
2	Group work is encouraged					
3	Learning is constructivist in nature					
4	Students are encouraged to give their predictions					
5	Teacher keeps eye contact to monitor student feeling					
6	Teacher conduct lesson considering individual differences					

APPENDIX 5: Questionnaire

INFORMATION AND CONSENT FORM

Dear Participant,

I am a master's student from the Department of Education, School of Education, Humanities and Sciences at University of Eastern Africa Baraton carrying out a study on **EFFECT OF PERSONALIZED LEARNING ON MATHEMATICS PERFORMANCE IN SECONDARY SCHOOLS IN AWENDO SUB COUNTY, KENYA.** You are hereby requested to participate in this study involving the collection of information in form of questionnaire. Your participation is optional and any assistance will be highly appreciated. The data collected will be treated with utmost confidentiality and your response remains confidential.

QUESTIONNAIRE

Indicate your choice using a tick (✓)

SECTION A: DEMOGRAPHIC CHARACTERISTICS

Gender

a) Male ( )

b) Female ( )

SECTION B. CIRCLE THE NUMBER THAT BEST MATCHES YOUR ANSWER

FLEXIBLE CONTENT AND TOOLS AND LEARNING ENVIRONMENT

1. Teacher brings books and mathematical instruments that aids my learning.
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

2. Teacher organizes time for me to be in the library and do personal studies.
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

3. Teacher assigns me to revise specific topics based on my need
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

4. Teacher uses my assignment results to inform and modify what to teach
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

5. Teacher frequently changes books and teaching instruments according to my needs and interest
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

6. Teacher uses different books to facilitate understanding and application of knowledge
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

7. I am guided to learn at my pace
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

8. I am allowed to do a lot of practice on my work
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

9. Teacher keeps on changing the discussion groups in every lesson
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

10. Teacher keeps on changing learning rooms (use of optional classes) for proper content delivery
    a) Agree b) Tend to agree c) Tend to disagree d) Disagree

TARGETED INSTRUCTION

1. Teacher reviews my assignments to identify my needs
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

2. Teacher adjusts teaching style for each group of students based on the student need
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

3. Students' work report is used to create students' groups based on interest, need, skill – level
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

4. Our discussion groups are changed with some frequency
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

5. My work is used as an integral part of daily instruction
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

6. Teacher gives direction on syllabus requirements
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

STUDENT REFLECTION AND OWNERSHIP (STUDENT CHOICE)

1. Teacher guides me on revisiting my work.
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

2. Teacher meets with me individually to listen and develop relationship with me
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

3. Teacher provides me with some form of choice in assignment
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

4. Teacher provides me with choice in prioritization of tasks or path to complete assignments
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

5. I am allowed to create my own daily priorities
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

6. I am allowed to make choices about the content guided by the syllabus
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

7. I am allowed to make choices on the structure of learning
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

8. Teacher sets time during the day for one-on-one academic support
   a) Agree b) Tend to agree c) Tend to disagree d) Disagree

Thank you for your participation!!!

APPENDIX 6: Table of Specification

Content	Objectives Knowledge	Understanding	Application	Total
Topic 1	2	1	1	4
Topic 2		1	1	2
Topic 3	1	2	1	4
Topic 4	1	1		2
Topic 5	1	1	1	3
Topic 6	2	1	2	5
Total	7	7	6	20

APPENDIX 7: Reliability Analysis

Reliability (FLEXIBLE CONTENT AND TOOLS AND LEARNING ENVIRONMENT)

Reliability Statistics

Cronbach's Alpha	N of Items
.654	10

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Teacher brings books and mathematical instruments that aid my learning	25.33	25.412	.636	.556
Teacher organizes time for me to be in the library to do my personal studies	26.06	23.467	.717	.526
Teacher assigns me to revise specific topics based on my need	25.39	31.663	.129	.667
Teacher uses my assignment result to inform an modify what to teach	25.50	32.029	.144	.660
Teacher frequently changes books and teaching instruments according to my needs and interest	26.11	24.693	.672	.545
Teacher uses different books to facilitate understanding and application of knowledge	26.44	27.556	.395	.611
I am guided to learn at my pace	25.06	32.056	.155	.658
I am allowed to do a lot of practice on my work	24.94	33.938	.065	.664
Teacher keeps on changing the discussion groups per every lesson	26.50	30.853	.159	.664
Teacher keeps on changing learning rooms(use of optional classes) for proper content delivery	25.17	32.500	.078	.675

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
28.50	34.971	5.914	10

Reliability (TARGETED INSTRUCTION)

Reliability Statistics

Cronbach's Alpha	N of Items
.686	6

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Teacher review my assignments to identify me needs	15.33	9.294	.589	.604
Teacher adjust teaching style for each group of students based on the student need	15.22	11.007	.627	.655
Students work report is used to create students groups based on interest, needs and skill level	17.06	9.350	.221	.732
Our groups are changed with some frequency and order	16.94	8.173	.352	.690
My work is used as an integral part of daily interaction	15.44	9.320	.544	.613
teacher gives direction on syllabus requirements	15.56	8.026	.622	.569

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
19.11	12.458	3.530	6

Reliability – STUDENT REFLECTION AND OWNERSHIP (STUDENT CHOICE)

