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DEPARTMENT OF COMPUTING & INFOMATICS

An Investigation on the Effectiveness of Digital Content Factors on Learning Outcomes, Case for Primary Schools within Nairobi County.

By

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Research Project Report submitted in partial fulfillment of the requirements for the award of Masters of Science Degree in Information Technology Management of the University of Nairobi.

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DECLARATION

This project is a representation of my original work and research. To the best of my knowledge, this research work has not been submitted to any University for any academic award.

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This research has been submitted for examination with my approval as the University supervisor.

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ACKNOLEDGMENT

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ABSTRACT

Learning institutions in Kenya are slowly embracing Digital Learning and incorporating various digitally-designed content to their learning experience. The launch of Competency Based Curriculum (CBC) by the National government has put more emphasis on building learners skills. Integrating digitally-designed content in learning is a key pillar in the CBC.

The aim of this study was to investigate how effective are digital content factors in achieving positive learning outcomes in primary schools. Understanding the effectiveness of the various digital content factors in learning outcomes among primary schools will form a basis in putting in place measures and policies for full integration. The study focused on schools within Nairobi County who have already established computer-based learning, either fully or partially. The research was a case of three primary schools within the Nairobi County. It focused on understanding the level of pupils' interaction with various digital devices in learning and whether such interaction had effect on their overall learning experience. Data collection was done using questionnaires composed on Likert scale where a total of 144 grade four pupils across the three selected schools participated.

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CHAPTER ONE

INTRODUCTION

1.1 Background

According to Boisselle (2016) both developing and developed countries have realized sustainable development with Education playing a major role. The significance of Education has by a great deal been outlaid by the desire of developing countries to be at par with their developed counterparts (Boisselle, 2016). Boisselle, 2016 further argued that developing countries have sought to address some hinderances in education for instance by providing compulsory and free education. This is aimed to foster general access to education. The United Nations (UN) has already committed the right of obligatory and free education for everyone (*Article 26 of the 1948 UN universal declaration of human rights*).

Internet connectivity and its access thereof has been on increasing trend across the world on year-to-year basis. Citizens from any part of the globe are more than ever before kept abreast to what's happen across the world. With the connectivity, different opportunities have risen thus multiple success stories for individuals. There is great improvement in Information and Communication Technology (ICT) implementation in education in Africa (Alcardo et al., 2019). Kenya like many other developing countries has defined a national ICT policy. The policy's mission is to improve its citizens' sustenance. This is to be achieved by ease access to ICT services in an efficient, reliable, and affordable manner. As technology is changing how the world operates, similar change is being experienced in learning and teaching environment. ICT policy has been embedded to various learning and teaching approaches. Common of these approached include electronic learning (e-learning), blended learning and distance learning. Through distance learning approach, learners and teachers can remotely conduct learning more or less similar to the traditional/physical approach. This has been greatly embraced during the COVID-19 pandemic where students from primary to universities across the country have undertaken their studies online (Mahona & Demetria, 2020).

1.1.1 Digital Content Factors

Three major perspectives exist for basic content factors. These three perspectives are environmental, educational, and architectural. Student characteristics which can be developed/natured are appraised and clustered to form affective, behavioral, and cognitive learning categories. Each of the resulting categories is then matched with learning goals and activities. From the defined learning goals and activities, stakeholders then evaluate, design, and recommend appropriate support systems that match the learning goals.

While building support systems for schools, there are two primary considerations, functional and structural designs. All happenings in the educational program (the total curriculum) center around the functional design aspect. Similarity, the program component is 'facilitated' by the structural design (natural and the environments). Both built and natural environments support student learning. Design should be considered in terms of 'what, why, and how,' and the philosophy, objectives, and processes that exist in the educational scheme (Hwan-Hee *et al*., 2014).

1.1.2 Learning Outcomes in Primary Schools

Learning outcomes in primary schools aims at enabling the child to live a full life as a child while realizing their own capability uniquely. Additionally, it seeks to attain development of a social being able to live and cooperate with others for the good of the society and to prepare the child for further education and lifelong learning.

1.2 Problem Statement

According to Reeves (2008) in his article, *'Evaluating what really matters in computer-based education'*, several aspects may impact computer-based education (CBE). First, Teachers, pupils and parents who are the consumers of this technology carry the assumption that various technological innovations are effective just as advertised. However, little if any research exists in support to this assumption. Secondly, assessment is statistically done where technology readiness is measured in terms of; the investment done on computing components, the ratio of users/pupils to technology devices and the technology access durations by the students daily, weekly, monthly, or even annually. The transfer of content from teacher to pupils and vice versa has always been overlooked. The design of content factors for delivery of the content largely contributes to determining the readiness, acceptance, and adoption levels.

This research proposes to evaluate the effectiveness of computer-enabled learning by establishing how digital content factors impact on the outcomes of learning in Primary schools. The research will focus on primary schools within Nairobi County, where internet penetration is high thus giving more conclusive results with higher level of accuracy.

1.3 Objectives

This study has primary and secondary objectives.

1.3.1 Primary objective

The overall objective for the research will be to establish how effective are digital content factors and organizational support in improving learning outcomes in primary schools.

1.3.2 Secondary Objectives

i. Explore the impact of different digitally enabled delivery modes on learning outcomes in primary schools.
ii. Identify how various organizational ICT policies and resources impact learning outcomes in primary schools.
iii. Investigate on the relationship between content quality and learning outcomes in primary schools.
iv. Establish how different context setups impacts learning outcomes.

1.4 Research Questions

This research intends to examine the following.

i. Which are the digitally designed content factors used by learners in Primary Schools?
ii. The expected outcomes for learners in primary Schools?
iii. How are the identified learning outcomes measured during/after each lesson and over a period?
iv. How different ICT policies and organizational resources facilitate learning in primary schools?

1.5 Significance of the Research

This study information will be crucial to education stakeholders in establishing whether computer-based learning should be fully on boarded to improve learning outcomes. The government can use the results of the research to put in place measures to facilitate e-learning across the country such as partnering with different entities to grow internet connectivity across the country and fast-tracking installation of computer facilities across schools. To the teachers, this will serve to determine the most appropriate digital content approaches to use for better learning outcomes.

In academics, the proposed research will add to the existing writings in the space of E-leaning. Precisely, the study findings will impact on of quality education within E-learning. Besides, the study will be a basis for further research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter reviewed various writings and information correlated and in tune with the identified study- objectives. The major issues and practical obstacles were highlighted and evaluated in depth to establish the current situation. The chapter was vital in determining the information that links the research with past studies and what future studies would need to embark on in realization of improved knowledge.

Studies on content design factors for impacting knowledge in primary schools lead to the reasoning behind the model being explored. As an effect/investigative study, employing a conceptual framework is important to show relationship between the different study variables.

The research model is borrowed from a study on Information and Communications Technology (ICT) effect gauging in learners and teachers' interactions within higher education (Adedokun-Shittu, 2012). The research is on ICT related content design factors investigation. Information and communications technology (ICT) is defined as the various technologies within telecommunications and broadcasting media, management systems for establishing intelligent, the various systems which process and transmit audiovisuals, and network-based control and monitoring functions.

