

**TEACHER PREPAREDNESS TO INTEGRATION OF  
INSTRUCTIONAL TECHNOLOGIES IN TEACHING PHYSICS IN  
PUBLIC SECONDARY SCHOOLS IN NAKURU COUNTY, KENYA**

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**A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE  
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## DECLARATION

I declare that this thesis is my original work and has not been presented in any other university/institution for consideration. This thesis has been complimented by referenced sources duly acknowledged. Where text, data (including spoken words), graphics, pictures or tables have been borrowed from other sources, including the internet, these are specifically accredited and references cited in accordance with anti-plagiarism regulations.

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## **DEDICATION**

To my dear wife, Kessy and my lovely children, Purity, Dave, Graham, Joy and Mercy.

You gave me the drive and motivation to complete this work.

## **ACKNOWLEDGEMENT**

First and foremost, I am grateful to the almighty God for His favour which has brought me this far. My Masters' degree program would not have succeeded without God's favour. Secondly, my lovely parents, you did me a great favour by taking me to school. Your advice and support opened my eyes and enabled me to set my targets high in life. Thirdly, I am grateful for the professional guidance offered to me by my able supervisors, the late Dr David W. Khatete and Dr, Hamisi O. Babusa. Without your guidance, my efforts would have been in vain. You walked with me all along and encouraged me whenever I grew weary. I would also like to thank all the administrators and teachers who supported me by responding to my questionnaires and interview guide. Your responses enabled me to compile this thesis. I thank the support staff in the Department of Educational Communication and Technology of Kenyatta University who were very supportive to me.

## TABLE OF CONTENTS

<b>DECLARATION</b> .....	ii
<b>DEDICATION</b> .....	iii
<b>ACKNOWLEDGEMENT</b> .....	iv
<b>TABLE OF CONTENTS</b> .....	v
<b>LIST OF APPENDICES</b> .....	viii
<b>LIST OF TABLES</b> .....	ix
<b>LIST OF FIGURES</b> .....	xi
<b>ABBREVIATIONS AND ACCRONYMS</b> .....	xii
<b>ABSTRACT</b> .....	xiii
<b>CHAPTER ONE: INTRODUCTION</b> .....	1
1.1 Background of the Study .....	1
1.2 Statement of the Problem .....	6
1.3 Purpose of the Study .....	7
1.4 Research Objectives .....	7
1.5 Research Hypotheses .....	8
1.6 Justification of the Study .....	8
1.7 Significance of the Study .....	9
1.8 Assumptions of the Study .....	10
1.9 Scope and Limitations of the Study .....	11
1.9.1 Scope of the Study .....	11
1.9.2 Limitations of the Study .....	11
1.10 Theoretical Framework .....	12
1.11 Conceptual Framework .....	12
1.12 Definition of Operational Terms .....	15
<b>CHAPTER TWO: LITERATURE REVIEW</b> .....	16
2.0 Introduction .....	16
2.1 Importance of Instructional Technologies in the Teaching Process .....	16
2.2 Categories of Instructional Technologies Useful in Classroom Teaching .....	18
2.3 Level of Preparedness of Teacher on Integration of Instructional Technologies .....	19
2.4 Factors Which Support Integration of Instructional Technologies .....	20

2.5	Factors Which Hinder Integration of Instructional Technologies .....	21
2.6	How Teachers Can Use Instructional Technologies in Teaching of Physics.....	22
2.7	Empirical Review .....	23
2.8	Summary of Reviewed Studies and Research Gaps .....	26
	<b>CHAPTER THREE: RESEARCH METHODOLOGY .....</b>	<b>31</b>
3.0	Introduction .....	31
3.1	Research Design .....	31
3.2	Location of the Study.....	32
3.3	Target Population .....	32
3.4	Sampling Procedure and Sample Size .....	32
	3.4.1 Sampling Procedure.....	33
	3.4.2 Sample Size Determination .....	33
3.5	Research Instruments .....	35
	3.5.1 Questionnaire for Teachers of Physics .....	35
	3.5.2 Interview Guide for HODs.....	36
3.6	Piloting.....	36
	3.6.1 Validity of the Research Instruments.....	37
	3.6.2 Reliability of the Research Instruments .....	38
3.7	Data Collection Procedures .....	39
3.8	Data Analysis .....	40
3.9	Ethical considerations .....	42
	<b>CHAPTER FOUR: DATA ANALYSIS, PRESENTATION AND DISCUSSIONS..</b>	<b>43</b>
4.1	Introduction .....	43
4.2	Response Rate .....	43
4.3	Demographic Information of the Respondents .....	44
	Table 4.3: Highest Academic Level of Respondents .....	45
4.4	Descriptive Findings of the Study .....	54
	4.4.1 Availability of Instructional Technologies.....	55
	4.4.2 Level of Preparedness of Physics Teachers .....	66
	4.4.3 Factors that Support Integration of Instructional Technologies .....	73
	4.4.4 Factors Which Hinder Integration of Instructional Technologies.....	78

4.4.5 Integration of Instructional Technologies in Pedagogy of Physics .....	83
4.4.6 Desirable Outcomes in Physics in KCSE .....	86
4.5 Inferential Findings of the Study .....	88
<b>CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.</b>	<b>97</b>
5.1 Introduction .....	97
5.2 Summary of Findings.....	97
5.2.1 Availability of Instructional Technologies and Desirable KCSE Outcomes ....	97
5.2.2 Level of Preparedness to Integrate ITs and Desirable KCSE Outcomes .....	98
5.2.3 Factors that Support ITs Integration and Desirable KCSE Outcomes.....	99
5.2.4 Factors Hindering Integration of Its and Desirable KCSE Outcomes .....	100
5.2.6 Integration of ITs in Pedagogy of Physics and Desired KCSE Outcomes .....	101
5.3 Conclusion of the Study.....	102
5.3.1 Conclusion on Availability of Instructional Technologies and Desirable KCSE Outcomes .....	102
5.3.2 Conclusion on Level of Preparedness to Integrate ITs and Desirable KCSE Outcomes .....	103
5.3.3 Conclusion on Factors Supporting Integration of ITs and Desirable KCSE Outcomes .....	103
5.3.4 Conclusion on Factors Hindering Integration of ITs and Desirable KCSE Outcomes .....	104
5.4 Recommendations of the Study.....	105
5.4.1 Recommendations on Availability of Instructional Resources .....	105
5.4.2 Recommendations on Level of Preparedness to Integrate ITs in Pedagogy of Physics .....	105
5.4.3 Recommendations on Factors Supporting Integration of ITs .....	106
5.4.4 Recommendations on Factors Hindering the Integration of ITs .....	106
5.5 Suggestions for Further Studies.....	107
<b>REFERENCES .....</b>	<b>108</b>

## LIST OF APPENDICES

<b>Appendix A:</b> Research Questionnaire For Physics Teachers.....	122
<b>Appendix B:</b> Interview Schedule For Heads Of Department .....	127
<b>Appendix C:</b> A Map Of Nakuru County .....	130
<b>Appendix D:</b> Research Authorization Letter. . . . .	131
<b>Appendix E:</b> Research Authorization From National Commission Of Science, Technology And Innovation .....	132
<b>Appendix F:</b> Research Permit .....	133
<b>Appendix G:</b> Research Authorization From The County Commissioner, Nakuru County .....	134
<b>Appendix H:</b> Research Authorization From The Director Of Education, Nakuru County .....	135

## LIST OF TABLES

Table 1.1:	Physics KCSE Performance for Nakuru County .....	5
Table 2.1:	Summary of Reviewed Studies and Research Gaps.....	27
Table 3.1:	Sampling Grid for Teachers of Physics and Heads of Science Departments .....	35
Table 3.2:	Reliability Test Results.....	38
Table 3.3:	Analysis of Variables .....	41
Table 4.1:	Response Rate .....	43
Table 4.2:	Gender of Teachers of Physics .....	44
Table 4.3:	Highest Academic Level of Respondents.....	45
Table 4.4:	Distribution of Teachers of Physics by School Category.....	47
Table 4.5:	Distribution of Teachers of Physics by Work Experience .....	47
Table 4.6:	Distribution by Experience of Teaching Physics in Current school .....	48
Table 4.7:	Distribution of Heads of Department by Working Experience .....	49
Table 4.8:	KCSE Physics Enrolment in 2015, 2016 and 2017.....	50
Table 4.9:	Average Number of Students per candidate Class.....	51
Table 4.10:	Teachers’ Recommendation on Media Category for Ensuring Quality Physics Teaching.....	52
Table 4.11:	Technologies Integration in Teaching of Physics in Public Secondary Schools.....	53
Table 4.12:	Descriptive Findings for Availability of Instructional Technologies.....	55
Table 4.13:	Adequacy of Physics Textbooks to Student Ratio .....	59
Table 4.14:	Available Resources for Raising Physics Mean Standard Score .....	60
Table 4.15:	Ways Teachers Deal with Physics Experiments .....	61
Table 4.16:	Roles of HODs in Purchase of Teaching Materials for Physics .....	62
Table 4.17:	Reliability of Internet Connectivity in Schools .....	63
Table 4.18:	Accessibility of Digital Teaching Materials by Physics Teachers.....	64
Table 4.19:	Students Allowed to Use the Internet in School .....	64
Table 4.20:	Limitations on Internet Use by Students .....	65
Table 4.21:	Descriptive Findings for Level of Preparedness .....	66
Table 4.22:	Attendance of In-service Training by Physics Teachers .....	69
Table 4.23:	In-Service Training Equip Teachers with Requisite Skills to Integrate ITs.....	71

Table 4.24: How HODs Ensure Teachers Prepare Well for Physics Lessons .....	71
Table 4.25: Descriptive Findings of Factors that Support ITs Integration .....	73
Table 4.26: Distribution of Factors That Support Integration of ITs .....	76
Table4.27: Descriptive Findings for Factors Hindering Integration of Instructional Technologies .....	79
Table 4.28: Factors Hindering Integration of Instructional Technologies .....	82
Table 4.29: Descriptive Findings for Integration of Instructional Technologies in Pedagogy of Physics.....	83
Table 4.30: The Extent of Integration of ITs in Pedagogy of Physics.....	85
Table 4.31: Descriptive Statistics for Desirable Outcomes in the KCSE .....	86
Table 4.32: Schools that have Met Set Targets in Physics since 2015 .....	87
Table 4.33: Correlation Analysis.....	88
Table 4.34: Regression Weights for Overall Model.....	91
Table 4.35: Model Significance .....	92
Table 4.36: Model Coefficients.....	93

## LIST OF FIGURES

Figure 1.1: Conceptual Framework.....	14
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## ABBREVIATIONS AND ACCRONYMS

<b>ASEI:</b>	Activity, Student, Experiment, Improve.
<b>CCTV:</b>	Closed Circuit Television
<b>CD-ROM:</b>	Read Only Memory Compact Disc
<b>CEMESTEPA:</b>	Centre for Mathematics, Science and Technology Education in Africa
<b>GoK:</b>	Government of Kenya
<b>HODs:</b>	Heads of Departments
<b>ICT:</b>	Information Communication Technology
<b>INSET:</b>	In-service Education and Training
<b>ITs:</b>	Instructional Technologies
<b>KCSE:</b>	Kenya Certificate of Secondary Education
<b>KICD:</b>	Kenya Institute Curriculum Development
<b>KSA:</b>	Knowledge Skills and Attitudes.
<b>LANs:</b>	Local Area Networks
<b>MoEST:</b>	Ministry of Education, Science and Technology.
<b>MSS:</b>	Mean Standard Score
<b>NACOSTI:</b>	National Commission of Science, Technology and Innovation
<b>NEPAD:</b>	New Partnership for Africa Development
<b>PDSI:</b>	Plan, Do, See, Improve
<b>PPMCC:</b>	Pearson's Product Moment Correlation Coefficient
<b>PSSC:</b>	Physical Science Study Committee.
<b>SMASE:</b>	Strengthening of Mathematics and Science Education
<b>SMASSE:</b>	Strengthening of Mathematics and Science in Secondary Education.
<b>SPSS:</b>	Statistical Package for Social Sciences
<b>TPAD:</b>	Teacher Professional Appraisal and Development
<b>TSC:</b>	Teachers Service Commission
<b>TVET:</b>	Technical and Vocational Education and Training.
<b>UNESCO:</b>	United Nations Educational Scientific and Cultural Organization
<b>Wi-Fi:</b>	Wireless Fidelity.