Reliability Statistics

Cronbach's Alpha	N of Items
.656	8

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Teacher guides me on revisiting my work	11.83	16.853	.540	.610
Teacher meets with me individually to listen and develop relationship with me	11.61	15.310	.430	.605
Teacher provides me with some form of choice in assignment	10.94	14.526	.474	.591
Teacher provides me with choice in prioritization of tasks or path to complete assignments	11.06	12.997	.604	.545
I am allowed to create my own daily priorities	11.83	16.500	.429	.615
I am allowed to make choices about the content guided by the syllabus	11.56	16.026	.243	.656
I am allowed to make choices on the structure of learning	10.89	15.516	.235	.666
Teacher sets time during the day for one on one support academic	11.67	18.118	.061	.691

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
13.06	19.585	4.425	8

APPENDIX 8: Ethical Clearance

OFFICE OF THE DIRECTOR OF GRADUATE STUDIES AND RESEARCH

UNIVERSITY OF EASTERN AFRICA, BARATON

P. O. Box 2500-30100, Eldoret, Kenya, East Africa

B0232019

March 12, 2019

Peter Ogwari
School of Education, Humanities and Social Sciences
University of Eastern Africa Baraton

Dear Peter,

Re: ETHICS CLEARANCE FOR THESIS PROPOSAL (REC: UEAB/02/03/2019)

Your master thesis proposal entitled ***Effect of Personalized Learning on Mathematics Performance in Secondary Schools in Awendo Sub County, Kenya"*** was discussed by the Research Ethics Committee (REC) of the University and your request for ethics clearance was granted approval.

This approval is for one year effective March 12, 2019 until March 11, 2020. For any extension beyond this time period, you will need to apply to this committee one month prior to expiry date.

Note that you will need a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI) and clearance from the study site before you start gathering your data.

We wish you success in your research.