2.2 Content design Factors

Gráinne & Sandra. W (2013) defined Content Designs as pedagogically informed learning activities which make effective use of appropriate tools and resources. Content design factors guide on how information is structured to ensure ease in delivery, understanding and uptake. Some of the main content design factors to be captured in this research include; instructive (teacher as the only active member) verses constructivism (more learning for learners), teacher centered verses student centered, multi – modal (a mix of audio, visual and diagrams) verses single- modal, sequential (theory then practice) verses non-sequential (theory and practices all in one), access to extra learning materials and remedial work (repeat lessons).

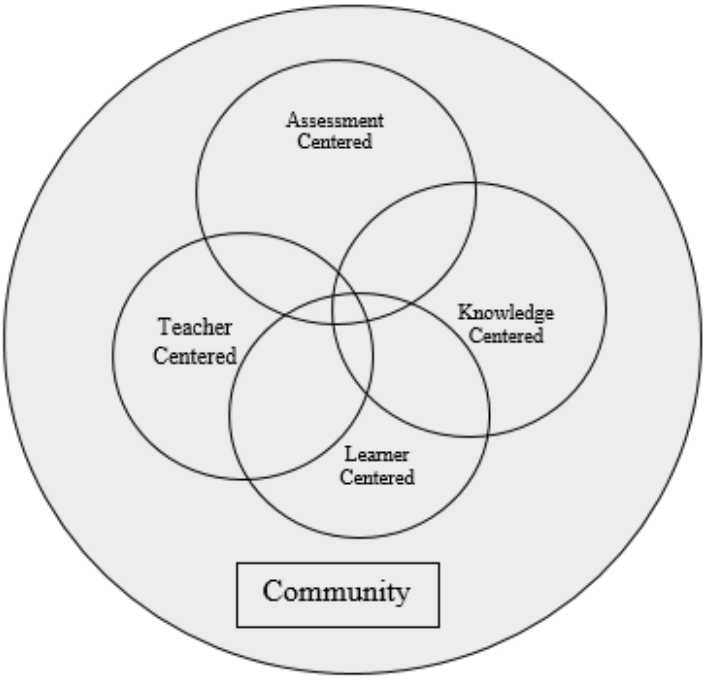

Figure 1: Content Design

2.3 Learning outcomes

Learning outcomes are assertions describing the remarkable and crucial training achieved by learners as demonstrated at the end of a course or program. Therefore, these learning results identifies the learner's ability regarding what has been taught by the end of a lesson and at large the learning journey. The outcomes allow educators to come up with effective programs to gauge progressive learning, and enhance learning experiences (Rienties *et al*., 2013). The learning demonstration will include some level of performance to show learning significance. Though it is essential to have significant content, this alone is not sufficient as content knowledge must be manifested through a sort of demonstration process. Such process may include ability to solve mathematical problems, write and pronounce words and correctly identify different geographical features.

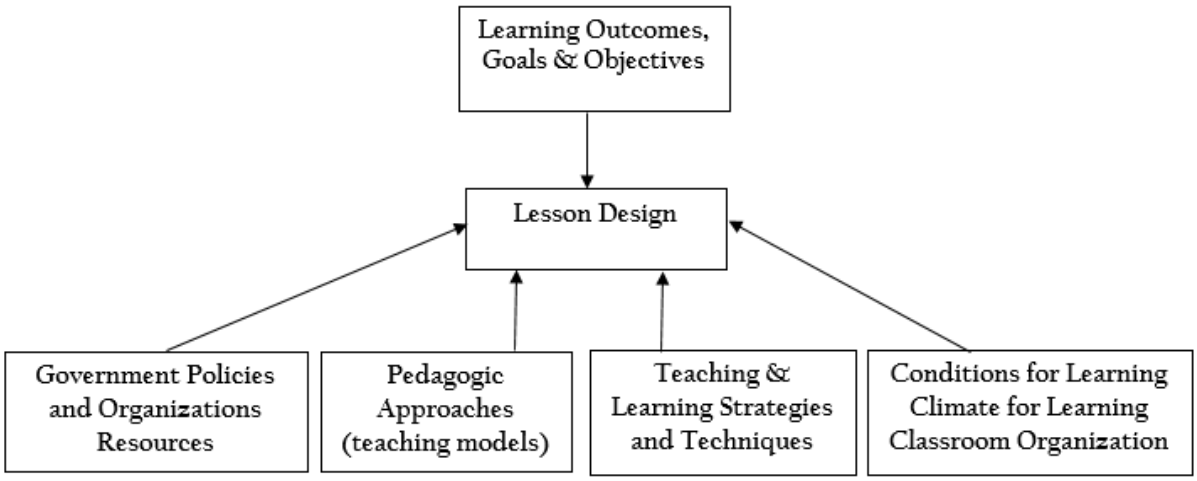

Figure 2: Factors Affecting Lesson Design

The lesson's learning objectives comes from the work scheme. After defining the learning objectives, the intended learning outcomes are be outlined. What will learning produce by the end of learning or sequence of lessons to demonstrate that learning took place – for instance ability to pronounce words, a piece of writing, ability to solve a mathematical problem. It is therefore necessary from the outset to define what a good-quality product will look like to help clarify expectations with learners.

The Kenyan government in 2013 announced a plan to integrate ICT in learning through a laptop project to class one pupils in all public primary schools. According to then Education Cabinet secretary Professor Jacob Kaimenyi, the project was to help in transforming education and address challenges of access, equity, quality, and relevance within the education system. Investigation includes systematically picking out both positive and negative effects, intended or not – on individuals, families, organizations, and the surrounding as caused by an identified development activity. In this study, investigation is the impact digital content design factors has on learning outcomes and experiences for primary school education.

2.4 Related Work

The related work part of the study evaluates various available writings on the highlighted aspects related content design factors and their effect on primary school learning outcomes with key interest on the impending E-learning roll out program within primary schools by the Kenyan government.

The formal content design structure requires tutors relay feedback to learners as teaching goes on (teacher centered approach). The relaying of knowledge should therefore be of very high accuracy delivered in accustomed form aligned to the goals superscribed in the learning curriculum. Audette & Roush (2013) used Context, Input, Process and Product (CIPP) evaluation model where teacher disseminates knowledge to students through depository format as inputs, processed though interactions and product realized in terms of learning outcomes such as performance in exams, ability to read and write, solving mathematics problems and general understanding of situations. A notable shortcoming of the teacher centered approach is that it may lead to rigid, standardized ways of managing learners' disquiet (Audette & Roush, 2013). The CIPP evaluation model part of product therefore could not be realized because of the rigidity and standardized way of learners' management. The learners will become irresponsive to further content thus not realizing the desired learning outcomes.

The student-centered style is concerned with learners' capacity to learn independently. These learners are the drivers of learning from suggestions, questions, and research. They are therefore encouraged to carry out tasks independently and the teacher only acts as an aid in the learning set up. A key benefit to this approach is that students are trained to become self-reliant and self-supporting. Shaari *et al*., (2014) employed Kirkpatrick four-level model in their study. The students are in control of the class; there reactions form the learning process. Transfer evaluation quizzes to establish whether a learner uses the recently onboarded skills, knowledge, or attitude in everyday environment. This stage therefore presents the best way in assessing program's effectiveness. The impossibility in detecting when change in behavior will occur is a challenge necessitating crucial resolutions regarding to evaluation sequence and how it's to be undertaken. The negative side of this approach is when teachers pre-assume learners' ability to work autonomously and some learners' anxiety when allowed to work independently. The Kirkpatrick four-level evaluation model does not therefore provide for remedies to the assumption if they are not true. The model's plan is of successive nature where an assessment level is built on information

provided by its predecessor and does not cater for a situation where the lower level does not achieve the desired results.