## ABSTRACT

Quality education is a global concern. It may be enhanced through a paradigm shift from traditional methods to modern methods in pedagogy. New methods of teaching may assure the teacher better results which in turn help the learners build on their careers at the tertiary institutions. There has been a fluctuating performance in Physics in public schools in Nakuru County. This thesis examined the level of preparedness of the teachers of Physics to integrate instructional technologies and its effect on KCSE Physics performance in public secondary schools of Nakuru County, Kenya. The objectives of the study included: to identify the types of instructional technologies available for teaching, to determine the level of preparedness of teachers to integrate these technologies, to identify factors which support and those which hinder integration of instructional technologies in teaching Physics. The study adopted a cross-sectional survey design. A total of 671 teachers of Physics and heads of science departments in public secondary schools of Nakuru County constituted the study population. Out of these, a sample of 88 respondents was obtained using stratified random sampling technique. A structured questionnaire and a semi structured interview guide were used to facilitate data collection from teachers of Physics and Heads of Science departments respectively. These instruments were pilot- tested to determine their reliability and validity. The collected data were analyzed using descriptive statistics as well as inferential statistics. This was facilitated by the Statistical Package for Social Sciences tool. The study findings were presented in tabular format. The study revealed that availability of instructional technologies had a significant relationship with performance in KCSE Physics ( $r = 0.588$ ;  $p < 0.05$ ). However, level of preparedness ( $r = 0.063$ ;  $p > 0.05$ ), factors supporting integration of ITs ( $r = 0.191$ ;  $p > 0.05$ ), and factors hindering integration of ITs ( $r = -0.141$ ;  $p > 0.05$ ) were not significantly correlated with desirable outcomes in KCSE Physics. The study findings also indicated that 28.8% of variance in desirable outcomes could be explained by integrations of the aforesaid technologies. Availability of instructional technologies was found to be the most critical factor regarding having the desired outcomes in KCSE Physics. The study drew the conclusion that instructional technologies played a critical role with regard to performance of students in KCSE Physics. It was concluded that level of preparedness of teachers of Physics had little consequences on students' performance in the subject. Supporting factors such as budgetary allocation and administrative support enhanced integration of ITs but not significantly. The performance of students in Physics was inferred to be negated by various hindrances to integration of instruction technologies. The study also concluded that integration of ITs in the teaching of Physics has not resulted in substantive improvement of the outcomes. It is recommended that all public secondary schools in Kenya should be provided with sufficient instructional technologies. It is advisable for administrators of public secondary schools to encourage teachers to integrate instructional technologies in the teaching of Physics. The administrators and the government should ensure that teachers of Physics are trained on how to integrate instructional technologies in pedagogy of Physics.

## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background of the Study

Quality education is a global concern. Education is also a very important means of enhancing social and economic development both at individual and national level. Research has shown that quality of education may be enhanced through integration of instructional technologies in pedagogy (Mugo, 2013). Research has also shown that integration of instructional technologies (ITs) in pedagogy improves on learners' retention, attracts learners' attention during learning, makes learning more meaningful and ensures flexibility which is denied by traditional teaching processes and methods (Omariba, 2012). Omariba further contends that ITs create a powerful classroom learning environment making learners to use their multiple senses.

Physics is a practical subject in which teaching and learning process demands that teachers use learner-centered approaches (Weimer, 2013). Physics should help learners in explaining the everyday occurrences around them such as causes of wind, solar system, geothermal and Hydroelectric power supply among others (Otieno, 2019). Otieno further alludes that, a population without proper knowledge of Physics may fail to understand the aforementioned phenomena. This may eventually lead to low technology levels and therefore low living standards. There is need for resources, facilities and other appropriate technologies to be used frequently in the teaching and learning of Physics. When all this is done, a favourable environment for teaching and learning will be realized (Mugo, 2013). Availability of Physics teaching/learning materials and the use of modern

methods of teaching cannot therefore be overlooked if quality teaching and learning of Physics is to be achieved.

Teachers of Physics should adopt a multisensory approach to supplement verbal explanation of concepts or descriptions to make Physics lessons real (Aina, 2013). Aina further alludes that, what students hear can be forgotten easily but what they do or see cannot be easily forgotten and will last longer in their memory.

The growth of the global economy has led educational systems to adopt integration of instructional technologies. The US government for instance, realized that paradigm shift was necessary for its educational system to remain relevant and competitive (UNESCO, 2004). During the First World War and the Second World War, Americans used audiovisual communications media (film technology) to train their army which turned out to be of great success. The two world wars taught the Americans and the whole world that traditional teaching methods could not manage the challenges experienced due to fast advances in science and technology (Kober, 2015).

An analysis of technology integration in teacher education in Ghana indicated that challenges associated with the use of ICT in education stemmed from a number of factors (Agyei, 2013). It revealed that, these challenges were not only linked to unavailability of technological resources, but also lack of enough skilled human resources and other institutional factors played an important role. These challenges were prevalent in spite of integration of ICT into Ghana's education system having formally been introduced as part of educational reforms in year 2007. According to the International Telecommunications Union (2009), similar to other countries in Africa, Ghana lagged

behind with regard to integration of ICT in teacher education. From the same viewpoint, it is stated that there exist pertinent questions on what teachers can do with ICTs in order to enhance integration of technologies in curriculum delivery or to extend instructional approaches. Another question is what teachers can do with instructional technologies so as to improve students' outcomes as manifested in their academic performance both in formative and summative evaluation.

In South Africa, teachers face the challenge of integrating technologies effectively into a coherent framework in schools (Ramorala, 2014). Ramorala also posited that there seemed to be a great probability of minimal integration of technologies into classroom activities in South Africa. This is albeit the fact that systematic planning and implementation of lessons require learners or students to think critically and work collaboratively while integrating technologies in support of learning. According to Ramorala (2014), schools in the country had insufficient technology equipment, unavailability of teachers qualified in technology integration and also technical and maintenance problems. Moreover, it was postulated that for effective integration of technologies in schools to be realized, planning, sufficient timeline, dedication, and adequate resources are required.

In Kenya, schools are under great pressure to integrate instructional technologies to equip learners with the knowledge and skills needed to cope with the challenges of the 21<sup>st</sup> Century (Omariba, 2012). This was the reason why the government came up with the Kenya Vision 2030 in which on education, other government initiatives have been adopted including teacher in-service training (INSET) programs for teachers by the Centre for Mathematics, Science and Technology in Africa (CEMASTEA) and Kenya

Institute Curriculum Development (KICD). SMASSE under CEMASTEIA emphasizes the adoption of a student-centered teaching and learning. This approach encourages active rather than passive learning, deep learning and understanding of concepts. The teacher becomes a facilitator and a resource person. These initiatives have put Kenya on the right track towards achieving quality education for her citizens. Sessional paper No.1 of 2005 on A Policy Framework for Educational Training and Research highlights the government's commitment in enhancing quality education at all levels to produce graduates with desired knowledge and skills required to face the challenges of the 21<sup>st</sup> century. Kenyan government has realized that there was a global change in technology use and believe that schools had a greater role to play in order to equip its youth with the skills needed in the current and future job market (Brewer,2013). Teachers should therefore prepare lessons well in order to achieve the set goals within the allocated time.

Secondary school Physics plays a vital role of ensuring that a country is on the right track as pertains to industrial and technological development. The subject generates fundamental knowledge required for technological advancement (Nderitu, 2009). Nderitu further advises that Physics is important in the choice of some of the degree and diploma courses at the tertiary level of education in Kenya. A student must excel in KCSE Physics examination to secure a place in most competitive courses like engineering, aviation, architecture among others. The study of Physics in secondary school is meant to instill quantitative and analytical skills which enable students to pursue higher education with ease.

However, Physics subject was not posting satisfactory performance in Nakuru County as shown in Table 1.1. The scores in Physics were below the expected mean standard score

over the four years, 2015, 2016, 2017 and 2018 considering that Physics is one of the elective subjects examined in KCSE. Kaptum (2018) made the same observation on the performance in Physics in Nakuru East Sub-County which falls within Nakuru County, Kenya. According to Kaptum (2018), many students continued to miss the opportunity build on their dream careers and participate in national development because of the unsatisfactory performance in this subject. This was mainly because most of the intervention measures mainly targeted teachers and left out the learners. This observation led to the study on the relationship between learning strategies and students' performance in Physics in public secondary schools of Nakuru East Sub-County.

**Table 1.1: Physics KCSE Performance for Nakuru County**

Year	Physics Mean Score (Out of 12.0)	Grade	KCSE Enrolment
2018	5.37	C-	9621
2017	4.28	D+	9246
2016	5.34	C-	8764
2015	4.90	C-	7383

**Source: County Directorate of Education, Nakuru County (2020)**

These scores were all below average and as Changeiywo and Wambugu (2008:299) observe, “Teaching methods are a crucial factor which affect academic achievement of students.” In consideration of the mean scores in Table 1.1, there was need to investigate the methods and approaches used in teaching Physics subject, availability of instructional materials and the challenges faced by the teachers of Physics while teaching the subject in the County. This observation lead to the pertinent question, “Were Physics teachers in Nakuru County using teacher-centered or learner-centered approaches in teaching Physics?” In view of the foregoing, this study investigated whether the teachers of

Physics were integrating instructional technologies as one of the modern methods of teaching Physics in public secondary schools of Nakuru County, Kenya.

## **1.2 Statement of the Problem**

Integration of instructional technologies in pedagogy of secondary school Physics is vital (Aina, 2013). It helps the teacher to take care of individual differences of the learners in class and this in turn supplements verbal explanation of concepts. Despite this fact, the extent to which secondary school teachers of Physics integrate instructional technologies needs to be enhanced in developing countries like Kenya. Research has shown that teaching methods are an important factor which partly determines academic achievement and the quality of teaching and learning (Changeiywo & Wambugu, 2008). Nationally, SMASSE training was designed for serving secondary school teachers of Mathematics and Science subjects. It was later on changed to SMASE in order to cover primary schools. It was meant to bring about a pedagogical paradigm shift in teaching through an introduction of ASEI / PDSI instructional approach with a projection that such an approach would improve the performance of students in KCSE examinations (Nangabo, 2014).

Learning of Physics should help learners in explaining the everyday occurrences around them such as the causes of wind, solar system, geothermal and Hydroelectric power supply among others. (Otieno, 2019). According to Otieno (2019), a population without proper knowledge of Physics may fail to understand the aforementioned phenomena. This may eventually lead to low technology levels and by extension low living standards. The issue of fluctuating County's mean standard scores in KCSE Physics examination for the years 2015 to 2018 (Table 1.1) and the importance emphasized about the integration of

instructional technologies in pedagogy were the reasons why this research was conducted in Nakuru County. It's evident that there was a gap which this research was intended to fill on the level of preparedness of teachers of Physics to integrate ITs, availability of ITs as well as the factors which support or hinder integration of instructional technologies in teaching secondary school Physics in Nakuru County. The use of instructional technologies in pedagogy of Physics to supplement verbal explanation of concepts may help in rectifying the situation (Aina, 2013).

### **1.3 Purpose of the Study**

The main objective of this study was to establish the level of preparedness of teachers of Physics to integrate instructional technologies in pedagogy of Physics versus desirable KCSE outcomes in Physics in public secondary schools of Nakuru County, Kenya. The study also investigated the availability of instructional technologies as well as factors which supported or hindered their integration of instructional technologies in pedagogy of Physics.

### **1.4 Research Objectives**

The objectives of the study included:

- i. To identify the types of instructional technologies available for teaching secondary school Physics in Nakuru County, Kenya.
- ii. To determine the level of preparedness of teachers of Physics to integrate instructional technologies in teaching secondary school Physics in Nakuru County, Kenya.
- iii. To identify factors which support integration of instructional technologies in teaching secondary school Physics in Nakuru County, Kenya.

- iv. To identify factors which hinder integration of instructional technologies in teaching secondary school Physics in Nakuru County, Kenya.

### **1.5 Research Hypotheses**

The following research hypotheses guided the study;

**H<sub>01</sub>:** There is no statistically significant influence of availability of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

**H<sub>02</sub>:** There is no statistically significant influence of teacher preparedness to integrate instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

**H<sub>03</sub>:** There is no statistically significant influence of factors supporting integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

**H<sub>04</sub>:** There is no statistically significant influence of factors hindering integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

### **1.6 Justification of the Study**

The main aim of students learning Physics in secondary school is to widen their knowledge about nature in order to generate fundamental knowledge needed for future technological advances in the world. Its study generates fundamental knowledge required for industrial and technological development. The study of Physics also helps to instill both quantitative and analytical skills which help students to solve problems in sciences,

engineering and medicine as well. It helps students to clearly understand the environment around them.

It is in line with this argument that students need to acquire quality Physics education to enable them pursue higher education with ease. When students acquire quality instructions, it leads to their independence, personal productivity and empowerment (Mugo, 2013). Integration of instructional technologies has been found to improve the effectiveness of teaching and learning. Kaptum (2018) noted that, the performance of Physics in Nakuru East sub-county which is part of Nakuru County was on the decline and suggested that there should be a change of strategies teachers use to deliver knowledge. Low grades in KCSE and the importance emphasized on integration of instructional technologies in teaching are the reasons why this research was conducted in order to explore teachers' level of preparedness on integration of instructional technologies for quality teaching and learning of Physics in Nakuru County. It formed the basis of making useful recommendations on ways to ensure desirable outcomes are achieved in KCSE Physics examinations. The study intended to fill the gap on performance by investigating the extent to which Physics teachers in Nakuru County integrated instructional technologies during Physics lessons to enhance retention and improve learners' performance.

### **1.7 Significance of the Study**

With the invention and use of instructional technologies in teaching of sciences like Physics, it is essential that in the 21<sup>st</sup> Century, teachers should enhance their skills in teaching Physics. This study was designed to establish the level of preparedness of teachers of Physics to integrate instructional technologies in pedagogy of Physics in

Nakuru County. The findings and suggestions of this study are envisaged to add to the already existing literature in pedagogy of Physics. Additionally, it is hoped that, the findings of this study will help the policy makers in the Ministry of Education to come up with better policies which will help to enhance teaching and learning of Physics in Kenyan secondary schools. This will guide the teachers' trainers when planning for training. It is hoped that the findings of this study will help the teachers of Physics to enhance their skills of teaching secondary school Physics. Furthermore, it is predicted that the findings and suggestions of the study will be helpful to the schools' administrators by enlightening them on the need to avail appropriate instructional technologies for use by teachers of Physics. The study findings and recommendations may also stimulate further research on the use of instructional technologies in the pedagogy of Physics to enhance quality education.