Sincerely yours,

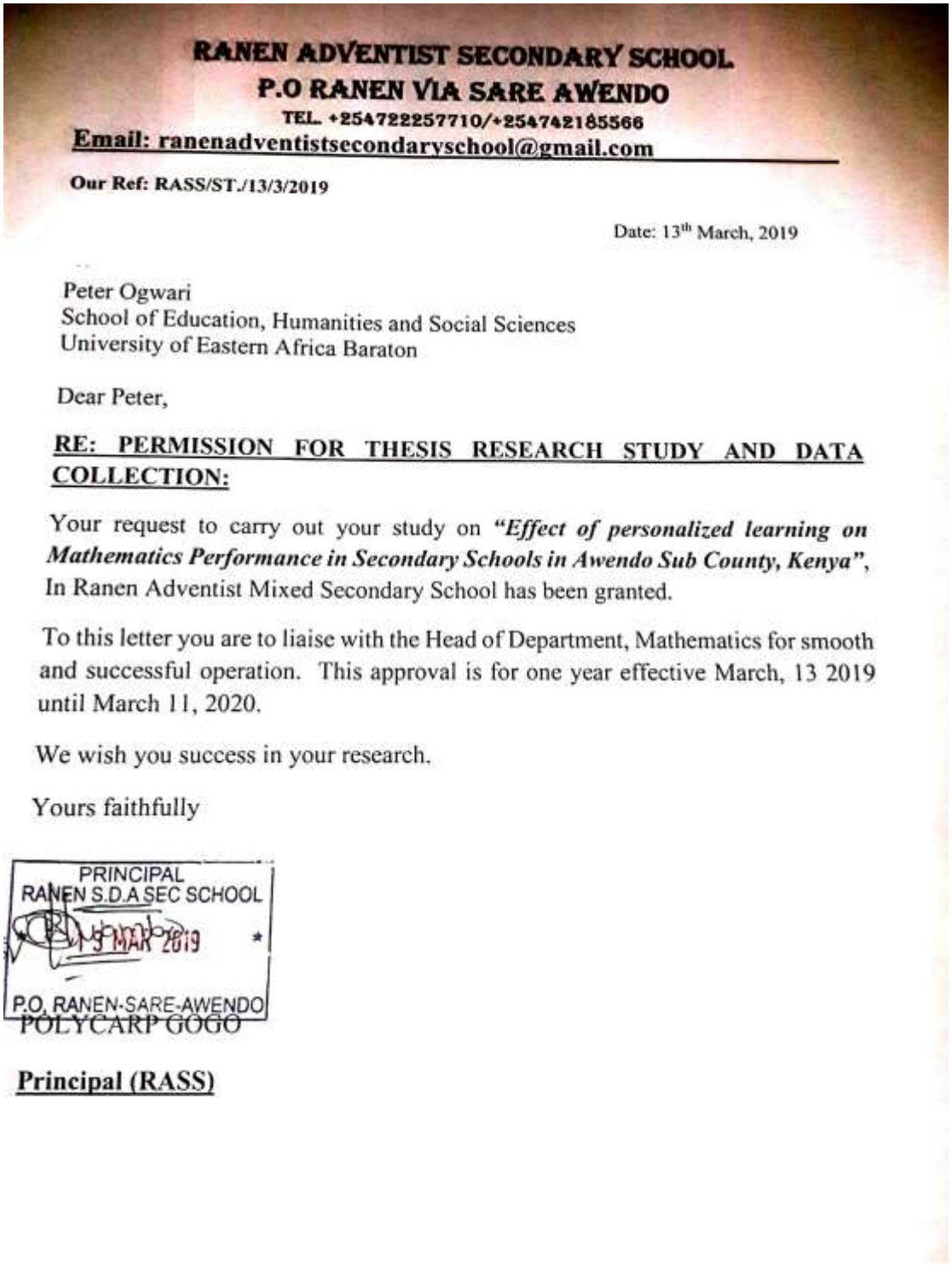
Jackie Obey

Prof Jackie K. Obey, PhD
Chairperson, Research Ethics Committee

12 MAR 2019

A SEVENTH-DAY ADVENTIST INSTITUTION OF HIGHER LEARNING
CHARTERED 1991

APPENDIX 9: Permission from Ranen Adventist Secondary School



RANEN ADVENTIST SECONDARY SCHOOL
P.O RANEN VIA SARE AWENDO
TEL. +254722257710/+254742185566
Email: ranenadventistsecondaryschool@gmail.com

Our Ref: RASS/ST./13/3/2019

Date: 13th March, 2019

Peter Ogwari
School of Education, Humanities and Social Sciences
University of Eastern Africa Baraton

Dear Peter,

RE: PERMISSION FOR THESIS RESEARCH STUDY AND DATA COLLECTION:

Your request to carry out your study on ***"Effect of personalized learning on Mathematics Performance in Secondary Schools in Awendo Sub County, Kenya"***, In Ranen Adventist Mixed Secondary School has been granted.

To this letter you are to liaise with the Head of Department, Mathematics for smooth and successful operation. This approval is for one year effective March, 13 2019 until March 11, 2020.

We wish you success in your research.

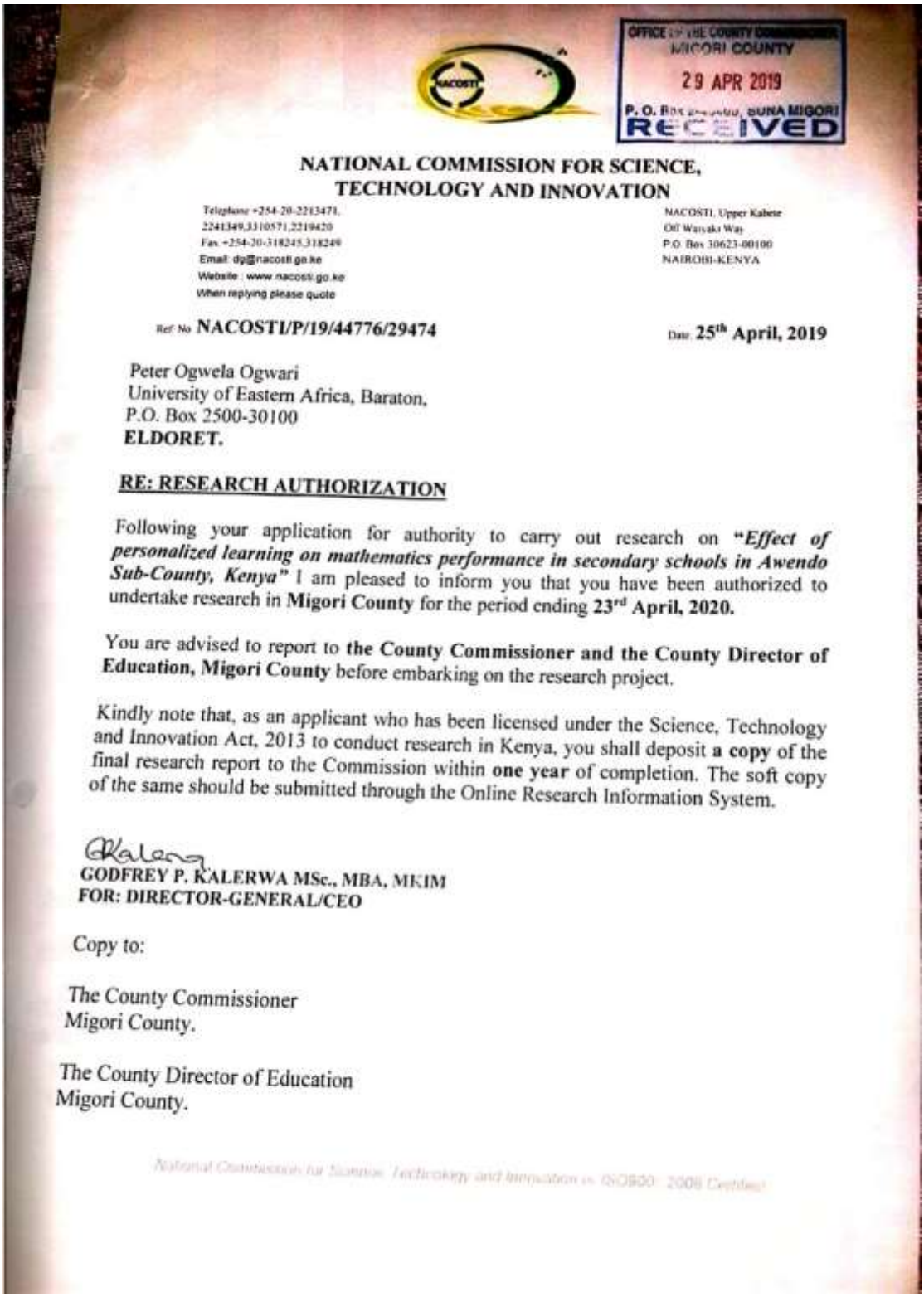
Yours faithfully

PRINCIPAL
RANEN S.D.A SEC SCHOOL
13 MAR 2019
P.O. RANEN-SARE-AWENDO

POLYCARP GOGO

Principal (RASS)