Instructive and constructive are the remarkable prepositions and applications on pedagogy today which still hinge on the works of earlier philosophy on knowledge sharing and transfer (International Journal of Advanced Computer Science and Applications, 2013). Instructive incorporates an instructor-directed, keenly articulated curriculum, where purpose-based teaching is essential. This approach holds the assumption the main reason for instructive approach is to help the student. It further presumes that teachers, here by instructors should guide the team while deciding on the components and frequency of the learning (Margules, 2012). Margules (2012) used CIPP evaluation approach where the instructor is the source of input; the directing serves the evaluation stage and students acquired knowledge to be product. However, with the increased uptake of technology among the young people, instuctivist approach is hardly effective as the learning sessions will turn to be boring with learning having to listen all through.

Constructivism class is the direct opposite of instructive. The focus shifts from the 'know-all-teacher' as the learners get actively involved in the own process of learning. In this approach knowledge is a dynamic, ever-changing view of the world.

The approach assumes that what the learner believes, whether correct or incorrect, is important and learning is an active rather than passive process highly depended on students taking responsibility to teach (Jordan, Carlile & Stack, 2018). This is a student-centered approach which employs Kirkpatrick's model where assessment levels are successive in relation to information being consumed. The flip side of this approach is that failure of learners to take responsibility to learn will mean no learning tool place. Also, the assumption that what learners believe whether correct or incorrect is important is conflicting and misguiding as incorrect information cannot be important.

Sequential learning entails the class going through the theory part and later practice. This can be either teacher centered, or student centered. In sequential learning, identifying solutions to problems is done in a systematic approach. A resemblance to writing a computer program - clearly laid out steps depending on each other. By engaging the instructor to close any gaps and organizing class contents logically, learners can achieve desired outcomes. Additionally, learners can help themselves by trying to establish connection between the subject material to a known topic. This study used Kirkpatrick four-level model of evaluation. Learning is a continuous process where

information from a lower evaluation level builds the successive level. A critique to this model for the study is that a challenge will arise when the learner does not under grasp the theory part.

The successive level which is practical part will be difficult to implement or wrong implemented all together. This will result evaluation level will therefore be undesired or unsatisfactory learning outcomes.

Non –sequential content design factor entails both theory and practice being handled concurrently in a learning set up. This is a more of practical approach, but the learner will have a theoretical knowledge of the subject matter (Graf, Kinshuk & Fuhua 2011). In this journal, CIPP evaluation model is used as the research framework. Learners constantly consult the teacher/instructor in trying to get a big picture to understand. Learning by combining both theory and practice at ago is aimed at making the learner understand the subject matter more quickly. Using this model, a standoff will be realized if the learner is totally unable to capture the big picture of the situation to understand. The goal of attaining desired learning outcomes will not have been met.

Multi-modal content design factors believes that the more non-identical approaches one uses to grasp a subject the more they understand it, additionally the more they will recollect it (Ganapathy. & Seetharam, 2016). Three common content design ways at the helm of formal education and learning in schools include reading, writing and arithmetic. Ganapathy & Seetharam (2016) used the Kirkpatrick four-level evaluation model to evaluate how learning is achieved through sequentially following the four steps of evaluation. The flip side of this model in a multi-modal content design structure is when the learner cannot clearly identify one mode which will effectively transform the reactions into the desirable results here in the learning outcomes.

2.5 Conceptual Framework

The researcher considered Guskey's Evaluation Framework in developing a conceptual framework to investigate the effectiveness of digital content design factors in primary school learning. Functional professional progress rating needs the combination and scanning of the five critical levels of information (Guskey, 2000). The various components of digital content design factors; delivery modes, quality of content and context setup together with organizational support (relevant ICT policies and resources) enable professional development while determining learning outcomes.

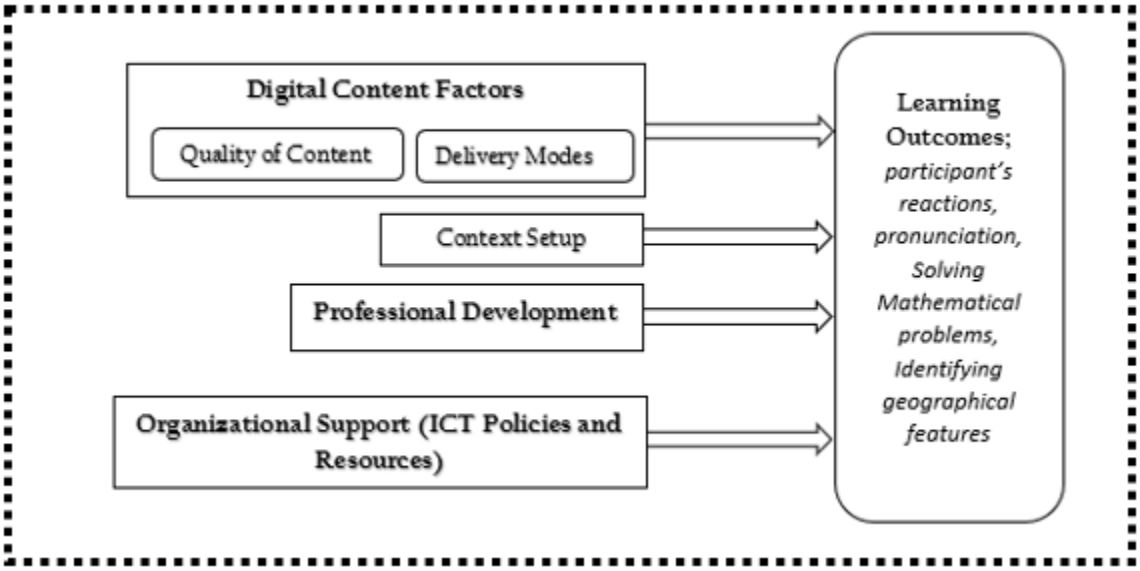

Figure 3: Conceptual Framework

2.6 Operationalization of the Research Variables

In this study, the researcher will explain the various components of Guskey's Evaluation Framework and how they have been integrated to the research.

Variable	Explanation	Operational definition
Professional Development	Relevant training and education towards realizing the desired learning outcomes.	How learners responded to different designs of content throughout the learning sessions. Did the learners feel time was well spend in implementing the content designs and teaching techniques? Was the delivery mode making sense in line to achieve the desired outcomes? To what extent were the digital devices help in learning? Was the teacher knowledgeable enough in delivery of content?
Digital Content Factors	How delivery mode (use of videos, audio, graphics) and quality of content (structured or unstructured) impact learning outcomes.	How effective the delivery mode was? Did learners seem to like it, did they participate during the learning sessions. Was the content quality helpful towards achieving desired learning outcomes, was it aligned to these outcomes? How the organization of the context facilitated achieving desired outcomes.
Context Setup	The ratio of digital devices per pupil, how often pupils use digital devices in learning	Where the available digital devices enough for the students? Did the pupils have enough time to interact with the devices?
Organizational Support (ICT policies and	The various initiatives aimed at facilitating use of	Include supportive and relevant policies and resources by the government/school to ensure

available resources).	digitally designed content for learning.	the content is designed in the best way possible to achieve desired learning outcomes. Such policies and resources can be reviewed periodically to best achieve the desired learning outcomes.
Learning outcomes	Improvement in student learning	Results of the process. Anticipated outcomes in each lesson, subject, and overall performance Unexpected outcomes which had not been thought off earlier.