### **1.8 Assumptions of the Study**

The study was conducted with the following assumptions:

- i. The teachers of Physics participating in this study were trained to teach in secondary schools in Kenya.
- ii. Secondary schools chosen in this study had instructional technologies for teaching Physics.
- iii. Secondary schools' administrators supported integration of instructional technologies in teaching of Physics.
- iv. Teaching of Physics in public secondary schools will continue for a long time even after the completion of this study.

## **1.9 Scope and Limitations of the Study**

### **1.9.1 Scope of the Study**

This study confined itself to investigation on integration of instructional technologies in pedagogy of Physics. The study centered on Heads of Science departments and teachers of Physics in public secondary schools. It was concerned with teacher preparedness to integrate ITs in teaching Physics in Nakuru County, Kenya in relation to Physics KCSE outcomes. It was also delimited to a number of variables which included; availability of instructional technologies, level of preparedness of teachers of Physics, factors supporting integration of ITs, factors hindering integration of ITs, and desirable outcomes in KCSE Physics. Additionally, the study examined the data for years 2015, 2016, 2017 and 2018.

### **1.9.2 Limitations of the Study**

This study faced the following limitations:

- i. The study was conducted in selected public secondary schools in Nakuru County. It would be important to conduct research in all secondary schools in Kenya. However, due to limited time and resources on the part of the researcher and for the purpose of in-depth information, the study was confined to public secondary schools in Nakuru County.
- ii. The study did not investigate integration of instructional technologies in other subjects taught in secondary schools or higher institutions of learning since this might require a different study altogether.

### **1.10 Theoretical Framework**

This study was guided by cognitive learning theory. The theory was developed by Jean Piaget in 1968. Cognitivism alludes that learning involves internal processing of information. The theory of cognitive constructivism is accredited to Piaget (1968). The theory states that learning is a process of active discovery. According to the theory, the role of the instructor is to instill knowledge through ensuring that the required resources are available. The instructor only provides guidance to the learners and does not get involved in consistent repetition. The learners assimilate new knowledge, modify the existing knowledge to accommodate new knowledge. Motivation for the cognitive learners is intrinsic since it involves the restructuring of cognitive structures (Perry, 1999).

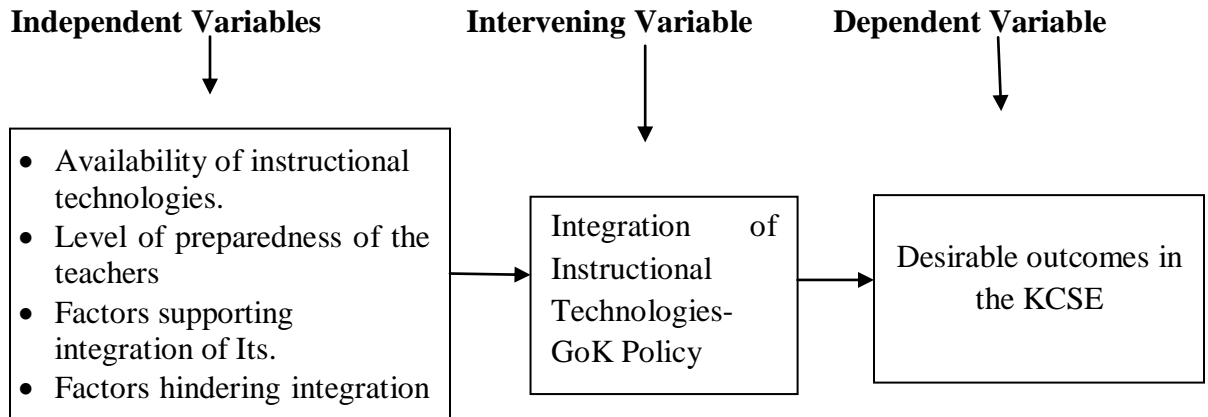
The learners in secondary schools are in the formal operational stage where they are capable of reasoning not only about tangible objects and events but also about hypothetical or abstract ones. These learners require very few props to solve problems and are therefore more self-directed than learners who rely on concrete operation. The teacher should have a good understanding of what the students already know and their expectations with regards to the instructional technologies. The teacher should also ensure that the instructional technologies involve learners actively in the learning process. Instructional technologies should be designed in such a way that the students understand easily the concepts taught by the teacher.

### **1.11 Conceptual Framework**

The main reason for educating a person is to prepare him or her for the future career. The educator should put more effort to ensure that students attain desired results which will

enable them to join competitive and job-guaranteed courses at the universities or TVET colleges. According to Omariba (2012), “learning is naturally an active mental and social process in which learners should interact with their environment and manipulate objects to have a proper interpretation of a phenomenon”. Doyle (2010) observes that, “The only way for students to increase their learning is by getting actively engaged in learning of the content and skills”. Students should do more than just listen to the teacher. Doyle further observes the goal of learner-centered curriculum is to create a favourable learning environment so as to optimize students’ attention to engage in authentic, meaningful and useful learning. This type of education is only possible if instructional technologies are properly integrated during the teaching and learning process. Integration of instructional technologies in teaching and learning may be summarized in the following conceptual framework in which variables are related to achieve desirable KCSE results. When the teacher integrates these technologies and then allow learner to interact with ITs frequently, they are likely to achieve learning objectives. Instructional technologies will arouse interest, and make learners more creative (Baya’a & Daher, 2013). There is need to consider the broad curriculum and the few lessons allocated for the subject on the time table.

Independent variables in this study included availability of instructional materials, level of preparedness of the teacher, factors supporting integration of ITs and factors hindering integration of ITs while the dependent variable is desirable outcomes in the KCSE as shown in Figure 1.1. The framework shows the relationship of the aforementioned variables.



**Figure 1.0.1: Conceptual Framework (Own Conceptualization, 2019)**

## 1.12 Definition of Operational Terms

<b>Academic performance:</b>	This refers to the outcome or output of students' learning as manifested in their scores in examinations. In this study, academic performance is represented by the KCSE results in Physics subject.
<b>Curriculum:</b>	Planned interaction of students with subject content, learning resources and processes for evaluating the attainment of educational objectives
<b>Instructional media:</b>	All materials and physical means the teacher may use to carry out the process of instruction in order to facilitate students' attainment of instructional objectives.
<b>Instructional technology:</b>	The application of technological processes, scientific knowledge and resources which are useful in solving problems of pedagogy.
<b>Integration:</b>	Making something part of a process e.g., instructional technologies in the teaching and learning process.
<b>Pedagogy:</b>	The method and practice of teaching, especially in an academic subject.
<b>Physics:</b>	The study of matter in relation to energy.
<b>Teacher preparedness:</b>	Teacher preparedness can be defined in terms of availability of instructional technologies, level of preparedness of the teachers, factors which support and hinder integration of instructional technologies in teaching secondary school Physics.

## **CHAPTER TWO**

### **LITERATURE REVIEW**

#### **2.0 Introduction**

This literature review focuses broadly on how various researchers have approached the idea of using instructional technologies in teaching. The chapter was divided into eight sections namely: Importance of instructional technologies in the teaching process; categories of instructional technologies useful in classroom teaching; level of preparedness of the teacher on integration of instructional technologies; factors which support integration of instructional technologies; factors which hinder integration of instructional technologies; how teachers may use instructional technologies in teaching of Physics; empirical review and: Summary of reviewed studies and research gaps.

#### **2.1 Importance of Instructional Technologies in the Teaching Process**

The growth of the global economy has shown the need for the integration of instructional technologies while teaching students the knowledge and skills needed for development (UNESCO, 2005). Teachers must use the available local resources to develop teaching and learning materials in schools (Surry et al., 2010). According to UNESCO (2005), many instructors, business and government leaders believe in the fact that a paradigm shift in teaching and learning process, together with the applications of information technologies plays a key role in aligning educational systems with the information-rich society.

Mugo (2007) postulates that instructional media when properly utilized should make instruction real and spice up the teaching and learning process to the point that students

can learn by themselves. He further cites Dills et al. (1987) alluding that instructional media, when used properly, arouse interest and makes learners' attentive; supplement verbal information and that they are interesting, challenging and reinforcing. Aina (2012) asserts that instructional materials are important because "what students hear can easily be forgotten but what they hear and see lasts longer in their memories."

The use of technology should at all times be intended to make life more comfortable than in the traditional classroom as it enables the learner to interpret and understand concepts more easily. Dick (1995), cited by Mugo (2007) postulates that teaching aids helps to open up channels of communication and create a variety of sensory impressions. Bryan (2006) observes that the use of some technologies like computers becomes useful when time, cost and safety among other issues are prohibiting factors. The way teachers integrate instructional technologies may affect what they do and their students' experiences (Kotrlik et al., 2003). Kotrlik et al. further observes that, "technology-based learning environments help students to acquire knowledge, skills and attitudes (KSAs) needed for success."

Instructional technologies make the teacher to become more organized in selection of methods which facilitates better understanding of the content (Moeller & Reitzes, 2011). It also simplifies concepts which would have otherwise appeared abstract and difficult to understand. Technologies arouse learners' interest and enhance retention of knowledge. In summary, instructional technologies when properly used should enhance creativity, positive educational experience, interest, and better understanding of concepts. Technology helps in the expansion of time and space, enhances the depth of

understanding, allows students to get the information they require without involving the teacher and ensures individualized learning. This study explored the importance Physics teachers attach to the use of instructional technologies in enhancing quality teaching of Physics in Nakuru County.

## **2.2 Categories of Instructional Technologies Useful in Classroom Teaching**

There are various instructional technologies which teachers may use to enhance quality teaching. No comprehensive and detailed taxonomy of media has been formulated so far for universal adoption. Different people have classified instructional technologies using different criteria (Mugo, 2007). Olulebe et al. (2015) classify instructional technologies into auditory, visual, audio visual, tactile, olfactory, gustatory and kinesthetic materials. According to Omariba (2012), instructional technologies may be classified into three categories which include; print materials, display materials, and ICT materials.

In the context of this study, instructional technologies were classified into audio, visual, audio-visual technologies and interactive technologies based on the manner of presentation. Audio materials comprise of audio tape, radio, Mp3, teleconferencing, public address system among others. Visual technologies include models, globes, sculptures, workbooks, pamphlets, cartoons, drawings, whiteboard, CD-ROMs, Overhead projectors, silent film projectors, posters, pictures, flashcards, photographs, maps, exhibits, flip books, flannel graphs, models, bulletin boards, mock-ups, real objects and slides. Audio-visual technologies include television, computer, film, filmstrips and video players. Interactive technologies include; Internet, Skype, WhatsApp, Facebook, telegram, games, simulations, mobile phones, and videoconferencing. This mode of categorization was adopted because it includes all the appropriate instructional

technologies that will ensure multiple intelligences are utilized. In this regard the study identified common technologies available and commonly used by teachers of Physics in the classroom environment to concretize Physics concepts in Nakuru County.

### **2.3 Level of Preparedness of Teacher on Integration of Instructional Technologies**

A well-designed lesson in this study means one that ensures objectives are achieved within the lesson time. Learners retain more and can apply the knowledge whenever required to do so. The design of the lesson majorly involves the teacher who outlines specific objectives for the lesson design, assessment instruments, exercises and content, does subject matter analysis, lesson planning and media selection. Guzey and Roehrig (2012) observe that teachers' use of technology for classroom instruction depends on their content knowledge, belief, and the availability of resources. Concerning technology integration, studies have shown that teachers' beliefs about the use of technologies influence the level of integration of technologies in classroom instruction (Osika et al., 2009).

Students should be involved in setting up learning objectives and preparation of lesson activities. Pitter et al. (2012) advises that if teachers communicate lesson objectives to students, the students will more easily see the connection between what they do in class and what they should learn. Learners' participation in preparation and improvisation of instructional materials makes them creative, innovative and arouse their curiosity, all of which are basic to teaching and learning of science like Physics (Adeniran, 2006). When creating activities for the lesson, the teacher should ensure that learners will be involved in doing more than the teacher in order to make the learning process learner-centered as opposed to the traditional teacher-centered learning process. Jennings (2012) observes

that “learner-centered lessons prepare the learner for the future and ensures the teacher achieves the goals of access, equity, and quality”.

Cennamo et al. (2012) argue that: Teachers should (i) support and induce original and innovative thinking and inventiveness; (ii) involve students in exploring real-world issues and solving real problems using digital tools and resources; (iii) promote students’ reasoning using collaborative tools to impart and clarify students’ understanding and thinking, planning and creative process and (iv) shape collaborative knowledge development by engaging in learning with other students, in face-to-face and virtual environments. This involvement of students should lead them to have fun in the learning process, improve their creative skills, get students excited about learning and prepare students for the life outside the classroom environment. This study sought to explore how teachers in Nakuru County design their Physics lessons and the role students play in preparation and during the lesson to enhance quality Physics outcomes.

#### **2.4 Factors Which Support Integration of Instructional Technologies**

There are various factors which may influence teachers’ integration of technologies in classroom teaching. Andoh (2012) identifies factors such as positive attitude of the teacher towards integration of instructional technologies, teacher’s readiness to integrate technologies when teaching, institutional support and institutional capacity among others. Jacovina et al. (2016) suggest that ready access to technologies, favourable policy and freedom in the curriculum environment are some of the factors which make teachers to either use or not use instructional technologies in class. Osika et al. (2009) contend that feelings, beliefs, attitudes and perceptions play a great role in determining whether teachers integrate instructional technologies during teaching.