APPENDIX 10: Authorization from NACOSTI



OFFICE OF THE COUNTY COMMISSIONER
MIGORI COUNTY
29 APR 2019
P. O. Box [illegible], SUNA MIGORI
RECEIVED

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone +254-20-2213471, 2241349,3310571,2219420
Fax +254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref. No **NACOSTI/P/19/44776/29474**

Date **25th April, 2019**

Peter Ogwela Ogwari
University of Eastern Africa, Baraton,
P.O. Box 2500-30100
ELDORET.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Effect of personalized learning on mathematics performance in secondary schools in Awendo Sub-County, Kenya"*** I am pleased to inform you that you have been authorized to undertake research in **Migori County** for the period ending **23rd April, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Migori County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

GODFREY P. KALERWA MSc., MBA, MKIM
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioner
Migori County.

The County Director of Education
Migori County.

National Commission for Science, Technology and Innovation is ISO9001: 2008 Certified

APPENDIX 11: Authorization from County Commisoner

OFFICE OF THEPRESIDENT
MINISTRY OF INTERIOR AND COORDINATION OF
NATIONAL GOVERNMENT

Telephone: (059) 20511
FAX (059)20361
Email:
countycommissionermigori@yahoo.com

OFFICE OF THE COUNTY COMMISSIONER
MIGORI COUNTY
P.O. BOX 2 - 40400
SUNA- MIGORI.

When replying please quote

Ref. No: CC/ED.12/19 VOL.II/368.

Date: 29TH APRIL, 2019

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORIZATION

This is to confirm that **Peter Ogwela Ogwari** of University of East Africa, Baraton NACOSTI/P/19/44776//29474 has been authorized to carry out research on ***"Effect of personalized learning on mathematics performance in secondary schools in Awendo Sub-County, Kenya".*** I'm pleased to inform you that you have been authorized to undertake this research within Migori County for the period ending **23rd April, 2020**

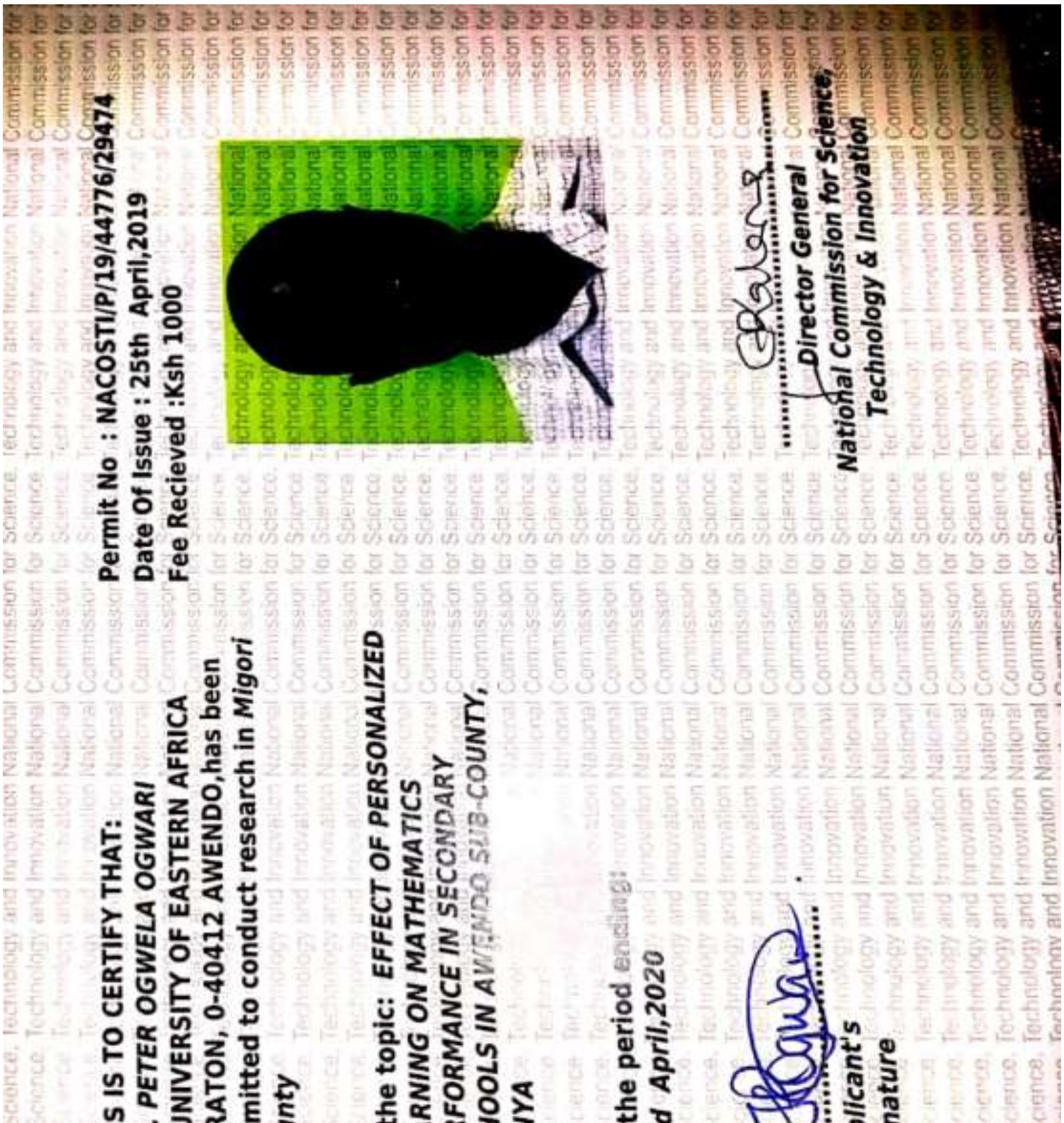
Accord him the necessary assistance.