Table 1: Research Variables Operationalization

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology explains the approach employed to attain information about the problem to be addressed by the study. Contents of the research methodology discussed included design of the study, research population with its sample size, sampling design and procedure, how data was collected and variables measurement.

3.2 Research Philosophy

Research philosophy is a belief in manner on how data collection about a phenomenon should be done, analyzed, and consumed (Abbott & McKinney, 2012). The researcher used interpretivist research philosophy. This study sought to establish how learners' perceptions will be influenced by experience obtained through learning process. The study also depicted how knowledge can be gained through class discussion, learning, watching videos & listening audios.

3.3 Research design

According to Abbott & McKinney (2012) a research design is a plan, layout, and blueprint of exploration aimed at arriving responses to research questions and control variance. The study's main objective was to establish the effectiveness of digital content factors in improving learning outcomes in primary schools. The researcher employed quantitative design (pure research) using questionnaires and Focus group discussion with as means of collecting information. This enabled quantification of used digital design factors to describe how they impact learning outcomes and later ascertain how introduction of aids in traditional learning (computers and tablets) effected the learning outcomes from the level of user interaction.

3.4 Study Population Sample

The population for the research was made of grade four pupils – who form the upper primary class in the Competency Based Curriculum (CBC) from various selected schools within Nairobi County. The researcher targeted the pupils, the schools' heads and teachers who guide the students in learning and evaluating the learning outcomes at the end of lesson, term and year. Being in the learning environment, the researcher targeted these respondents as they directly interact with

the research study variables; design factors and learning outcomes. Although the Competency based Curriculum requires after each topic pupils undertake a task on a digital device, many primary schools lack relevant infrastructure (tablets or computers) to actualize this requirement. This therefore leaves teachers with the only option of requesting the pupils to seek assistance from parents/guardians to accomplish the digital task.

3.5 Sample Size and Sampling Procedure

A sample is a small-scale composition derived from the accessible population keenly chosen to form a representation of the larger population while retaining the relevant characteristics (Anokye, 2020). Anokye (2020) further defines sampling as a systematically defined approach of obtaining a small group from a populace to help on the research. A sampling scheme is made of the unit, frame, procedures, and the size for the study. It is on the sampling frame where the list of all population units from which the sample was selected is described (Abbott & McKinney, 2012). Confidence level and error margin are key considerations when determining a sample size.

Cluster sampling was user to select the population sample. A multistage sampling cluster was used to narrow down the population to smaller clusters. With Nairobi County having the highest number of primary schools within the country, the researcher grouped the schools into two clusters; public schools (national and county governments sponsored) and private schools (Individual and church sponsored). Each of the two clusters where further grouped as per two broader locations: those either to the East or West of Nairobi Central Business District (CBD). Partitioning on these broader locations was done using the main highway feeding CBD – Mombasa Road/Uhuru highway/Waiyaki Way. Further the researcher only considered schools which had on boarded computer-based learning. Such schools either had a fully operational computer lab where pupils attained computer lessons or had tablets which facilitated learning. In this case referral sampling was used where from one school the researcher got referred to another school with the similar infrastructure. The researcher selected a total of three primary schools as the sample size. Those to the East of CBD where Tassia Catholic Primary school in Embakasi East sub-county (private school) and Roysambu Primary School (Public school) in Roysambu sub-county. To the west of CBD, the researcher selected Greenwood Academy Primary School (private school) in Dagoretti North sub-county.

3.6 Data Collection

Questionnaires and focus group discussions where the main instruments used to collect primary data. On secondary data collection, reviews of relevant documents such as pupils' performance reports over different periods (week, term, and year) and observation of pupils' interaction and responses in class sessions was done.

The study used structured questionnaires designed for the pupils to complete to collect data. To attain maximum respondents' participation and achieve response uniformity the questionnaires were kept short and straight to the point. The respondents were only required to mark their level of agreement/dis-agreement with the aspect in the question. An option to take a neutral position in any question was as well provided.

The researcher's inclination to use of questionnaires for data collection was because of the participants direct interaction with the study variables thus giving them precise understanding of each of the variables. Anokye (2020) submitted that questionnaires are effective instruments' to obtaining in depth information about a population under study.

A questionnaire had three (3) sections aimed at exhausting all required data. Section A: General Knowledge and usage aimed at establishing the extent on usage of digital devices in learning/teaching by the respondent. Section B –covered learning/teaching techniques. This listed the different techniques from which various content design factors are derived. The level of achieving desired learning outcomes amongst each technique was established. Section C covered Overall response. This sought to ascertain how the population felt on integrating ICT in teaching/learning. Each question had a five level Likert scale with weights between 1 and 5. This enabled the respondents appraise their level of agreement or disagreement. While weight 5 meant strongly agree the same gradually shifted to strongly disagree at weight 1. Neutral was at the middle for weight 3. The filled questionnaires were checked to affirm data completeness, ciphered and captured into Microsoft Excel and IBM SPSS for analysis. Descriptive statistics used included tables, frequencies, weighted mean, and percentages.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Analysis

4.1.1 Response rate

In total, one hundred and forty-four (144) pupils completed the questionnaires which was a 100 percent response rate. Seven teachers participated in the focus group discussion.

4.1.2 Demographic data

The correspondents were in grade four within the same age group ranging from 10 years to 13 years. Their gender composition was seventy-eight (78) boys and sixty-six (66) girls.

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	78	54.2	54.2	54.2
	Female	66	45.8	45.8	100.0
	Total	144	100.0	100.0	

Table 2: Demographic Data

4.1.3 Descriptive Statistics

The following sections summarizes main results which are organized into two categories based on our variables

	N	Mean
I use computer at home	144	3.17
I use computer when guided	144	2.69
I use computer without any guidance	144	3.03
I use computer in each lesson	144	3.72
I use computer only during the computer lesson	143	2.43
Students participate in deciding on what to be done in each lesson	144	3.42
I like reading only pictures on the computer	142	2.20
I like reading diagrams, charts and pictures on the computer	144	3.61
I like watching only video and audio on the computer	143	2.62
I like reading only text-based notes on the computer	144	3.30
The teacher takes pupils through class work then gives practices and exercise after	144	3.62

The teacher gives exercises while still taking students through class work	142	2.54
I get other learning materials apart from what is in the computer for learning e.g., books, charts	143	2.45
I have learnt to pronounce words using the computer	143	3.23
I have learnt to write words using the computer	143	3.22
I have learnt to read words using the computer	143	1.94
I solve mathematical exercises with the computer	144	3.64
I understand everything when the teacher is in class	144	2.68
The teacher repeats previous lessons for pupils to understand better	144	2.97
I repeat what the teacher has taught in class during my free time to understand better	142	2.65
With the computer I can read and understand on my own	144	3.01
The teacher tells us when to use the computer	143	2.48
Narrative text that gives stories	142	2.85
Notes that contain pictures, charts, tables	144	3.40
Videos and audio (sound)	144	2.40
English	144	2.55
Mathematics	143	3.27
Kiswahili	144	2.16
Computer Lesson	142	2.70
Social Science	142	2.96