According to Cox et al. (2000), in-servicing of teachers, developing a functional school's policy to integration of technologies, teachers taking responsibility in teaching, provision of professional support by the administrators, giving teachers more prestige and allowing greater access to resources will support teachers' integration of technologies in teaching and learning. This study investigated the factors which may encourage teachers of Physics to integrate instructional technologies in teaching in Nakuru County.

## **2.5 Factors Which Hinder Integration of Instructional Technologies**

Ayoti and Poipoi (2013) observe that there are various challenges associated with the use of instructional technologies in the classroom which include: (i) Lack of connectivity to the internet; (ii) Inadequate funds for hiring and transporting media resources to school; (iii) Lack of time to identify location of media for hiring and (iv) Uncooperative learners who do not want to participate in getting the resources. Redmann et al. (2003) posits that resistance to change, poor attitude on technologies by teachers, lack of training time, inaccessibility to technology, lack of expertise, and lack of funds are barriers to integration of technologies for teaching. Omariba (2012) points out that teachers face numerous challenges during the use of instructional technologies which includes: (i) inadequacy; (ii) lack of exposure on how to use some resources; (iii) Lack of standard Local Area Networks (LANs); (iv) Lack of staff to guide in the use of some technologies; and (v) Large content to be covered within a limited time among others. Fu (2013) highlights a number of barriers to effective use of ICT in teaching which includes insufficient skills, insufficient time, and pressure to increase scores in national examinations at the expense of quality, lack of encouragement, lack of in-service training, large class sizes and lack of motivation among others. Bingimlas (2008) indicate

lack of teacher confidence, resistance to change and negative attitudes, lack of effective training, inadequate time, inaccessibility and lack of technical support as some of the common barriers to successful integration of technologies in teaching and learning environments. This study investigated whether these challenges are prevalent in Nakuru County, Kenya.

## **2.6 How Teachers Can Use Instructional Technologies in Teaching of Physics**

Teachers of science can use Instructional technologies to support teaching and learning of science concepts and processes (<http://scimathmn.org/stemtc/resources/science>). Their use enables teachers to enhance teaching and learning, and also increase national productivity (Lee & Winzenried, 2009). Cennamo et al. (2013) suggest that teachers may use instructional technologies to inspire students' creativity and to promote learners' autonomy and active learning. Bryan (2006) posits that "technology such as computer simulations may be used to enhance teaching and supplement models which are not readily available in the Physics laboratory". Technology may be used to support key practices of student-centered learning especially in the case of digital books, cloud computing, collaborative environments, and mobile devices (Moeller & Rietzes, 2011).

Bryan (2006) advises that when instructional technologies are introduced in the context of science, they address issues related to science using appropriate methods and make scientific views accessible. He further asserts that technology instruction should be used to enhance better understanding of science subjects like Physics. Proper use of technologies ensures that students post good results in examinations and can also apply the knowledge acquired to create jobs or fit well into the job market.

## **2.7 Empirical Review**

Several past empirical studies have been reviewed in relation to preparedness of teachers in integrating instructional technologies in schools. A past study conducted by Suleman, Aslam, Javed and Hussain (2011) examined the barriers to the successful integration of educational technologies in teaching and learning process at secondary school level in Pakistan. The main objective of the study was to investigate the main barriers to the successful integration of educational technologies in teaching and learning process and to find out the proper ways and means for the successful integration of educational technologies in secondary schools. Descriptive research design was adopted in the study. The study noted that unavailability of technologies was the main barrier to the technology integration. In addition, the study observed that, lack of funding, lack of technical support, lack of necessary skills, lack of administrative support and knowledge and lack of time for preparation were recorded as some of the possible barriers to integration of technologies.

An empirical study conducted by Baya'a and Daher (2013) analyzed the teachers' readiness to integrate information communication technology in the classroom in Israel. The study focused on verifying the readiness of Arab teachers in elementary and middle schools regarding the integration of information communication technology in the classroom. The study used questionnaires to collect data and their findings indicated that the teachers were ready to integrate technologies in teachings. In addition, the study also noted that readiness was represented not only by the teachers' perceptions and attitudes towards integration of technologies in the teaching and learning process, but also their intention to do so.

Ghavifekr and Rosday (2015), in an empirical investigation on effectiveness of information communication technology integration in schools in Malaysia, the study used descriptive research design. The study found that information communication technology has a great effect for teachers and the students. The study also established that equipping the teacher with ICT devices and facilities was one of the main factors in success of technology-based teaching and learning.

A study carried out by Ayotola and Morenikeji (2011) examined the teacher readiness to integrate information technology into teaching and learning processes in Nigerian Secondary schools. The study sought to investigate the level of preparedness of teachers to integrate the information technology in pedagogy. The study adopted descriptive survey design. The studies found that majority of the educators have low level of knowledge about information technology. It also established that majority of teachers had inadequate information technology skills, however they had a positive attitude towards the integration of information technology.

Another study conducted by Ngeze (2017) analyzed the information communication technology in teaching and learning in Secondary schools in Tanzania. The main objective of the study was to look into the readiness of secondary schools to successfully integrate information communication technology during teaching and learning activities, and teachers in terms of knowledge, skills. The study found that teachers were ready to use ICT in their teaching activities if only they had the skills and knowledge to do so. It further noted that most schools did not have information communication technology infrastructure in place.

In an empirical investigation Barde (2017) examined the teachers' readiness for integration of information communication technology in the teaching of Biology in secondary schools in Nigeria. The study focused on investigating the teacher's readiness for information communication technology integration in the teaching of Biology. The study adopted a descriptive survey design. It established that for information communication technology to be effectively adopted in public secondary schools, more emphasis should be put on developing the competence of teachers. It also found out that teachers' perception in terms of using information communication technology was positive but was hindered by other aspects such as unavailability of technology equipment.

Locally, a study conducted by Omariba (2016) examined the teachers' preparedness in integrating information communication technology in training teachers in public primary schools. The main aim was to investigate the preparedness of tutors in integrating information communication technology in teaching and learning process. The study adopted descriptive survey design. The study found that the types of information communication technology available were not adequate and access to computers was poor and with limited internet connectivity. It also concluded that there was lack of proper training in the use of information communication technology and that preparedness in integration of information communication technology was at an infant stage.

A study carried out by Mwai (2015) analyzed the application of instructional technologies in teaching and learning in public secondary schools. The study sought to examine application of instructional technologies in teaching and learning in public

secondary schools in Kiambu Sub-County. The study used mixed methods approach to collect data by using questionnaires and semi structured interviews. The study revealed that most of the instructional technologies were available but inadequate in terms of quantity. It further illustrated that information communication technology application in teaching and learning was low despite capacity in the skills of both teachers and the students.

Another study by Ngatia (2015) examined the level of preparedness of public secondary schools on the use of information communication technology in teaching and learning in Nyeri County-Kenya. Descriptive survey design was adopted. The study revealed that the schools' preparedness was poor with the schools' support being low while the teachers had positive attitudes towards integration of information communication technology in teaching. It was further noted that teachers were not adequately trained and experienced in the use of information communication technology thus very low self confidence in the use of information communication technology in teaching and learning.

## **2.8 Summary of Reviewed Studies and Research Gaps**

The reviewed studies are summarized, critiqued and resultant research gaps presented as illustrated in Table 2.1.

**Table 2.1: Summary of Reviewed Studies and Research Gaps**

<b>Topic</b>	<b>Author(s) &amp; Year</b>	<b>Findings</b>	<b>Research Gaps</b>
Barriers to the successful integration of educational technology in the teaching and learning process at secondary school level in Khyber Pukhtunkhwa Pakistan	Suleman, Aslam, and Javed (2011)	unavailability of technologies is the main barrier to the technology integration. Secondary schools lacked technical support, administrative support, funding, necessary skills and knowledge, and time for preparation.	The study focused on barriers to integration of educational technology as opposed to preparedness of teachers in integrating the aforesaid technologies.
Mathematics teachers' readiness to integrate ICT in the classroom: The case of elementary and middle school Arab teachers in Israel	Baya'a and Daher (2013)	Teachers were ready for the integration of technology in their teachings. Teachers' readiness is represented not only by the perceptions and attitudes of teachers towards integration of technologies in teaching and learning, but also their intention to do so	The study centred on mathematics teachers whereas the present study's focus is on Physics teachers.
Teaching and learning with technology: Effectiveness of ICT integration in schools	Ghavifekr and Rosday (2015)	Information communication technology has a great effect on both, the teachers and students. Teachers being well equipped with ICT tools and facilities is one of the main factors in success of technology-based teaching and learning.	Whereas the study examined the effectiveness of ICT integration, it fell short of analyzing the extent of teachers' preparedness in the ICT integration in schools.
Teacher readiness to	Ayotola	Majority of teachers	The study did not

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integrate information technology into teaching and learning process in Nigerian secondary schools	and Morenikeji (2011)	have low level of knowledge about information technology, but they had a positive attitude towards the use of information technology.	specifically examine the preparedness of Physics teachers in respect of integration of instructional technology.
ICT integration in teaching and learning in secondary schools in Tanzania: Readiness and way forward	Ngeze (2017)	Teachers are ready to use ICT in teaching and learning activities if only they have the skills and knowledge to do so. Most schools do not have information communication technology infrastructure in place.	The study did not adequately articulate the level of teachers' preparedness in reference to ICT integration.
Teachers' readiness for integration of information communication and technology in the teaching of Biology in secondary schools of Bauchi State, Nigeria.	Barde (2017)	For information communication technology to be effectively adopted in public secondary schools, more emphasis should be put in developing the competence of teachers. Teachers' perception in terms of using information communication technology were found to be positive but hindered by other aspects such as unavailability of adequate equipment.	The study centered on teaching of Biology whereas the current study focuses on teaching of Physics following the integration of instructional technologies in schools.

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<p>Teachers' preparedness in integrating information communication technology in training teachers in public primary teacher training colleges in Central Region, Kenya</p>	<p>Omariba (2016)</p>	<p>The types of information communication technology available were not adequate and access to computers was poor with limited internet connectivity. There was lack of proper training on the use of information communication technology and that preparedness in integration of information communication technology was at an initial stage.</p>	<p>The study examined the preparedness of teachers in training teachers instead of preparedness of the aforesaid teachers in inculcating knowledge in students undertaking Physics subject in public secondary schools.</p>
<p>Application of instructional technologies in teaching and learning in public secondary schools in Kiambu Sub-County</p>	<p>Mwai (2015)</p>	<p>Most of the instructional technologies were available but inadequate in terms of quantity. Information communication technology application in the process of teaching and learning was low despite capacity in the skills of both teachers and the students.</p>	<p>The study did not precisely focus on teaching of Physics in public secondary schools.</p>
<p>Preparedness of public secondary schools on the use of information communication technology in teaching and learning in Mukurweini, Nyeri</p>	<p>Ngatia (2015)</p>	<p>School preparedness was poor with school support being low. Teachers had positive attitudes towards integration of information</p>	<p>The study examined the preparedness of schools as opposed to preparedness of Physics teachers in public secondary schools</p>

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County-Kenya	communication technology in teaching, but adequately trained and experienced on the utilization of information communication technology
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This section had delved into literature related to importance of instructional technologies in the teaching process; categories of instructional technologies useful in classroom teaching; level of preparedness of the teacher on integration of instructional technologies; factors which support integration of instructional technologies; factors which hinder integration of instructional technologies; as well as summary of reviewed studies and research gaps. The next chapter focusses on research methodology that guided the research.

## **CHAPTER THREE**

### **RESEARCH METHODOLOGY**

#### **3.0 Introduction**

This chapter gives a description of the research methodology. It describes the study design, location of the study, study population, sampling procedure and sample size, research instruments, piloting, validity and reliability of instruments, data collection procedures, and data analysis methods.

#### **3.1 Research Design**

The study used a mixed research method since the study used both qualitative and quantitative data from questionnaires and interviews as well. The study adopted a descriptive cross-sectional survey design. Hall (2015) postulates that a cross-sectional survey provides a real situation of the population at a given point in time. Descriptive survey is preferred when the researcher wants to establish the extent to which various conditions persist among the subjects (Lin & Jeng, 2015). According to Creswell (2014), descriptive research determines and reports things the way they are without manipulation. It attempts to describe aspects such as possible behavior, values, attitudes, and characteristics. The choice of cross-sectional design, therefore, was premised on the fact that the study was carried out over a specified period of time. Moreover, the descriptive research design was chosen since there was no intention to influence the subjects comprising of teachers of Physics and Science HODs in public secondary schools in Nakuru County.

### **3.2 Location of the Study**

The study was conducted in Nakuru County, Kenya (Appendix C). Nakuru County borders Kiambu, Kajiado, Narok, Nyandarua, Laikipia, Baringo, Bomet and Kericho Counties. This County was selected for this study because of poor academic performance (Table 1.1). These scores were far below the average score. Secondly, it had all categories of schools needed for stratification. Thirdly, the schools in the County were distributed both in rural and urban areas and lastly, it was accessible using its well-developed road network. This implied that the results obtained from this study are generalizable to other counties with little caution.