DENNIS N. MUTISO
FOR: COUNTY COMMISSIONER
MIGORI COUNTY

CC

-The County Director of Education
Migori County

APPENDIX 12: Permit



THIS IS TO CERTIFY THAT:
MR. PETER OGWELA OGWARI
of UNIVERSITY OF EASTERN AFRICA BARATON, 0-40412 AWENDO,has been permitted to conduct research in *Migori County*

on the topic: *EFFECT OF PERSONALIZED LEARNING ON MATHEMATICS PERFORMANCE IN SECONDARY SCHOOLS IN AWENDO SUB-COUNTY, KENYA*

for the period ending:
23rd April,2020

....
Applicant's Signature

Permit No : NACOSTI/P/19/44776/29474
Date Of Issue : 25th April,2019
Fee Recieved :Ksh 1000

....
Director General
National Commission for Science, Technology & Innovation

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013

The Grant of Research Licenses is guided by the Science, Technology and Innovation (Research Licensing) Regulations, 2014.

CONDITIONS

1. **The License is valid for the proposed research, location and specified period.**
2. **The License and any rights thereunder are non-transferable.**
3. **The Licensee shall inform the County Governor before commencement of the research.**
4. **Excavation, filming and collection of specimens are subject to further necessary clearance from relevant Government Agencies.**
5. **The License does not give authority to transfer research materials.**
6. **NACOSTI may monitor and evaluate the licensed research project.**
7. **The Licensee shall submit one hard copy and upload a soft copy of their final report within one year of completion of the research.**
8. **NACOSTI reserves the right to modify the conditions of the License including cancellation without prior notice.**

National Commission for Science, Technology and innovation
P.O. Box 30623 - 00100, Nairobi, Kenya
TEL: 020 400 7000, 0713 788787, 0735 404245
Email: dg@nacosti.go.ke, registry@nacosti.go.ke
Website: www.nacosti.go.ke

REPUBLIC OF KENYA

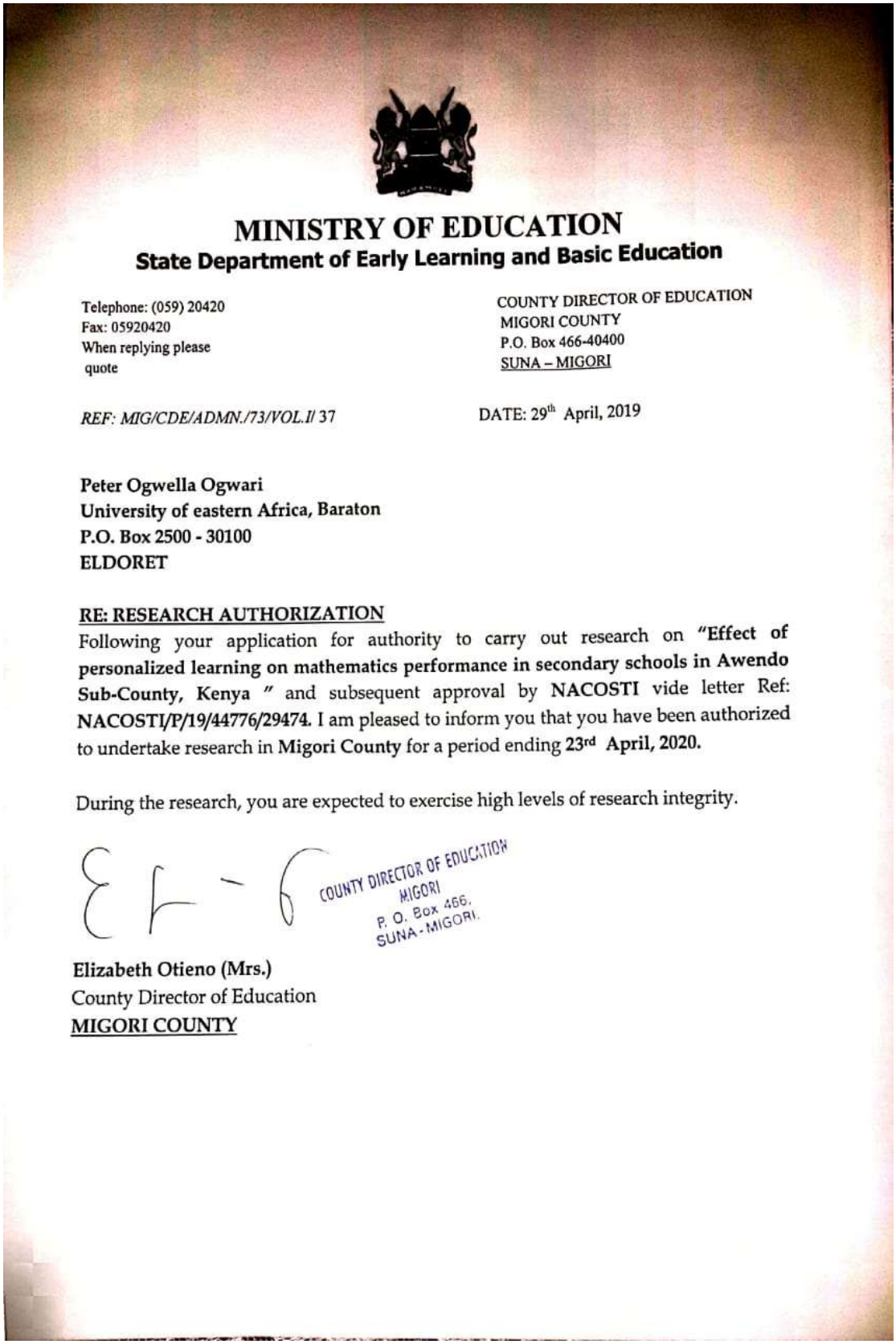
National Commission for Science, Technology and Innovation