Table 3: Descriptive Statistics

4.1.3.1 Usage of Computers Analysis

i. I use computer at Home

Almost half of the participants (45.1%) agreed to use computer at home. This shows high computer usage among primary pupils which points towards large exposure to digital content.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	49	34.0	34.0	34.0
	Agree	16	11.1	11.1	45.1
	Neutral	5	3.5	3.5	48.6
	Disagree	9	6.3	6.3	54.9
	Strongly Disagree	65	45.1	45.1	100.0
	Total	144	100.0	100.0	

Table 4: Use Computers at Home

ii. I use computer without guidance

Almost the same number as those who use computers at home (44.4%) agreed to us without any guidance. This shows the pupils have gained on their own enough experience to undertake the basic operations of a computer.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	38	26.4	26.4	26.4
	Agree	26	18.1	18.1	44.4
	Neutral	6	4.2	4.2	48.6
	Disagree	42	29.2	29.2	77.8
	Strongly Disagree	32	22.2	22.2	100.0
	Total	144	100.0	100.0	

Table 5: I use computer without guidance

iii. I use computer only during the computer lesson

From the data analyzed, two-thirds of the respondents only used computer during computer lessons. This shows however the schools have on boarded digitally designed content factors, such content factors where mostly consumed during the computer lesson.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	47	32.6	32.9	32.9
	Agree	47	32.6	32.9	65.7
	Neutral	9	6.3	6.3	72.0
	Disagree	20	13.9	14.0	86.0
	Strongly Disagree	20	13.9	14.0	100.0
	Total	143	99.3	100.0	
Missing	System	1	.7		
Total		144	100.0		

Table 6: I use computer only during the computer lesson

iv. With the computer I can read and understand on my own

An encouraging number of up to 51.4% of the respondents were in agreement that they can read and understand using the computer on their own. This could easily translate to the number of pupils who acknowledged to have used computers at home.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	37	25.7	25.7	25.7
	Agree	37	25.7	25.7	51.4
	Disagree	27	18.8	18.8	70.1
	Strongly Disagree	43	29.9	29.9	100.0
	Total	144	100.0	100.0	

Table 7: With the computer I can read and understand on my own

4.1.3.2 Digital Content Factors

i. I like reading only pictures on the computer

On how the students used computers, much usage was of graphical in nature. 73.9% of the respondents acknowledged only to use the computer for pictures. In this, 43% strongly agreed while 31% agreed.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	61	42.4	43.0	43.0
	Agree	44	30.6	31.0	73.9
	Neutral	5	3.5	3.5	77.5
	Disagree	11	7.6	7.7	85.2
	Strongly Disagree	21	14.6	14.8	100.0
	Total	142	98.6	100.0	
Missing	System	2	1.4		
Total		144	100.0		

Table 8: I like reading only pictures on the computer

ii. I like watching audio-visual content on the computer

From the response received, pupils mostly preferred audio-visual content factors. Large number of the respondents (60.1%) agreed to like watching audio-visual content from the computers.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	37	25.7	25.9	25.9
	Agree	49	34.0	34.3	60.1
	Neutral	4	2.8	2.8	62.9
	Disagree	37	25.7	25.9	88.8
	Strongly Disagree	16	11.1	11.2	100.0
	Total	143	99.3	100.0	
Missing	System	1	.7		
Total		144	100.0		

Table 9: I like watching audio-visual content on the computer

iii. I like reading only text-based notes on the computer

Text based content wasn't much popular among the respondents. Only 32.6% agreed to like reading text from the computer. However, more than the same number (38.9%) remained neutral which could be translated as somehow keen though not already practicing. With more efforts and encouragement, this number to be tilted to like reading.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	28	19.4	19.4	19.4
	Agree	19	13.2	13.2	32.6
	Neutral	9	6.3	6.3	38.9
	Disagree	58	40.3	40.3	79.2
	Strongly Disagree	30	20.8	20.8	100.0
	Total	144	100.0	100.0	

Table 10: I like reading only text-based notes on the computer

4.1.3.3 Mode of Teaching

i. Exercise during Lesson

Slightly more than half of the respondents (50.7%) indicated that the teacher gives exercise during the class lesson. This implied learning and measuring of learning outcomes took place in course of the lesson. Two pupils didn't respond to this question.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	48	33.3	33.8	33.8
	Agree	24	16.7	16.9	50.7
	Neutral	24	16.7	16.9	67.6
	Disagree	37	25.7	26.1	93.7
	Strongly Disagree	9	6.3	6.3	100.0
	Total	142	98.6	100.0	
Missing	System	2	1.4		
Total		144	100.0		

Table 11: Exercise during Lesson

ii. Learning Materials

Despite the presence of computers in learning, pupils still relied on books, charts and other materials for learning. Almost 75% of the respondents agreed to use either books or charts for learning apart from what was in the computer.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly agree	40	27.8	28.0	28.0
	Agree	46	31.9	32.2	60.1
	Neutral	21	14.6	14.7	74.8
	Disagree	24	16.7	16.8	91.6
	Strongly Disagree	12	8.3	8.4	100.0
	Total	143	99.3	100.0	
Missing	System	1	.7		
Total		144	100.0		

Table 12: Extra Learning Materials

4.1.3.4 Learning Outcomes

i. I have learnt to read words using the computer

Learners' ability to read is a key learning outcome. The learner is perceived to have gained when their ability to read after a leaning session or lesson improves. From the respondents, 84.6% agreed to have learnt reading words using the computer. This is an encouraging statistic as it depicts the effectiveness of digital-designed content factors in positively impacting on learning outcomes amongst the learners.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	49	34.0	34.3	34.3
	Agree	72	50.0	50.3	84.6
	Neutral	5	3.5	3.5	88.1
	Disagree	15	10.4	10.5	98.6
	Strongly Disagree	2	1.4	1.4	100.0
	Total	143	99.3	100.0	
Missing	System	1	.7		
Total		144	100.0		

Table 13: Reading Words

ii. I have learnt to write words using the computer

Though little relationship derived between ability to write and use of computer, 41.3% percent of the respondents acknowledged to have learnt to write using the computer. This question had one missing response.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	30	20.8	21.0	21.0
	Agree	29	20.1	20.3	41.3
	Disagree	47	32.6	32.9	74.1
	Strongly Disagree	37	25.7	25.9	100.0
	Total	143	99.3	100.0	
Missing	System	1	.7		
Total		144	100.0		

Table 14: Writing Words

iii. I solve mathematical exercises using the computer

The question was majorly targeting those who use computer during all their lessons. As earlier noted, 72% of the respondents used computer only during the computer lesson. For those who use computer in all lessons, 20.1% agreed to be able to solve mathematical problems with the aid of the computer.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	15	10.4	10.4	10.4
	Agree	14	9.7	9.7	20.1
	Neutral	21	14.6	14.6	34.7
	Disagree	52	36.1	36.1	70.8
	Strongly Disagree	42	29.2	29.2	100.0
	Total	144	100.0	100.0	

Table 15: Solving Mathematical Problems

4.1.3.5 Repeating Lessons

i. I understand everything when the teacher is in class

The respondents were asked on their level of understanding content being taught during each lesson. From this, 61.1% agreed to fully understand during lesson. This was meant to measure the effectiveness of delivery modes used.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	49	34.0	34.0	34.0
	Agree	39	27.1	27.1	61.1
	Disagree	21	14.6	14.6	75.7
	Strongly Disagree	35	24.3	24.3	100.0
	Total	144	100.0	100.0	

Table 16: Understand During Lesson

ii. I repeat what teacher has taught to understand

More than half of the respondents acknowledged to repeat learned lesson during their free time to understand. This implied the need to use different modes of content delivery. Two respondents returned null to this question.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	28	19.4	19.7	19.7
	Agree	51	35.4	35.9	55.6
	Neutral	10	6.9	7.0	62.7
	Disagree	48	33.3	33.8	96.5
	Strongly Disagree	5	3.5	3.5	100.0
	Total	142	98.6	100.0	
Missing	System	2	1.4		
Total		144	100.0		

Table 17: Revise After Lesson

iii. The teacher repeats what was taught in previous lesson.