### **3.3 Target Population**

According to Fischer (2016) target population is described as the aggregate of subjects, entities or persons who share similar or related characteristics. Teachers of Physics and respective heads of science departments working with public secondary schools in Kenya constituted the target population. However, due to the large number of these teachers, the study narrowed down to an accessible population which comprised teachers of Physics and Science HODs working with public secondary schools in Nakuru County. There were 370 teachers of Physics in 301 public secondary schools in Nakuru County by the time of this study. In addition, there was a total of 301 science HODs in the aforesaid schools. Thus, the accessible population totaled 671 members of the teaching staff.

### **3.4 Sampling Procedure and Sample Size**

Sample size refers to the proportion of the population selected by a researcher in order to examine phenomenon under investigation and make generalization to the entire population (Rogelberg, 2014). Sampling procedures on the other hand refers to the steps

that are used to determine the proportion of the population to include in the sample (Adeyinka-Ojo et al., 2014).

### **3.4.1 Sampling Procedure**

A multi-stage random sampling procedure was used. This procedure encompassed both purposive and stratified random sampling techniques. According to Bilgin (2017), multi-stage random sampling is preferred for a large geographical region. Nakuru County was considered wide and with three hundred and one (301) public secondary schools at the time of this study. The choice of stratified random sampling technique was prompted by the heterogeneity in the distribution of teachers of Physics across these categories of schools. Moreover, this method ensured that there was both fair and equitable distribution of respondents across the sampled schools.

According to Gathii et al., (2019) stratified random sampling ensures that the existing cluster groups are reproduced in the final sample. Since not all schools offer Physics as an examinable subject to students, the researcher purposively selected only those schools which had Physics as one of the examinable subjects. Schools were first grouped into National, Extra-County, County, and Sub-County schools. Proportionate representation of teachers of Physics was considered when picking respondents from the various categories of schools.

### **3.4.2 Sample Size Determination**

A representative sample was determined using Nassiuma's (2008) formula as espoused below.

$$n = \frac{NC^2}{C^2 + (N-1)e^2}$$

Where;

n represents sample size

N represents study population (671)

C represents coefficient of variation (21% - 30%)

e represents error margin (0.02 - 0.05)

The above equation is substituted as follows:

$$n = \frac{671(0.3)^2}{0.3^2 + (671-1)0.03^2}$$

$$n = 87.14$$

$$n \approx 88 \text{ respondents}$$

As illustrated above, the sample size constituted a total of 88 respondents. It comprised of 58 (15.7% of 370) teachers of Physics and 30 (10% of 301) Heads of Science departments working with public secondary schools in Nakuru County, Kenya. The sampling was done according to Mugenda and Mugenda (2003) who recommends a sample of 10-50% of the target population for descriptive research. Table 3.1 outlines the various categories of schools, number of schools in each category, sampling ratios and the sample from each category.

**Table 3.1: Sampling Grid for Teachers of Physics and Heads of Science Departments**

<b>School Category</b>	<b>Number</b>	<b>Sampling Ratio</b>	<b>Teachers of Physics</b>	<b>Heads of science departments</b>	<b>Sample</b>
National	4	$(4/301) = 0.0133$	1	0	1
Extra County	17	$(17/301) = 0.0565$	3	2	5
County	15	$(15/301) = 0.0498$	3	2	4
Sub-County	265	$(265/301) = 0.8804$	51	26	78
<b>Total</b>	<b>301</b>	<b><math>(301/301) = 1.00</math></b>	<b>58</b>	<b>30</b>	<b>88</b>

### 3.5 Research Instruments

In this study, data was collected using two instruments which complemented each other. This helped in overcoming intrinsic bias that would have been experienced if only one instrument was used (Hartwig, 2015). The study used a research questionnaire for teachers of Physics (Appendix A) and an interview guide for heads of science departments (Appendix B).

#### 3.5.1 Questionnaire for Teachers of Physics

According to Nicholson (2011), a questionnaire is a standardized set of questions used to gather information from a subject. Nicholson (2011) alludes that, questionnaires are appropriate where relatively simple and quantitative information is required from a large

sampled group. Bryman (2012) observes that questionnaires help the researcher to obtain information from a larger sample in diverse regions and it upholds confidentiality. The questionnaire was structured in that it had closed-ended items in order to facilitate collection of quantitative data. The closed-ended questions had multiple choices from which respondents gave their opinions by ticking without giving reasons for their choices. The various aspects of integration of instructional technologies in the teaching of Physics were measured using five-point Likert scale where; 1= Strongly Disagree (SD), 2=Disagree (D), 3=Not Sure (NS), 4=Agree (A) and 5=Strongly Agree (SA). Such responses were considered as appropriate for collecting primary data which would be specific and precise. This kind of a survey was preferred as it would enable the researcher to make conclusions about the large population in Nakuru County based on data drawn from a relatively small number of teachers of the total population.

### **3.5.2 Interview Guide for HODs**

The study used a semi-structured interview guide (Appendix B) to gather information from the Science HODs working in public secondary schools in Nakuru County. Wanjohi (2014) recommends that a structured interview guide is one of the best interview tools. The author further asserts that structured interviews produce better results than unstructured interviews. In this study, the interview guide helped in gathering information on teacher preparedness to integrate ITs in teaching Physics and its effect on the performance of students in the KCSE.

### **3.6 Piloting**

To ensure that research instruments are understandable, appropriate and with minimal errors, a pilot study was conducted before the commencement of the main study. It also

helped the researcher to establish the feasibility of this study. According to Clements and Sarama (2016) piloting allows for comments on the suitability and clarity of the instruments. The researcher used 9 ( $0.1 \times 88 \approx 9$ ) teachers of Physics to pilot the questionnaires, who were purposively selected across all categories of schools as follows; One (1) in national schools, one (1) in extra County schools, one (1) in County and six (6) Sub County secondary schools. The instruments were administered through the science HODs to eliminate the “Hawthorne effect”. The schools and the staff who participated in the pilot study were excluded from the main study. The items in the instruments which were found vague were duly rectified before the main study. They were either reframed or re-written altogether. The final package of the items was then prepared for the main study. Ideally, the rationale of conducting a pilot study was to determine the validity and reliability of the data collection instrument.

### **3.6.1 Validity of the Research Instruments**

A measurement instrument is valid if it can measure what it is intended to measure (Neuendorf, 2011). Validity is the accuracy and meaningfulness of inferences, based on the results obtained after analysis is done (Hall, 2015). It’s all about whether the data obtained accurately represents the variables of the study (Rogelberg, 2014). Validity of instruments was established using the opinions of teachers and HODs who participated in the pilot study. They evaluated the content of the instruments to advice on face and content validity. The piloted instruments were also useful at rectifying ambiguities in the questions which would have otherwise yielded skewed results. In line with the foregoing, the number of items under each study variable was further adjusted according to the suggestions of the two university supervisors.

### 3.6.2 Reliability of the Research Instruments

Reliability is the measure of the degree of accuracy with which an instrument measures what it is intended to measure (Neuendorf, 2011). It is the consistency of a research instrument across time. A measuring instrument is reliable if it produces consistent results when administered again under similar conditions (Hall, 2015). Reliability of the instrument (research questionnaire) was established by computing the Cronbach's alpha coefficient for each of the study constructs. The results of reliability testing effected on the questionnaire are outlined in Table 3.2.

**Table 3.2: Reliability Test Results**

<b>Study Variable</b>	<b>Test Items</b>	<b>Cronbach's Alpha Coefficient</b>
Availability of instructional materials	8	0.801
Level of teacher preparedness	4	0.770
Factors that support ITs integration	5	0.791
Factors hindering ITs integration	4	0.852
Integration of ITs in pedagogy of Physics	4	0.788
Desirable outcomes	3	0.707

It was established that all the 6 study variables yielded alpha coefficients greater than the minimum threshold of 0.7 as recommended by Creswell (2014). Therefore, the entire research instrument was considered to be reliable for use in collection of requisite data.

### 3.7 Data Collection Procedures

The researcher obtained authorization to collect data from Kenyatta University in form of introduction letter. Before going to the field, the researcher obtained a research permit from the National Commission of Science, Technology and Innovation (NACOSTI) as an authorization to carry out research in the selected schools of Nakuru County. The researcher thereafter organized to visit the selected schools in order to establish rapport and also seek permission from the schools' principals. These visits helped to minimize the "Hawthorne effect" during the actual exercise. The study questionnaire (Appendix A) was administered by the researcher to the sampled (58) teachers of Physics in the sampled schools. They included one ( $\frac{4}{301} \times 58 \approx 1$ ) teacher from national schools, three ( $\frac{17}{301} \times 58 \approx 3$ ) teachers from extra County schools, three ( $\frac{15}{301} \times 58 \approx 3$ ) from County schools and fifty-one ( $\frac{265}{301} \times 58 \approx 51$ ) from Sub County schools. To reduce the limitation of low return rate, the researcher gave teachers time to fill questionnaires and collected them at a later agreed time.

The interview guide was administered by the researcher to the respective Science HODs of the sampled public secondary schools. The HODs were selected proportionately, that is; two ( $\frac{17}{301} \times 30 \approx 2$ ) from extra County schools, two ( $\frac{15}{301} \times 30 \approx 2$ ) from County schools and twenty-six ( $\frac{265}{301} \times 30 \approx 26$ ) from Sub County schools. The time for the interview was agreed upon by the researcher and each sampled HOD. During the interview, the researcher made brief notes with the respondents' permission and after the interview, the notes were summarized in themes.

### **3.8 Data Analysis**

The collected data were screened to ensure that it was in conformity with the instructions hitherto provided. This served to reduce or eliminate outliers which would otherwise have compromised the integrity of the study findings. Data analysis was conducted using the Statistical Package for Social Sciences (SPSS) Version 24.0 tool. Precisely, descriptive statistics comprising of frequencies, means, percentages, and standard deviations were used. In addition, inferential statistics which were used included Pearson's Product Moment Correlation Coefficient (PPMCC) and multivariate regression analysis. Pearson's Product Moment Correlation Coefficients were used to determine the relationships between each independent variable to desirable outcomes in the KCSE. Regression analysis on the other hand was used to give the influence of teachers' capability to integrate ITs as characterized by availability of ITs, level of preparedness to integrate ITs in teaching Physics, factors which support and factors which hinder integration of ITs on achieving desirable outcomes in KCSE Physics. The research hypotheses were tested using regression results. The results emanating from the analyzed data were presented in tabular form and also in narrative form. Table 3.3 shows the data analysis plan.

**Table 3.3: Analysis of Variables**

<b>Objective</b>	<b>Statistics</b>
i. To establish the influence of availability of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.	Frequencies, percentages, means, standard deviations, Pearson's Product Moment Correlation Coefficient and multivariate regression analysis
ii. To determine the influence of teacher preparedness to integrate instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.	Frequencies, percentages, means, standard deviations, Pearson's Product Moment Correlation Coefficient and multivariate regression analysis
iii. To establish the influence of factors supporting integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.	Frequencies, percentages, means, standard deviations, Pearson's Product Moment Correlation Coefficient and multivariate regression analysis
iv. To determine the influence of factors hindering integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.	Frequencies, percentages, means, standard deviations, Pearson's Product Moment Correlation Coefficient and multivariate regression analysis

### **3.9 Ethical considerations**

The researcher consulted all concerned persons, committees and authorities to be allowed to go on with the study. This comprised of authorization from Kenyatta University and NACOSTI. Participation in this study was made voluntary to the sampled teachers. The researcher took the responsibility of ensuring that high level of confidentiality of data was observed. The researcher also desisted from seeking to collect sensitive data or data that could infringe on the privacy of the respondents. Moreover, data collected and the findings thereof were exclusively to be used for academic purposes.

## CHAPTER FOUR

### DATA ANALYSIS, PRESENTATION AND DISCUSSIONS

#### 4.1 Introduction

This chapter presents the results of data analyses, interpretations and pertinent discussions. The first part illustrates the response rate. This is followed by demographic information of the respondents and their respective public secondary schools. The descriptive and inferential results relative to integration of instructional technologies and performance of students in Physics in the aforesaid schools are presented, interpreted and discussed.

#### 4.2 Response Rate

This refers to the proportion of the number of respondents who actually took part in the study vis-à-vis the total number projected to participate in the study (Sloan & Quan-Haase, 2017). In line with the unit of analysis or sample size, a total of 58 questionnaires were administered to the teachers of Physics. On the other hand, the researcher projected to interview a total of 30 heads of science departments. Table 4.1 shows the response rate achieved from the study.

**Table 4.1: Response Rate**

<b>Respondents</b>	<b>Sample</b>	<b>Response</b>	<b>Response Rate (%)</b>
Teachers of Physics (Questionnaires)	58	49	84.48
Heads of Science Departments (Interviews)	30	30	100.00

<b>Respondents</b>	<b>Sample</b>	<b>Response</b>	<b>Response Rate (%)</b>
Teachers of Physics (Questionnaires)	58	49	84.48
Heads of Science Departments (Interviews)	30	30	100.00
<b>Total</b>	<b>88</b>	<b>79</b>	<b>89.77</b>

Out of the 58 issued questionnaires to teachers of Physics, 49 questionnaires were completed and collected by the researcher for subsequent analysis. This represented 84.48% response rate. All 30 interviews projected were successfully conducted which represented 100% response rate. Creswell (2014) noted that a response rate of 80% is adequate to make generalization of the study findings to the target population. The overall response rate, therefore, was 89.77% which was considered acceptable in a survey study.