RESEARCH LICENSE

Serial No.A 24259

CONDITIONS: see back page

APPENDIX 13: Authorization from County Education Director



MINISTRY OF EDUCATION
State Department of Early Learning and Basic Education

Telephone: (059) 20420
Fax: 05920420
When replying please quote

COUNTY DIRECTOR OF EDUCATION
MIGORI COUNTY
P.O. Box 466-40400
SUNA – MIGORI

REF: MIG/CDE/ADMN./73/VOL.I/ 37

DATE: 29th April, 2019

Peter Ogwella Ogwari
University of eastern Africa, Baraton
P.O. Box 2500 - 30100
ELDORET

RE: RESEARCH AUTHORIZATION

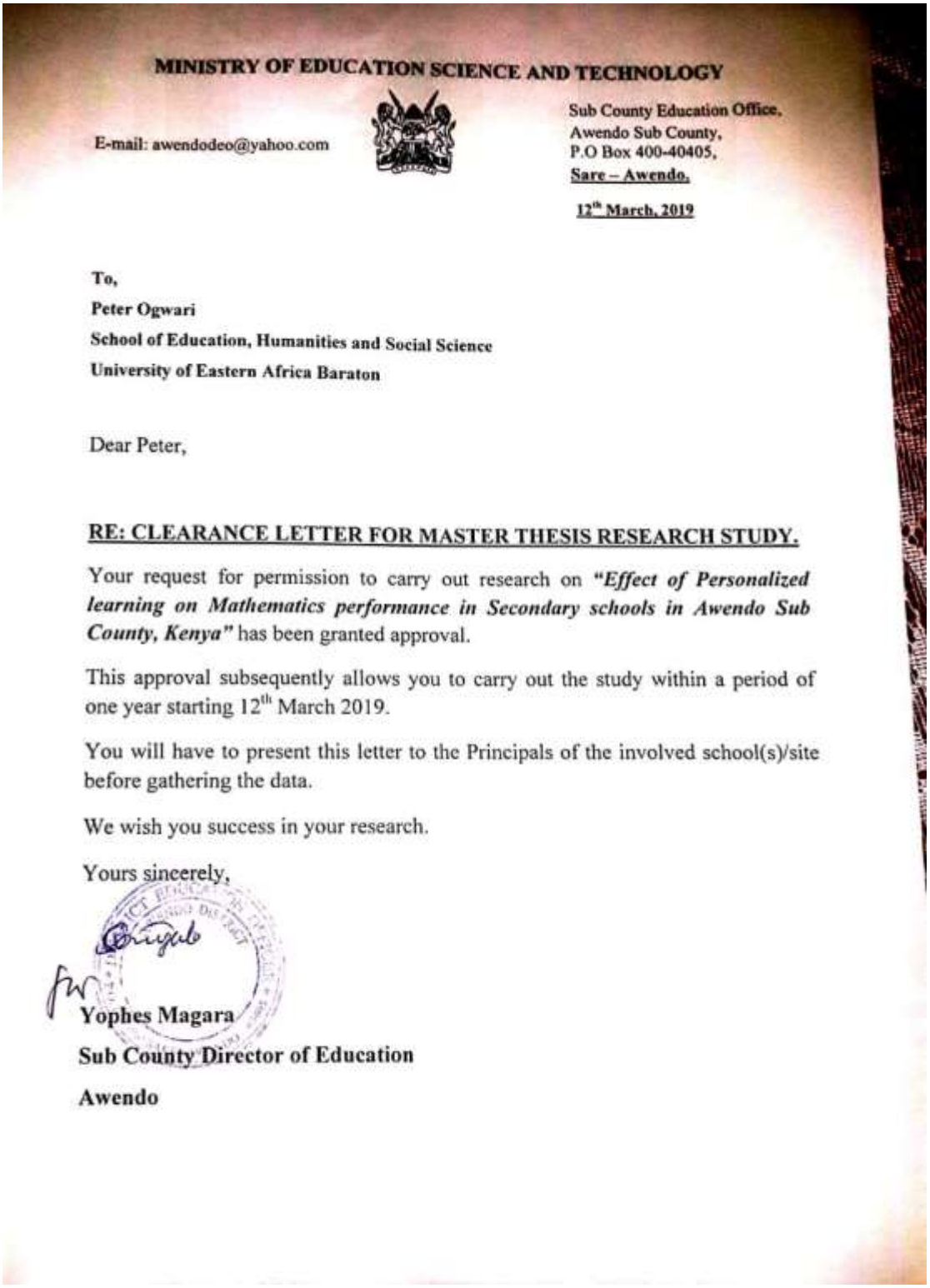
Following your application for authority to carry out research on **"Effect of personalized learning on mathematics performance in secondary schools in Awendo Sub-County, Kenya "** and subsequent approval by **NACOSTI** vide letter Ref: **NACOSTI/P/19/44776/29474.** I am pleased to inform you that you have been authorized to undertake research in **Migori County** for a period ending **23rd April, 2020.**