Among the respondents, the need for the teacher to summarize the previous lesson before starting any new lesson was key for then to understand. The respondents had 43.8% agreeing to this question.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	38	26.4	26.4	26.4
	Agree	25	17.4	17.4	43.8
	Disagree	65	45.1	45.1	88.9
	Strongly Disagree	16	11.1	11.1	100.0
	Total	144	100.0	100.0	

Table 18: Teacher Summarizes Previous Lesson

4.2 T-Test

A T -Test analysis was done for the data. Use of computers at home was mapped as the basic variable which guided on other variables. The tested variables representing digital content factors were reading diagrams, charts, and pictures, reading pictures only, watching videos only and reading text-based content.

4.2.1 Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	I use computer at home	3.17	144	1.826	.152
	I like reading diagrams, charts, and pictures on the computer	3.61	144	1.626	.136
Pair 2	I use computer at home	3.15	142	1.826	.153
	I like reading only pictures on the computer	2.20	142	1.442	.121
Pair 3	I use computer at home	3.16	143	1.826	.153
	I like watching only video and audio on the computer	2.62	143	1.398	.117
Pair 4	I use computer at home	3.17	144	1.826	.152
	I like reading only text-based notes on the computer	3.30	144	1.439	.120

Table 19: Paired Sample Statistics

4.2.2 Paired Samples Correlations

A paired sample correlation was done for the selected variables.

		N	Correlation	Sig.
Pair 1	I use computer at home & I like reading diagrams, charts and pictures on the computer	144	-.158	.058
Pair 2	I use computer at home & I like reading only pictures on the computer	142	-.090	.288
Pair 3	I use computer at home & I like watching only video and audio on the computer	143	-.097	.247
Pair 4	I use computer at home & I like reading only text-based notes on the computer	144	-.070	.402

Table 20: Paired Sample Correlation

4.2.3 Paired Samples Test

The below tabulation is the outcome of the Paired Sample T-Test.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	I use computer at home – I like reading diagrams, charts and pictures on the computer	-.438	2.630	.219	-.871	-.004	-1.996	143	.048
Pair 2	I use computer at home – I like reading only pictures on the computer	.944	2.426	.204	.541	1.346	4.636	141	.000
Pair 3	I use computer at home – I like watching only video and audio on the computer	.538	2.405	.201	.141	.936	2.677	142	.008
Pair 4	I use computer at home – I like reading only text-based notes on the computer	-.125	2.403	.200	-.521	.271	-.624	143	.533

Table 21: Paired Samples Test

4.3 Correlations

The researcher analyzes the correlation between selected variables. Use of computers was correlated against learning outcomes measured by ability to pronounce and read words, ability to write and ability to solve mathematical problems.

		I use computer at home	I have learnt to pronounce words using the computer	I have learnt to write words using the computer	I have learnt to read words using the computer	I solve mathematical exercises with the computer
I use computer at home	Pearson Correlation	1	.162	-.018	-.038	.012
	Sig. (2-tailed)		.053	.834	.651	.886
	N	144	143	143	143	144
I have learnt to pronounce words using the computer	Pearson Correlation	.162	1	-.316**	.162	.338**
	Sig. (2-tailed)	.053		.000	.054	.000
	N	143	143	143	142	143
I have learnt to write words using the computer	Pearson Correlation	-.018	-.316**	1	-.544**	.036
	Sig. (2-tailed)	.834	.000		.000	.666
	N	143	143	143	142	143
I have learnt to read words using the computer	Pearson Correlation	-.038	.162	-.544**	1	-.131
	Sig. (2-tailed)	.651	.054	.000		.118
	N	143	142	142	143	143
I solve mathematical exercises with the computer	Pearson Correlation	.012	.338**	.036	-.131	1
	Sig. (2-tailed)	.886	.000	.666	.118	
	N	144	143	143	143	144

**. Correlation is significant at the 0.01 level (2-tailed).

Table 22: Correlations

4.4 Histogram of Regression for Dependent Variables

4.4.1 I have learnt to write words using Computer

This variable measured the ability of pupils to write words using the computer. Majority of the respondents agreed to have learnt writing words which was one of the learning outcomes being measured.

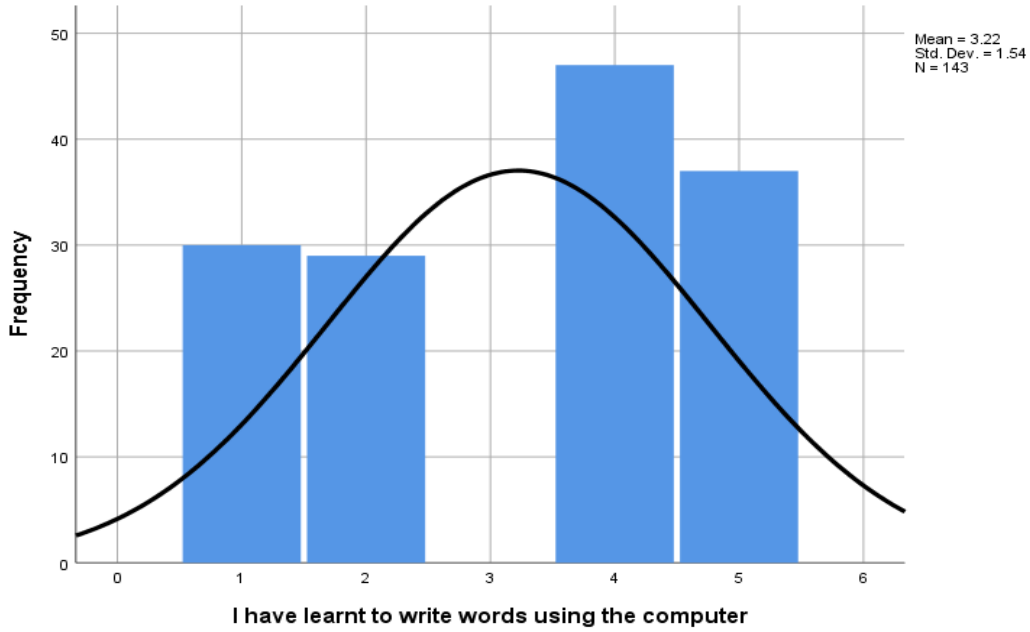

Figure 4: I Have Learnt to Pronounce words using Computer

4.4.2 I have learnt to pronounce words using computer

The ability for learners to pronounce words was a learning outcome measured during the research. The top two highest number from the respondents were strongly agreed and agreed to have improved their pronunciation skills when exposed to computer.