### **4.3 Demographic Information of the Respondents**

Various demographic information regarding teachers of Physics in public secondary schools in Nakuru County was examined. These included gender, schools' categories, teaching experience, and the extent of integration of instructional technologies in teaching of Physics. On the distribution of teachers of Physics by gender, the results were as presented in Table 4.2.

**Table 4.2: Gender of Teachers of Physics**

<b>Gender</b>	<b>Frequency</b>	<b>Percentage</b>
Male	43	87.8

Female	6	12.2
<b>Total</b>	<b>49</b>	<b>100.0</b>

As shown in Table 4.2, it was revealed that majority (87.8%) of teachers of Physics working with public secondary schools in Nakuru County were male while only 12.2% were female. These results indicates that teachers of Physics in Nakuru County were majorly dominated by male teachers. The results underlined the stereotype that most females shy away from pursuing science courses including teaching the same (Mulambe, 2017). The study further examined the academic qualifications of teachers of Physics in Nakuru County. This information is presented in Table 4.3.

**Table 4.3: Highest Academic Level of Respondents**

<b>Highest Qualifications</b>	<b>Frequency</b>	<b>Percentage</b>
Diploma	6	12.2
Undergraduate	35	71.4
Postgraduate	8	16.3
<b>Total</b>	<b>49</b>	<b>100.0</b>

The researcher found that most of the teachers (71.4%) possessed undergraduate degree. A significant number (16.3%) of the teachers had a postgraduate degree with only 12.2% possessing a diploma certificate. The results implied that teachers of Physics in public secondary schools of Nakuru County were qualified enough to teach Physics in secondary school for the minimum requirement to teach in secondary school is at least a

diploma (Mwangi & Njuguna, 2019). This further implied that the teachers were knowledgeable on the instructional technologies in pedagogy of Physics in public secondary schools and thus the study was able to obtain valid and reliable data. Teachers who participated in this study were drawn from all categories of public secondary schools as illustrated in Table 4.4.

**Table 4.4: Distribution of Teachers of Physics by School Category**

<b>School Category</b>	<b>Frequency</b>	<b>Percentage</b>
National schools	1	2.0
Extra-County schools	3	6.1
County schools	3	6.1
Sub-County schools	42	85.8
<b>Total</b>	<b>49</b>	<b>100.0</b>

It was established that most (85.8%) of the participating teachers of Physics were drawn from Sub-County schools while 2% of them were drawn from National schools. It was also revealed that 6.1% of them were from extra County schools and the same proportion were from County schools. These results were attributed to the fact that, Nakuru County had only 4 National Schools and 265 Sub County schools. This implied that the distribution of the teachers across the school categories were proportional to the distribution of the categories of schools and thus the findings can be generalizable to the entire study population. With regard to teaching experience, study results were represented in Table 4.5.

**Table 4.5: Distribution of Teachers of Physics by Work Experience**

<b>Teaching Experience in Years</b>	<b>Frequency</b>	<b>Percentage</b>
5 and below	15	30.6
5-9	10	20.4
10-14	10	20.4
15 and above	14	28.6
<b>Total</b>	<b>49</b>	<b>100.0</b>

The study observed that majority (30.6%) of the teachers of Physics who took part in the study had taught Physics for a period of less than 5 years (Table 4.4). However, almost a similar number (28.6%) had taught Physics for duration of 15 years and above. The study further found that 40.8% of the teachers had a teaching experience of between 5-14 years. The results implied that there was reduction of uptake of Physics as a teaching subject among graduating teachers as compared to the last five years. The study further examined the teaching experience of the sampled teachers of Physics in their current schools. These results are as shown in Table 4.6.

**Table 4.6: Distribution by Experience of Teaching Physics in Current school**

<b>Teaching Experience in Years in the Current School</b>	<b>Frequency</b>	<b>Percentage</b>
1 and below	4	8.2
1-5	28	57.1
6-10	11	22.5
10 and above	6	12.2
<b>Total</b>	<b>49</b>	<b>100.0</b>

The results shown in Table 4.6 revealed that 57.1% of the teachers had taught in their current respective schools for a period ranging from 1 to 5 years. It was also found that 8.2% of the teachers had taught for less than one year, and 22.5% taught for between 6 and 10 years. Only 12.2% of the surveyed teachers had been working in their present workstations for a period of more than 10 years. The findings implied that there were frequent transfers of teachers of Physics in public secondary schools in Nakuru County.

The study further interviewed the heads of science departments (HODs) in charge of public secondary schools in Nakuru County with regard to preparedness of teachers of Physics to integrate instructional technologies in teaching in their respective institutions. Table 4.7 shows the working experience of Heads of Department.

**Table 4.7: Distribution of Heads of Department by Working Experience**

<b>Working Experience in Years</b>	<b>Frequency</b>	<b>Percentage</b>
5 and below	14	46.7
6 to 9	9	30.0
10 and above	7	23.3
<b>Total</b>	<b>30</b>	<b>100.00</b>

It was revealed as shown in Table 4.7, that majority (46.7%) of the HODs had worked with secondary schools in their current position for a period of less than 5 years. However, 30.0% of them had been working as HODs for duration of 6 to 9 years. The remaining proportion (23.3%) had worked as HODs for at least 10 years. Interpretatively, to be selected to head the Science department, a teacher had to have considerable teaching experience. That experience helps the HODs in inducting new teachers in their departments. KCSE Physics Enrolment rate in 2015, 2016 and 2017 is as shown in Table 4.8.

**Table 4.8: KCSE Physics Enrolment in 2015, 2016 and 2017**

<b>Students' Enrolment</b>	<b>2015 (%)</b>	<b>2016 (%)</b>	<b>2017 (%)</b>
9 and below	23.1	0	7.7
10 – 25	15.4	38.5	23.1
26 – 50	30.8	23.1	38.5
51 – 75	15.4	15.4	7.7
76 – 100	0	7.7	7.7
101 and above	15.4	15.4	15.4
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

As displayed in Table 4.8, whereas in 2015, 23.1% of public secondary schools recorded less than 10 Physics students, the number dropped to 0% the following year. The increment of the same in 2017 to 7.7% could have been occasioned by other schools that newly introduced Physics as an examinable subject. It could also have been caused by a high dropout rate in some of the schools. However, the number of schools with more than 100 Physics students remained constant at 15.4% over the three years period. These schools could probably be national or extra county schools which have a huge population. Many schools enrolled between 26 and 50 students for KCSE in each year. This is probably because Physics is not a compulsory subject in forms three and four. The number of students who were doing Physics in the KCSE kept on fluctuating during the three years. The study also sought to find out the average number of candidates enrolled per class. The results were recorded in Table 4.9.

**Table 4.9: Average Number of Students per candidate Class**

<b>Students per Class</b>	<b>Frequency</b>	<b>Percentage</b>
51 and above	8	26.6
26 – 50	20	66.7
25 and below	2	6.7
<b>Total</b>	<b>30</b>	<b>100.0</b>

As shown in Table 4.0, most of the schools (66.7%) offering Physics, had an average of between 26 and 50 students per class. Only 6.7 % had at most 25 students per candidate class. The results implied that the surveyed schools had modest ratio of teachers to students which is within the recommended ratio of 1:40 (Miller, 2017). It also implied that Physics subject popularity has gone up and more students have been taking have been enrolling for Physics KCSE examination. This is probably due to the fact that Physics has been one of the cluster subjects which qualifies one to join some of the most competitive courses in the universities like engineering and medicine (Mulambe, 2017). In addition, the study sought to know the most preferred category of media which could ensure quality teaching of Physics. The sampled teachers of Physics in public secondary schools in Nakuru County were asked to indicate their opinion to this effect. Their views were summarized in Table 4.10.

**Table 4.10: Teachers' Recommendation on Media Category for Ensuring Quality Physics Teaching**

Category of Media	Frequency	Percentage
Visual	1	2.0
Audio-visual	32	65.3
Interactive media	16	32.7
<b>Total</b>	<b>49</b>	<b>100.0</b>

The results shown in Table 4.9 illustrates that audio-visual media was highly recommended by the teachers of Physics at 65.3%. These findings agree with Wambugu et al., (2014) assertion that teachers of Physics should use a multisensory approach to supplement verbal explanation of concepts or any description to make Physics lessons real. These were followed by the interactive media (32.7%) while visual media were the least preferred since only 2.0% of the sampled teachers showed a preference towards them. Therefore, it is imperative to infer that, the management of public secondary schools should emphasize more on audio-visual media such as computers and tablets in teaching of Physics in their respective schools in order for those institutions to achieve impressive performance in the aforesaid subject. In tandem with the foregoing, teachers were asked to indicate their opinion with regard to the extent of integration of instructional technologies in pedagogy of Physics in their respective schools. Their views are as shown in Table 4.11.

**Table 4.11: Technologies Integration in Teaching of Physics in Public Secondary Schools**

<b>Extent of Integration</b>	<b>Frequency</b>	<b>Percentage</b>
Large extent [61 to 100%]	5	10.2
Moderate extent [ 31 to 60% ]	31	63.3
Small extent [1 to 30% ]	12	24.5
No integration at all [ 0% ]	1	2.0
<b>Total</b>	<b>49</b>	<b>100.0</b>

It was observed in Table 4.11 that in majority of public secondary schools (63.3%) in Nakuru County, instructional technologies had been integrated to a moderate extent (31-60%). This meant that instructional technologies were integrated in most of their lessons. Those that had not integrated the said technologies constituted only 2.0% of all public secondary schools in the County. Other schools (24.5%) had either integrated technology in teaching of Physics to a small extent (1 – 30%) while 10.2% of the sampled schools had integrated ITs to a large extent (61 -100%). Commensurate to the distribution of various categories of public secondary schools in Nakuru County (Table 4.3), it is very probable that the schools which had integrated technologies in teaching of Physics to a large extent were National and extra County schools. County schools had integrated the aforesaid technologies to a moderate extent while most of the Sub-County schools had integrated the same to a small extent (1-30%). The schools which had not integrated the technologies in the teaching of Physics were most probably located at the remote areas of

the County where the supporting infrastructure were lacking at the time this study was conducted.

#### **4.4 Descriptive Findings of the Study**

In this section, the results regarding various aspects of integration of instructional technologies in the teaching of Physics and the desirable outcomes in KCSE in public secondary schools are presented. The various aspects of integration of instructional technologies in the teaching of Physics were measured using five-point Likert scale where; 1= Strongly Disagree (SD), 2=Disagree (D), 3=Not Sure (NS), 4=Agree (A) and 5=Strongly Agree (SA).

The descriptive results are presented in terms of percentages, mean scores and standard deviation According to Bilgin (2017), a high percentage of certain response indicates that majority of the respondents are in agreement to the response. On the other hand, in using a five point Likert scale where; 1= Strongly Disagree (SD), 2=Disagree (D), 3=Not Sure (NS), 4=Agree (A) and 5=Strongly Agree (SA), Ruijuan et al., (2016) asserts that a mean score of less than 3.00 indicates that on average the respondents tended to disagree while a mean score of more than 3.00 indicates that on average the respondents tended to agree with the corresponding statement. In respect to the standard deviation, a standard deviation of more than 1.00 implies that the respondents were not in consensus in rating the corresponding metric and thus the large spread of the responses (Clements & Sarama, 2016). A standard deviation of less than 1.00 implies that there is a small spread of responses among the respondents and thus consensus in rating the corresponding metric (Clements & Sarama, 2016).

#### 4.4.1 Availability of Instructional Technologies

The first objective of the study sought to identify the types of instructional technologies available for teaching secondary school Physics in Nakuru County, Kenya. This objective was achieved by the respondents answering the question: Which instructional technologies are available for use in teaching secondary school Physics in Nakuru County? In order for the respondents to answer this question, the researcher used the questions in section B of the questionnaire. The section had 8 questions on a five level Likert scale which were answered by 49 respondents. Table 4.12 shows the descriptive findings of the available instructional technologies for teaching Physics.

**Table 4.12: Descriptive Findings for Availability of Instructional Technologies**

Availability of Instructional Technologies	SA	A	NS	D	SD	Mean	Std. Dev
There are enough Physics textbooks in my class at a ratio of 1 book to 1 student.	69.4	20.4	0.0	8.2	2.0	4.47	1.002
In my class conventional media resources (e.g., photographs, charts, real objects, and white boards) are regularly used in teaching Physics.	20.4	61.2	6.1	10.2	2.2	3.88	0.927
There is regular use of modern/digital media resources (e.g., computers, laptops, Smart phone and CDs) in teaching Physics lessons.	14.3	59.2	4.1	16.3	6.1	3.59	1.117
Our school has sufficient resources which may help ensure quality education is given to learners.	12.2	57.1	0	6.1	24.5	3.57	1.000
There is uninterrupted Internet access in our school.	14.3	22.4	10.2	32.7	20.4	2.78	1.388
Internet is completely integrated in teaching of Physics.	2.0	10.2	4.1	49.0	34.7	2.45	1.062
Students are often allowed to use the Internet during Physics lessons.	2.0	10.2	4.1	49.0	34.7	1.96	0.999
As a teacher of Physics, I have been given a tablet by the school to facilitate my teaching.	2.0	12.2	0.0	24.5	61.2	1.69	1.103
<b>Overall</b>						<b>3.05</b>	<b>1.075</b>

Focusing on the percentages, established that most of the respondents (89.8%) were of the view that there were enough Physics textbooks in their classes at a ratio of one book to one student; conventional media resources such as photographs, charts, real objects, and white boards were regularly used in teaching Physics (81.6%); and that there was regular use of modern or digital media resources like computers, laptops, Smart phone and Compact discs in the teaching of Physics lessons (73.5%) in public secondary schools in Nakuru County. Moreover, it was revealed that while majority (69.3%) of the sampled teachers concurred that their respective schools had sufficient resources which would help ensure that quality education was given to learners. Almost a third of the teachers (30.6%) disputed this assertion. Slightly more than half of the respondents (53.1%) disputed that there was uninterrupted internet access in their schools; 83.7% also disputed the assertion that internet was completely integrated in teaching of Physics; students were often allowed to use the Internet during Physics lessons; and that Physics teachers had been given tablets by their respective schools to facilitate their teaching (85.7%).