During the research, you are expected to exercise high levels of research integrity.

COUNTY DIRECTOR OF EDUCATION
MIGORI
P. O. Box 466,
SUNA - MIGORI.

Elizabeth Otieno (Mrs.)
County Director of Education
MIGORI COUNTY

APPENDIX 14: Authorization from Sub County Education Director



MINISTRY OF EDUCATION SCIENCE AND TECHNOLOGY

E-mail: awendodeo@yahoo.com

Sub County Education Office,
Awendo Sub County,
P.O Box 400-40405,
Sare – Awendo.

12th March, 2019

To,
Peter Ogwari
School of Education, Humanities and Social Science
University of Eastern Africa Baraton

Dear Peter,

RE: CLEARANCE LETTER FOR MASTER THESIS RESEARCH STUDY.

Your request for permission to carry out research on ***"Effect of Personalized learning on Mathematics performance in Secondary schools in Awendo Sub County, Kenya"*** has been granted approval.

This approval subsequently allows you to carry out the study within a period of one year starting 12th March 2019.

You will have to present this letter to the Principals of the involved school(s)/site before gathering the data.

We wish you success in your research.

Yours sincerely,

Yophes Magara
Sub County Director of Education
Awendo

APPENDIX 15: Curriculum Vitae

PETER OGWELA OGWARI

P.O.BOX 77 NDHIWA
Phone No: *0726-423 448*
E-mail: *kogwari@gmail.com*

Personal Information
Nationality: Kenyan
Date of Birth: 15th December 1976
Languages: English and Kiswahili
Gender: Male
ID No 20790427

Objectives

To develop my career as a teacher that leads to further growth in my professional skills and ability to enthusiastically work for the growth of an institution especially those that have a solemn devotion to promote human welfare. Concurrently strive to be a proactive leader, team player, team builder and to create a positive change in my society

Experience

Professional Development in Education
December2008 to date | **Ranen Adventist Sec School** **Migori**
Teacher of physics and mathematics
2016 to *2017* **| Kiriiria Sda, Meru**
Teacher of physics and mathematics
2005 to2006 Teacher, Makina secondary school, Nairobi
Teacher of physics and mathematics

Professional Qualifications

Registered teacher by TSC
2017 – University of Eastern Africa, Baraton, Kenya
Master of Education (Curriculum and Teaching). ongoing
2011-2012: Egerton University (Kisii University College)
Post Graduate Diploma in Education (Physics and Mathematics)
1998 – 2003: Moi University -
Eldoret
Bachelor of technology (textile engineering)
2nd Class (lower Division) Honors

Educational Background

1993-1996: Alfred alara mixed sec school
Homabay
Kenya Certificate of Secondary Education (KCSE)
1983-1990: **Miranga Primary School**, Homabay
Kenya Certificate of Primary Education (KCPE)

Leadership Experience

1. January 2018 up to date: **Director of Studies**
Responsibilities
The academic curriculum and academic life of the School

- To take responsibility for all teaching and learning within the school.
- To develop and implement the educational philosophy of the school and to promote a culture of best practice.
- To advise the principal and management on academic matters.
- To assist in the creation and maintenance of academic policies and to update accompanying handbooks, where they relate to the curriculum.
- To manage the school's curriculum plan.
- To keep the principal, and all staff, abreast of developments in education; to promote individual departmental initiatives where appropriate.
- To develop links, for the benefit of the school, with other educational organizations, including senior schools.
- To attend any senior management or Governors' meetings as required.
- To oversee the balance of co-curricular activities and trips off campus, logging all activities as appropriate.

Staff Management

- To lead and manage the Heads of Department; to encourage, support and challenge them to maintain and raise the already high academic standards.
- To monitor constantly staff performance and to be the first port of call for any teacher in need of advice or support.
- To chair Curriculum Committee meetings.
- To assist the Headmaster with the school's staff appraisal system.
- To assist in the arrangement and oversee all staff academic professional development.
- To assist the Headmaster with interviewing applicants for teaching posts and to advise on the appointment of staff.
- To assist and deliver parts of the staff INSET programme.