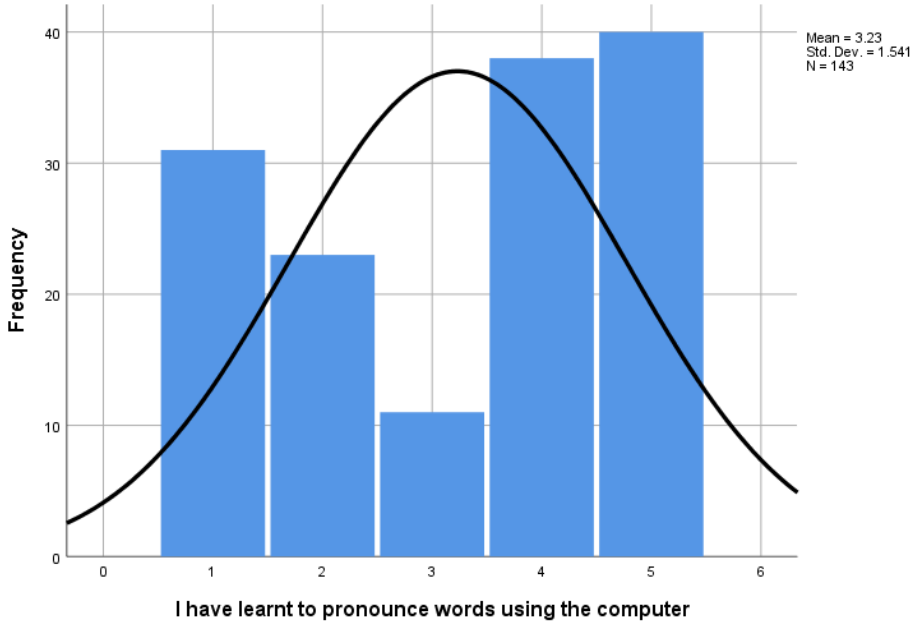

Figure 5: I Have Learnt to Pronounce words using Computer

4.4.3 I solve Mathematical problems using the computer

The third learning outcome being measured was learners' ability to solve mathematical problems using computer. The mean from the respondents was recorded as 3.64 which indicates agreement to the statement.

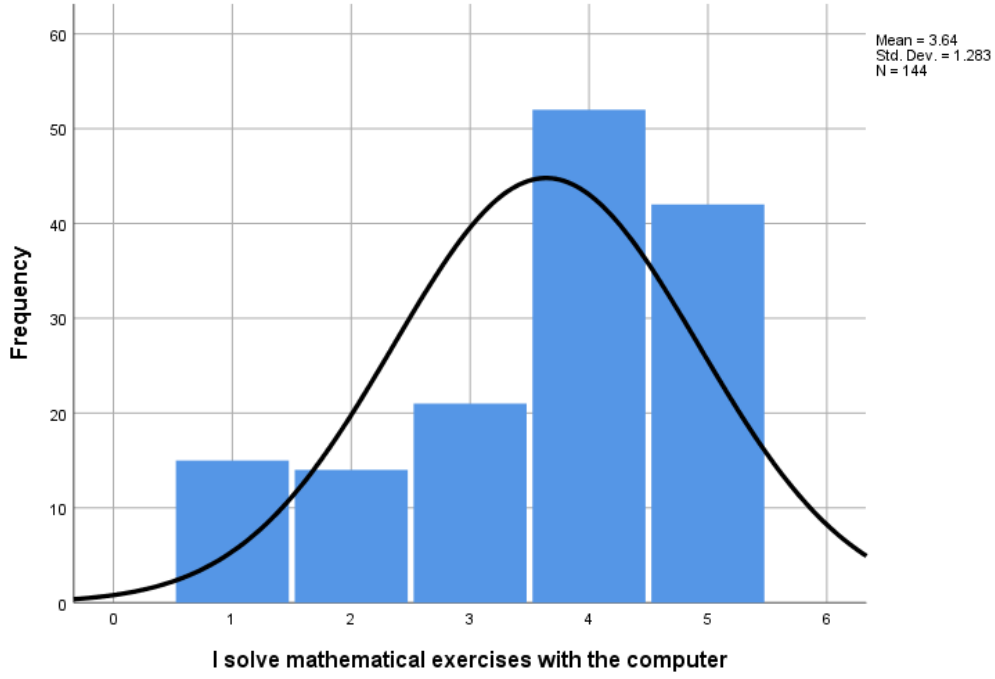

Figure 6: I Solve Mathematical Exercises using Computer

4.4.4 I learn Social Science using computer

The effectiveness of computers when learning social science was also measured as a learning outcome. From the results not much of learning social science was one using computer. On average, the results showed 2.96 which represents a neutral ground. While half of the respondents agreed to learn social science using computer, an equal number disagreed.

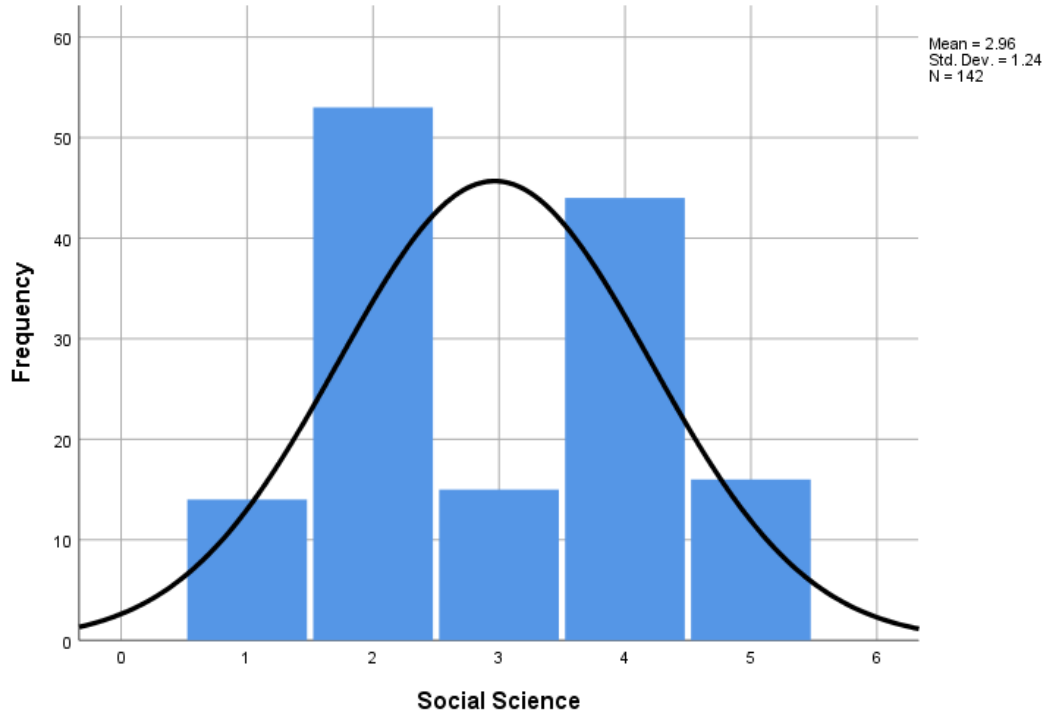

Figure 7: I Learn Social Science Using Computer

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Chapter five summarizes findings of the study and give conclusions. The chapter further highlights recommendations and submissions for future research around the subject.