Focusing on the mean scores, it was admitted that public secondary schools in Nakuru County had sufficient Physics textbooks where every student had a Physics textbook (mean = 4.47); conventional media resources were regularly employed in teaching Physics (mean = 3.88); there was regular use of modern/digital media resources in teaching Physics lessons (mean = 3.59); and that the aforesaid schools had sufficient resources that could have aided in ensuring quality education was given to learners (mean = 3.57). This is because of mean score more than 3.00 on the above statements on availability of instructional technologies.

However, the sampled teachers on average disagreed that their schools had uninterrupted Internet access (mean = 2.78); Internet had completely been integrated in teaching of Physics (mean = 2.45); students were often allowed to use Internet during Physics lessons (mean = 1.96); and that teacher of Physics had been provided with tablets to facilitate their teaching (mean = 1.69). This is because of mean score of less than 3.00.

In regard to the achieved standard deviation, it was revealed that the views of the respondents were largely divergent in rating the availability of enough Physics textbooks in my class at a ratio of 1 book to 1 student (std dev = 1.002); the regular use of modern or digital media resources (std dev = 1.117); sufficiency of resources which may help ensure quality education is given to learners (std dev = 1.000); availability of uninterrupted internet access in the school (std dev = 1.388); internet being completely integrated in teaching of Physics (std dev = 1.062); and availability of tablet provided by the school to facilitate teaching (std dev = 1.103).

This implies that on these metrics the teachers held divergent views and that there was no consensus on the availability of these resources. This could be due to heterogeneity of the sampled school in terms of integration of instruction technologies in teaching Physics as well as different resource endowment across the sampled schools. In respect to this, the schools with high resources had most of the instructional technologies in their school while those schools with low resources lacked the instructional resources for teaching Physics.

On the other hand, the study found that there was consensus among the respondents in rating the availability of regular use of conventional media resources (std dev = 0.927), and students being allowed to use the internet during Physics lesson (std dev = 0.999). This implied that the respondents were in consensus in agreeing that conventional media resources such as photographs, charts, real objects, and white boards are regularly used in teaching Physics. It further implied that the teachers were also in consensus in disagreeing that the students are often allowed to use the internet during Physics lessons. The consensus among the teachers in regard to the two items implied that almost all the sampled schools were homogeneous in terms of the use of conventional media resources and internet during Physics lessons.

The overall mean score was 3.05 which implied that on average the instructional technologies for teaching Physics were available in the sampled public secondary schools in Nakuru County. This is because the overall mean score was slightly above 3.00. The overall standard deviation was 1.075 which implied that each of the sampled schools had different level of availability of the instructional technologies for teaching Physics and thus the overall divergence of views. This further implied that among the sampled schools, any intervention in regard to the instructional technologies for teaching Physics should be school-specific and not universal for all schools.

According to Sale (2016), textbooks help the teacher and the learners when planning for a classroom activity. Conventional media are visual aids are useful when it comes to stimulating, motivating and focusing learner's attention in the classroom environment (Chukwudi et al., 2018). This in turn arouses learners' interest and enhance the teacher's explanation to concepts. Digital media on the other hand is more interactive than

traditional teaching methods as they allow one to reach out to more students (Jobo, 2016). Bridwell-Mitchell (2015) observes that digital content such as YouTube keeps students awake, makes them happy and that they don't even realize how much time has passed when they are watching videos for any purpose. The students are usually attracted to videos because of the inclusion of both the audio and visual effects. They also allow the educator to disseminate new concepts faster (Sharp & Sharp, 2017).

The views of HODs on adequacy of Physics textbooks were collected through interview guides. The descriptive findings of their views were presented in Table 4.13.

**Table 4.13: Adequacy of Physics Textbooks to Student Ratio**

<b>Physics Books</b>	<b>Percentage</b>
Adequate	83.33
Inadequate	16.67
<b>Total</b>	<b>100.0</b>

According to the results indicated in Table 4.13, the study revealed that 83.33% of public secondary schools in Nakuru County which offered Physics had adequate number of textbooks. This means there was minimal or no sharing of Physics textbooks by students in these schools, a factor which could have contributed to their improved performance in the national examination. The HODs were interviewed on available resources useful in raising their schools' mean standard score and whose views are presented in Table 4.14.

**Table 4.14: Available Resources for Raising Physics Mean Standard Score**

<b>Available Resources</b>	<b>Percentage</b>
Text books, laboratory equipment/apparatus,	30.8
Projectors, personal laptops	7.7
Past papers / revision materials	15.4
Improvised teaching materials, real objects, photos, charts	15.4
ICT materials, Internet, DVDs	30.8
<b>Total</b>	<b>100.0</b>

Table 4.14 indicates that most of the surveyed schools (30.8%) had textbooks and laboratory equipment/apparatus as the key resources they employed to raise the performance of students in Physics. One of the interviewed HOD said that;

**Excerpt 1:** *“We use mainly textbooks, laboratory equipment, personal laptops and personal phones to raise the mean standard score of Physics.”*

A considerable number of schools (30.8%) used ICT materials, internet and DVDs to raise their academic performance in the aforementioned subject. It was also found that 15.4% of schools used past papers and revision materials while an equal number (15.4%) used improvised teaching materials, real objects, photos and charts to teach in order to improve their schools’ mean standard score. Notably, only 7.7% used projectors and personal laptops as means of boosting their KCSE Physics performance. The HODs through interviews outlined ways of dealing with Physics experiments whose views are presented in Table 4.15.

**Table 4.15: Ways Teachers Deal with Physics Experiments**

<b>Ways of Dealing with Experiments</b>	<b>Percentage</b>
Visual demonstrations and observations	38.5
Videos and computer simulations, YouTube, DVDs	30.8
Using available resources within the compound	7.7
Power point presentations, computers, laptops	7.7
Manipulated data, improvisation	15.4
<b>Total</b>	<b>100.0</b>

According to the sampled HODs, Physics teachers employed various ways in handling Physics experiments outside of laboratories (Table 4.14). Most of them (38.5%) held the view that visual demonstrations and observations played a critical role in Physics experiments conducted outside of laboratories. According to Ganyaupfu (2014), demonstration is very useful mostly when the classroom size is large. Those who used videos, DVDs, YouTube and Computer simulations stood at 30.8%. The videos are used to stimulate, motivate as well as focus learners' attention during the learning process (Kini & Podolsky, 2016). In support of this, one of the interviewed head of departments said that;

**Excerpt 2:** *“In this era of computers and smart phones, there are so many videos and computer simulations that the teacher may download from the internet. They can be used to supplement experiments as they can be watched more than once and at individual level.”*

There were some (7.7%) who used available resources in the compound while 7.7% used PowerPoint presentations, computers and laptops. There was another group of HODs (15.4%) who said that they used manipulated data and improvisation. According to Ngatia et al., (2019), there is always a need to use other methods to supplement the experiments as this helps the teacher to handle those experiments which are either dangerous or when the requirements are unavailable. ITs are also helpful when the class size is huge and laboratory materials inadequate or unaffordable. It is also safer to use digital content for the otherwise dangerous experiments. The HODs were also interviewed on their roles in the purchase of instructional materials and their views were presented in Table 4.16.

**Table 4.16: Roles of HODs in Purchase of Teaching Materials for Physics**

<b>Roles</b>	<b>Percentage</b>
Suggesting or recommending materials to be bought	23.1
Check available materials, follow-up, order, inspection of delivered materials	76.9
<b>Total</b>	<b>100.0</b>

It was further revealed as shown in Table 4.16, that HODs played various roles in the purchase of teaching materials for Physics. Majority (76.9%) stated that they were involved in checking available materials, preparing requisitions, making follow-ups, and inspecting the delivered materials. Slightly less than a quarter (23.1%) made suggestions or recommendations in regard to the Physics materials to be bought. These results

underline the significant part HODs played in the purchase of pertinent Physics materials and the subsequent availability of teaching materials in their respective departments. It is expected that the HODs should ensure that their departments get the necessary supplies which would in turn ensure a successful implementation of the instructional programs. One of the interviewed HODs said that;

**Excerpt 3:** *“My role in the acquisition of instructional technologies includes preparation of a requisition, receiving the materials when they are delivered and inspection of these materials to ascertain whether the right quality and quantity was delivered.”*

Through interviews, the science HODs’ views on reliability of internet connectivity were sought and the results presented in Table 4.17.

**Table 4.17: Reliability of Internet Connectivity in Schools**

<b>Reliability</b>	<b>Percentage</b>
Reliable	38.5
Unreliable	61.5
<b>Total</b>	<b>100.0</b>

The results shown in Table 4.17 revealed that majority of public secondary schools (61.5%) in Nakuru County had unreliable internet connectivity with only 38.5% having reliable internet connectivity. These findings could be premised on the fact that majority of the aforesaid schools were based in rural or remote areas where there was inadequate infrastructure to support internet connectivity. In line to this, Silla et al., (2018) indicated

that there was low connection of internet in most of the schools to aid in teaching science subjects. The researcher further enquired from the HODs on accessibility of digital teaching materials by Physics teachers. Their views in this regard are presented in Table 4.18.

**Table 4.18: Accessibility of Digital Teaching Materials by Physics Teachers**

<b>Accessibility of Digital Teaching Materials</b>	<b>Percentage</b>
Have access	75.0
Do not have access	25.0
<b>Total</b>	<b>100.0</b>

The study established that most (75%) of teachers of Physics in public secondary schools in Nakuru County had access to digital teaching materials such as laptops, smart phones and tablets. The digital materials included those provided by the schools and the ones which belonged to teachers such as the smartphones. However, 25% did not have such access. This limitation was probably as a result of the financial constraints, unreliable internet network and electricity mainly in the rural areas. The HODs also gave their views on whether the students were allowed to use internet in school and their views were presented in Table 4.19.

**Table 4.19: Students Allowed to Use the Internet in School**

<b>Use the Internet in School</b>	<b>Percentage</b>
Yes	38.5
No	61.5
<b>Total</b>	<b>100.0</b>

The results of the interviews shown in Table 4.19 indicated that according to heads of science departments, only 38.5% of public secondary schools in Nakuru County allowed students to access the internet. Most likely, the schools were mainly the national, extra County and County schools and those in urban areas. The rest (61.5%) did not allow students to access such, largely, due to the unavailability of supporting resources in those schools. This limitation may have been occasioned by limited internet connectivity as most schools had no Wi-Fi network and enough computers to facilitate integration. This study further sought to find out on the limitation to the use of the internet as presented in Table 4.20.

**Table 4.20: Limitations on Internet Use by Students**

<b>Internet Limitations</b>	<b>Percentage</b>
Limit	62.5
No Limit	37.5
<b>Total</b>	<b>100.0</b>

Out of the number of public secondary schools which allowed their Physics students to use the internet while in school, majority (62.5%) limited the accessibility and how such internet was used (Table 4.20). In line to this, one of the Science HOD said that;

**Excerpt 4:** *“It is highly advisable to limit the time and how student and even the sites they visit. Some of them, if allowed could use it to watch harmful or irrelevant content”.*

A few schools (37.5%) on the other hand allowed the students to use the internet without limitation. These findings reflect maximization of the internet in respect to promoting students' performance in Physics in the KCSE while at the same time exposing abuse of the internet by potentially truant students (Awusabo-Asare et al., 2017).

#### 4.4.2 Level of Preparedness of Physics Teachers

The second objective of the study sought to determine the level of preparedness of teachers of Physics to integrate instructional technologies in teaching secondary school Physics in Nakuru County. This objective was achieved by the respondents answering the question: How prepared are the teachers of Physics to integrate instructional technologies in teaching secondary school Physics? In order for the respondents to answer this question, the researcher used the questions in section C of the questionnaire. The section had 4 questions on a five level Likert scale which were answered by 49 respondents. Descriptive findings from respondents' views in regard to level of preparedness of the teacher to integrate instructional technologies in teaching Physics in their respective public secondary schools is presented in Table 4.21.

**Table 4.21: Descriptive Findings for Level of Preparedness**

Level of Preparedness	SA	A	NS	D	SD	Mean	Std. Dev
I currently use ITs in preparing schemes of work, lesson plans and mark sheets	16.3	65.3	0.0	18.4	0.0	3.80	0.935
When in college/university, I learnt technology education	16.3	63.3	0.0	20.4	0.0	3.76	0.969
I frequently use ITs in-teaching Physics	8.2	61.2	4.1	26.5	0.0	3.51	0.982
Over the last three years I have participated in professional development	6.1	55.1	6.1	0	32.7	3.35	1.011

related to integration of ITs in the teaching of Physics

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<b>Overall</b>	<b>3.61</b>	<b>0.974</b>
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According to the results shown in Table 4.21, the study found out that 81.6% of the sampled teachers of Physics admitted to be currently using ITs in preparing schemes of work, lesson plans and mark sheets. A total of 79.6% of the aforesaid teachers concurred that when they were in college or university, they learnt technology education. Whereas 69.4% of teachers admitted to frequently use ITs while teaching Physics, a sizeable number (26.5%) disagreed. Over the previous three years prior to the research period, majority of the teachers (61.2%) admitted to have participated in professional development courses related to integration of ITs in the teaching of Physics. However, 32.7% had not participated in the professional development courses related to integration of ITs in the teaching of Physics.