Timetable

- To the assist the Deputy Head with the timetable structure.

- To oversee the allocation of staff in consultation with the Headmaster/Deputy Head.
- To oversee the timetabling and administration of prep.

Administration

- To organize all school examinations, both internal and external, including Common Entrance.
- To oversee arrangements for external senior school Scholarship examinations.
- To oversee arrangements for setting and streaming throughout the school.
- To assist the Headmaster with pupil admissions policy and constantly to monitor and manage arrangements for entrance testing and assessment; to contribute to all entrance decisions
- To administer all pupil assessment, monitoring and tracking, including CAT testing and entries on the school's own academic recording systems.
- To prepare the pupils for senior school pre-tests.
- To liaise with the pupils' academic teachers and when necessary, with parents to monitor the progress of all pupils' within the school and to deal with any concerns.
- To advise, in conjunction with the Headmaster, pupils and parents on suitable senior school choices.

Health & Safety

- To comply with all health and safety procedures as required by the School.

Child Protection

- All staff share the responsibility for safeguarding and promoting the welfare of children and must adhere to, and comply with, the School's Child Protection and Welfare Policy.

2.Jan 2014 To Jan 2018: Principal Ranen Adventist Secondary School

Responsibilities

- Overall head of the institution.
- Chief accounting officer.
- Interpret and implement policy decisions.
- Secretary to the Board of Management.
- Planning, acquisition, development and maintaining physical facilities.
- Coordinate specific training activities
- Promote linkage between school and neighbouring communities and other organizations
- Promote welfare of all staff and students.

3. 2010-2013: Deputy Principal Ranen Adventist Secondary School

Responsibilities

- Working closely with the principal on a daily basis to ensure the smooth overall operation of the school.
- Supporting committees of staff and parents that function to improve the learning and social environment of the school for the students.
- Teaching classes and developing rapport with the students
- Resolving conflicts between students, teachers, parents or combinations of conflicts between various individuals.
- Assisting in annual teacher evaluations, assisting in providing guidance to staff and students, and encouraging a positive culture in the school.
- Developing emergency response plans for schools as required by education agencies.
- Record keeping as required through the use of various logs, tracking records, computer programs, inter or intranet software or other programs.

4. *2008-2010:* class teacher

Responsibilities

- Mmaintain a channel of communication between teachers and the school
- Aaccord student's opportunity for advice and necessary assistance.
- Mmarking and maintaining class register.
- Eensure report forms are properly and accurately completed before updating parents on the students' progress.
- Aassisting in preparation of school leaving certificates, testimonials and letters of recommendation in consultation with other relevant teachers.
- Gguiding students on study habits, checking their study timetables, assisting them set individual as well as class targets.

Honors

Academic awards

- Certificate of recognition for presenting a paper at Baraton interdisciplinary research conference 2018 version.
- Awarded certificate of participation at Baraton interdisciplinary research conference 2018 version.
- Awarded a certificate of academic excellence for outstanding performance in Kenya Certificate of Secondary Education teacher of physics-2012 by Rongo District,Awendo district(2011)
- Certificate of participation in teachers conference in Gahongo Adventist Academy,Muhanga Rwanda 2013 by seventh day Adventist church
- Certificate of participation in teachers' conference in kanga national school in 2013 by seventh day Adventist church
- Certificate of participation in teachers retreat in Kamagambo Adventist college in 2016 by seventh day Adventist church

Responsibilities

- Special delegate to the 60th session of the General Conference of Seventh Day Adventist church USA San Antonio Texas USA 2015.
- Member of Ranen Conference education board 2016-2017
- Commissioner Ranen Conference sub division into two conference 2014

Publication

- **Best Practices in Instructional Supervision: A Study of Adventist Secondary Schools in Ranen Conference**
- **Effect of Personalized Learning on Mathematics Performance among Secondary Schools in Awendo Sub-County, Kenya**

Interests

Volleyball. I have served as a volleyball coach taking the students to the county games.

Personal Qualities

I am a loyal, humble and dynamic resourceful professional with a genuine interest in education research and classroom teaching and learning. I have been actively involved in classroom teaching with a specialty in physics chemistry and mathematics. I am exceptionally energetic and enthusiastic teacher who projects a charisma that captures the imagination of students. I am a self – driven leader with excellent communication and interpersonal skills who effectively collaborates with all levels of staff members and fosters quality relationships with my clients. As a result, there is a strong level of trust, which allows me to provide direction in working towards realizing shared goals and objectives. I have a strong will and the ability to pick up workable ideas fast, implement and follow through to successful conclusion. I am computer literate, able to use Microsoft word & excel well.

Referees

1. **Prof. Elizabeth Mendoza-Role, PhD**
   Research and Statistics Consultant and Data Analyst
   Riverside, California
   Tel.: +1 (812) 223-6115
   Email: *bethrole@gmail.com*
2. **Pr. SAMWEL MOSOBA**
   Education director
   Ranen Conference
   TEL: *0729837927*
3. **Mr. GILLEARD LITHE**
   Principal Ranen Adventist Sec School, Kenya
   TEL: *0710396785*