5.2 Summary of Major Findings

This research sought to undertake an investigation on the effectiveness of digital content factors on learning outcomes, a case of primary Schools within Nairobi County. The research objectives were as follows.

i. To establish how effective are digital content factors and organizational support in improving learning outcomes in primary schools.
ii. Investigate the impact of different digitally enabled delivery modes on learning outcomes in primary schools.
iii. Identify how various organizational ICT policies and resources impact learning outcomes in primary schools.
iv. Investigate on the relationship between content quality and learning outcomes in primary schools while establishing how different context setups impacts learning outcomes.

The primary goal for the research was to examine the effectiveness of digital content factors and organizational support in improving learning outcomes in primary schools.

Objective 1: To establish how effective are digital content factors and organizational support in improving learning outcomes in primary schools

Through use of questionnaires administered to students from three different schools within Nairobi County, the researcher got response in relation to this objective. Descriptive analysis was done for the provided responses. The results indicated a strong response that learners found it very effective when learning involves use of digital content factors. Organizational support in terms of good learning environment also strongly had positive effect in learning outcomes.

The results strongly showed that learners posted good learning outcomes when the two variables; digital content factors and favorable organizational support were integrated in their learning.

The findings supported the study by Ganapathy & Seetharam (2016) which pointed that use multimodal methods had positive impact on learning outcomes. In the study, different multimodal learning approaches were found to have positive effect to students on finding meanings which is a learning outcome.

Objective 2: Investigate the impact of different digitally enabled delivery modes on learning outcomes in primary schools.

The questionnaires used to collect data had questions on how different digital content delivery modes such as graphics, videos and audio impacted learning outcomes. The responses from students were put through regression analysis and results tabulated into Histograms as indicated in figures 4, 5, 6 and 7.

This showed learners reported positive impact when different digital delivery modes were used in learning. While some learners grasped concepts sail through graphics and videos, others were more comfortable with audio delivery mode. What was common was that learners agreed different digitally enabled delivery modes had beneficial repercussions on their learning outcomes.

The results to this objective concurred with the study by Mahona & Demetria (2020) on Online Classes during COVID-19 Pandemic in Higher Learning Institutions in Africa. Their research found out that students understood better when different digitally enabled delivery modes were employed during learning process.

Objective 3: Establish whether various organizational ICT policies and resources impact learning outcomes in primary schools.

The research wanted to establish whether organizational ICT policies and resources impact learning outcomes in primary schools. The organizational ICT policies include any guidelines on when learners should use digital devices for learning, when to access computer labs and when digitally enabled delivery modes were used for learning. The resources included present of enough devices for learners.

Results were analyzed using paired sample T-Test which indicated a strong relationship between different ICT policies and learning outcomes. In cases where learners had enough devices and spend much time with the devices, they posted improved learning outcomes.

The results agreed with (Jordan, *et al* 2018) which found out ICT policies and resources providing good learning environment had positive impact on learning outcomes. In their book '*Approaches to learning'* any ICT policies and related resources were necessary in helping learners achieve the desired learning outcomes.

Objective 4: Investigate on the relationship between content quality and learning outcomes in primary schools.

The questionnaires had questions relating to content quality where leaners had to state whether they understand better when learning is run concurrently using digitally enabled delivery modes and whether the teacher had to repeat content learnt for the to understand better.

Through descriptive analysis, the results were captured in tables 16, 17 and 18. Repeat sessions to do a recap of previously learnt lessons using digitally enabled delivery modes which represent content quality had a direct relationship with learning outcomes. Learners reported to have I levels of understanding when a repeat session was done using any digitally enabled delivery mode either alone or with the teacher.

5.3 Conclusion of the Study

The research findings stemming from descriptive and regression analysis revealed that digital content design factors were effective in improving learning outcomes within primary schools within Nairobi County.

Developing and implementing relevant organizational ICT policies and providing related resources would make learning within primary schools more diverse, allowing multimodal learning which had a beneficial influence on learning outcomes.

Identification of a good context setup and more effective multimodal learning methods all have an impact on learning outcomes amongst primary school learners.

5.4 Recommendations

The study therefore recommends a more aggressive approach to have digital content factors integrated into learning within primary schools.

While individual schools make the decision on what level of digital integration to be done in learning, the government through the ministry of education should set bare minimums for adopting digital learning in primary schools. This will play a key role in ensuring the success on Competency Based Curriculum (CBC) which has computer literacy as a key learning outcome.

Investment into infrastructure to facilitate digital learning within primary schools is required. While the study only focused on Nairobi, different schools across the country lag in necessary infrastructure for digital learning.

5.5 Suggestion for Future Research

The research only concentrated on Primary Schools within Nairobi Metropolitan. The level of infrastructure within the Metropolitan is better as compared to other parts of the country. A further study should focus on wide scope to explain the exact situation in rural and remote areas of the country.

While the researcher chose to focus on grade four students, it will be necessary for further research to be done on lower grades (grade 1, 2 and 3) to establish at what level is it more effective to start integrating digital learning in primary schools.

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Appendix 1: Questionnaire

STUDENTS' QUESTIONNAIRE

Dear Respondent,

We are conducting investigation on the Effectiveness of Digital content factors on learning outcomes in your school. The study aims at improving teaching and learning experience for primary school pupils in Kenya. Your responses will only be used for academic purposes.

	GENDER:		**YEAR OF BIRTH:**		
Questions	**Strongly agree**	**Agree**	**Neutral**	**Disagree**	**Strongly disagree**
I use computer at home					
I use computer when guided					
I use computer without any guidance					
I use computer in each lesson					
I use computer only during the computer lesson					
Students participate in deciding on what to be done in each lesson					
I like reading only pictures on the computer					
I like reading diagrams, charts and pictures on the computer					
I like watching only video and audio on the computer					
I like reading only text-based notes on the computer					
The teacher takes pupils through class work then gives practices and exercise after					
The teacher gives exercises while still taking students through class work					
I get other learning materials apart from what is in the computer for learning e.g., books, charts					

I have learnt to pronounce words using the computer					
I have learnt to write words using the computer					
I have learnt to read words using the computer					
I solve mathematical exercises with the computer					
I understand everything when the teacher is in class					
The teacher repeats previous lessons for pupils to understand better					
I repeat what the teacher has taught in class during my free time to understand better					
With the computer I can read and understand on my own					
The teacher tells us when to use the computer					
I read the following using the computer	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Narrative text that gives stories					
Notes that contains pictures, charts, tables					
Videos and audio (sound)					
English					
Mathematics					
Kiswahili					
Computer Lesson					
Social Science					

Thank you for your participation

Appendix 2: Cover letter

Dear Head Teacher,

RE: VOLUNTARY INVOLVEMENT IN ACADEMIC RESEARCH

I am a postgraduate student conducting a study on effectiveness of Digital Content design Factors on Learning Outcomes in Primary Schools within Nairobi County.

This survey aims to seek opinions from your grade four (4) students on how different digital devices affect learning and their impact on learning outcomes. The survey will also seek to establish the various digitally enabled delivery modes the learners find useful in impacting their learning experience.

Finally, the survey will be keen to point out the different institutional ICT policies and resources put in place to facilitate digital learning and their impact on overall learning outcomes amongst the learners to be surveyed.

The researcher will guide respondents when filling the questionnaires to ensure learners understand clearly what each question requires. The survey will only take utmost 20 minutes of their time.

Your participation in this academic research is highly appreciated. I take this opportunity to re-assure you that the information provided will be used exclusively for intended research purpose and that confidentiality of information given will be earnestly safeguarded.

Benjamin Nzioka
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