On average, it was admitted that teachers of Physics working in public secondary schools in Nakuru County were at the time of conducting this study, using ITs in preparing schemes of work, lesson plans and mark sheets. This is because of a mean score of 3.80, which is greater than 3.00 and standard deviation less than 1.000 (std dev. = 0.935). This implied that the teachers were in consensus in agreeing that they used IT in preparing schemes of work, lesson plans and mark sheets. These findings concurs with those by Mulambe (2017) who noted that teachers used ICT to make schemes of work, lesson plans and mark sheets as well as timetables.

The study further observed that on average, the teachers tended to agree that they learnt technology education when in their respective colleges or universities. This is due to a

mean score greater than 3.00 (mean = 3.76) and standard deviation less than 1.000 (std dev. = 0.965). This therefore implied that respondents were in consensus in agreeing that they learnt technology education when in their respective colleges or universities. In agreement to this, Sariah et al., (2018) found that majority of the teachers underwent ICT training courses in their college as they were training to become teachers.

It was further observed that the sampled teachers were on average in agreement that they frequently used IT in teaching Physics (mean = 3.51, std dev. = 0.982). The mean score greater than 3.00 achieved in regard to this metric implied that respondents trended to agree on average that they frequently used ITs in teaching Physics. Their views in respect to this metric did not vary significantly since the standard deviation was less than 1.000 and thus consensus among the Physics teachers. In line to this, Wambugu and Changeiywo (2018) observed that teachers often integrated ICT in the teaching of science subjects in order to improve the level of student understanding.

In regard to participation in professional development courses related to integration of ITs in the teaching of Physics, a mean score of 3.35 and a standard deviation of 1.011 were achieved. The achieved mean score implied that on average the teachers tended to agree that they participated in professional development courses related to integration of ITs in the teaching of Physics (mean greater than 3.00). However, there was lack of consensus among the teachers in rating this metric as evidenced by a standard deviation greater than 1.000.

The overall mean score of 3.61 implied that on average the teachers of Physics prepared for the integration of instructional technologies in the teaching of Physics. On the other

hand, the overall standard deviation of 0.974 implied that on average the respondents were in consensus in rating teacher preparedness to integrate instructional technologies in teaching Physics. Altun (2015) contends that for the teacher to effectively integrate technologies in teaching, one needs to have content knowledge and should have the exposure on how to integrate instructional technologies in teaching. The government has put in an ICT policy to guide teachers on how to integrate technologies.

Science HODs were interviewed on whether teachers in their schools attended in-service training. Their views on attendance of in-service training by Physics teachers are presented in Table 4.22.

**Table 4.22: Attendance of In-service Training by Physics Teachers**

<b>Attendance of In-service Training</b>	<b>Percentage</b>
Attend	69.2
Do not attend	30.8
<b>Total</b>	<b>100.0</b>

According to the results shown in Table 4.22, most of the public schools in Nakuru County (69.2%) had their teachers of Physics attend in-service training while only 30.8% expressed a contrary opinion. It was, however, not clear what occasioned some schools to have their teachers of Physics attending the aforementioned training while others failed to do so. It may have been caused by teachers' attitude towards the in-service training when it is done far from the working station since it may have a financial implication on them. In line to this, Mwangi and Njuguna (2019) found that most of teachers were able to

attend professional development courses in order to improve the effectiveness of the teachers.

HODs were further asked whether they agreed with the assertion that in-service training equipped Teachers with requisite skills to integrate ITs in pedagogy of Physics. Their views are presented in Table 4.23.

**Table 4.23: In-Service Training Equip Teachers with Requisite Skills to Integrate ITs**

<b>Effectiveness of In-Service Training</b>	<b>Percentage</b>
Yes	88.9
No	10.1
<b>Total</b>	<b>100.0</b>

It was established as shown in Table 4.23, that almost all (88.9%) of the teachers of Physics who attended in-service training were equipped with necessary skills to integrate instructional technologies in teaching of Physics. These results underscore the importance of the aforesaid training. Wanjala et al., (2019) found that in service training among teachers is effective at improving the quality of the teachers. The study sought to find out how HODs ensured that teachers prepare well for physics lessons and whose findings were presented in Table 4.24.

**Table 4.24: How HODs Ensure Teachers Prepare Well for Physics Lessons**

<b>Lesson Preparation</b>	<b>Percentage</b>
Ensure TPAD files have lesson observations schedules	9.1
Supervision: Ensuring they prepare instructional materials e.g., lesson notes, lesson plans, schemes of work, digital content etc.	36.4
Ensure teachers have all professional documents and confirming they are up-to-date.	18.2
Check whether teachers attain set targets.	9.1
By checking students' performance.	9.1
Avail adequate instructional materials and instructional technologies, discuss subject content delivery methods between HODs and teachers.	18.2

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Ensure TPAD files have lesson observations schedules	9.1
Supervision: Ensuring they prepare instructional materials e.g., lesson notes, lesson plans, schemes of work, digital content etc.	36.4
Ensure teachers have all professional documents and confirming they are up-to-date.	18.2
Check whether teachers attain set targets.	9.1
By checking students' performance.	9.1
Avail adequate instructional materials and instructional technologies, discuss subject content delivery methods between HODs and teachers.	18.2
<b>Total</b>	<b>100.0</b>

The results shown in Table 4.23 led to the observation that in order to ensure that teachers prepared well for Physics lessons, most of the HODs (36.4%) made sure that the teachers prepared learning and teaching materials such as lesson notes, lesson plans, and schemes of work among other related tools. Proper planning of the schemes of work, lesson notes and records of work ensures that the teacher remains focused, builds confidence, creates a clear roadmap for effective teaching and prevents teachers' over reliance on textbooks (Wanjala et al., 2019). A significant number (18.2%) ensured teachers had all professional documents and also confirmed that the said documents were up-to-date. Similarly, 18.2% of the HODs besides availing adequate teaching and learning materials and also discussed with the teachers of Physics on the most suitable methods of content delivery the subject. However, low scores (9.1%) were obtained on the level in which HODs ensure TPAD files have lesson observations schedules, check whether teachers attain set targets and also check students' performance. Mwai and Muchanje (2018) asserts that teachers need to prepare well for their lessons in order to

achieve the lesson objectives and improving the teacher effectiveness and student performance in the long run. One of the HODs said that;

**Excerpt 5:** *“It’s important to check the level of preparation of the teachers first by involving them in preparation of the schemes of work, filling in the records of work covered and also ensure that they have lesson notes.”*

The HODs were also asked whether they ensured teachers of Physics prepare the necessary professional documents and their results indicated that all the interviewed HODs (100%) were in agreement that they ensured teachers of Physics in their respective schools prepared necessary professional documents with respect to the teaching of Physics. It is one of the duties of the HODs to ensure that teachers in their departments adequately prepare before teaching and learning takes place (Wanjala et al., 2019).

#### **4.4.3 Factors that Support Integration of Instructional Technologies**

The third objective of the study sought to identify factors which support integration of instructional technologies in teaching secondary school Physics in Nakuru County. This objective was achieved by the respondents answering the question: Which factors support integration of instructional technologies in teaching secondary school Physics? In order for the respondents to answer this question, the researcher used the questions in section D of the questionnaire. The section had 5 questions on a five level Likert scale which were answered by 49 respondents. The descriptive findings in respect to factors that support integration of instructional technologies in respective public secondary schools is presented in Table 4.25.

**Table 4.25: Descriptive Findings of Factors that Support ITs Integration**

<b>Factors that Support ITs Integration</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>Std. Dev</b>
It is a TPAD requirement that teachers integrate ITs in teaching Physics	14.6	64.6	14.6	6.3	0.0	3.87	0.733
The administration of our school has always been supportive in my mission to integrate ITs in teaching Physics.	10.2	67.3	8.2	14.3	0.0	3.73	0.836
The budgetary allocation to our school is sufficient in sourcing instructional technologies.	8.2	28.6	26.5	30.6	6.1	3.02	1.090
Governmental and non-governmental agencies support integration of ITs in teaching of Physics in our school.	4.2	22.9	41.7	29.2	2.1	2.98	0.887
There is a clear vote head for procurement of ITs	2.1	20.8	54.2	14.6	8.3	2.94	0.885
<b>Overall</b>						<b>3.31</b>	<b>0.886</b>

The results shown in Table 4.25 indicated that most of the sampled teachers (79.2%) held the view that it was a TPAD requirement that teachers should integrate ITs in teaching Physics. One of the areas of assessment in the lesson observation tool require that the teacher integrate technologies in teaching (Chepkuto et al., 2018). A mean score of 3.87 was achieved in this metric and therefore implying that on average the teachers tended to agree that it is a TPAD requirement that teachers integrate ITs in teaching Physics. A standard deviation of 0.733 which is less than 3.00 implied that the teachers of physics were in consensus in rating this metric.

Similarly, 77.5% of the teachers admitted that the administrators of their schools had always been supportive in their mission to integrate instructional technologies in teaching Physics. This happens by facilitation of teacher in acquisition of the materials, provision of a reliable internet and the infrastructure required (Ministry of Education, 2018). A mean score of 3.73 and a standard deviation of 0.836 achieved on this metric implied that

on average the teachers of Physics were in consensus in agreeing that the administration of their school had always been supportive in their mission to integrate ITs in teaching Physics. Mwai and Muchanje (2018) allude that ready access to technologies and having a favourable institutional policy on integration encourages teachers to integrate technologies in teaching.

It was further found that 36.8% agreed and 36.7% disagreed that the budgetary allocation to their respective schools was sufficient in sourcing instructional technologies. The fee structures of Kenyan schools only reflect money allocated for teaching, learning materials & examinations. It may not be sufficient to provide all the required technologies (Ministry of Education, 2018). A mean score of 3.02 was achieved in rating the extent in which budgetary allocation to their respective schools was sufficient in sourcing instructional technologies. This implied that most teachers were indifference on whether budgetary allocation to their respective schools was sufficient in sourcing instructional technologies. A standard deviation of 1.090 was achieved which implied that there was significant variation in the pertinent opinions in regard to whether budgetary allocation to their respective schools was sufficient in sourcing instructional technologies among the sampled teachers. These results differ with those by Sengottuvel and Aktharsha (2015) who noted that school budgetary allocation helps in purchasing instructional materials that enhance learning and teachers among students and teachers.

Similarly, most of the teachers were uncertain regarding the governmental and non-governmental agencies supporting integration of ITs in teaching of Physics in public secondary schools in Nakuru County (NS = 41.7%); and also, in respect of there being a clear vote head for procurement of instructional technologies (NS = 54.2%). Equally,

respondents were on average not sure regarding these propositions due to mean score close to 3.00 (mean =2.98, mean =2.94), and their views were convergent (standard deviation = 0.887; standard deviation = 0.885 ) due to standard deviation less than 1.000. Sale (2016) suggests the need for institutional support as teachers request for the relevant materials in order to realize the set goals.

The overall mean score was 3.31 and an overall standard deviation of 0.886 were achieved from the five statements on factors that support instructional technologies integration. This implied that on average the teachers of Physics from the public secondary schools in Nakuru County were in agreement with the five factors that support instructional technologies integration. The results further implied that teachers were in consensus in rating the five factors that support instructional technologies integration. Mikre (2011) asserts that schools need to integrate instructional technologies in teaching in order to improve the performance of schools by adopting supporting initiatives.

The views from interviews of the sampled science HODs in regard to factors which support integration of ITs are descriptively presented in Table 4.26.

**Table 4.26: Distribution of Factors That Support Integration of ITs**

<b>Supporting Factors</b>	<b>Percentage</b>
TPAD, lesson observations, sensitization of teachers by Principals	9.1
Students' aggressiveness, students' cooperation, administration's support, Parents' support, Government support via SMASSE INSET training	18.2
Early coverage of topics by teachers, increased interest in Physics by learners	9.1

Availability of ITs and infrastructure e.g., Computer laboratories, computers, CDs, TV sets, laptops, white boards, and projectors, internet connectivity, Electricity availability, computer literacy exposure, small class size	48.5
Administration's support, cooperation and teamwork	15.4
<b>Total</b>	<b>100.0</b>

The study established several key factors that supported integration of instructional technologies in the teaching of Physics in public secondary schools of Nakuru County. As shown in Table 4.26, majority of the HODs (48.5%) asserted that the crucial factors that supported the aforementioned integration included the availability of ITs and supporting infrastructure such as computer laboratories, computers, CDs, TV sets, laptops, white boards, and projectors, internet connectivity, electricity availability, computer literacy exposure, small class size. The support offered by the school's administration, cooperation, and teamwork were also viewed by 15.4% of the HODs as an important factor in the integration of ITs in the teaching of Physics. A few HODs (9.1%) were for the opinion that sensitization by the principals to teachers on the importance of integration of ITs, lesson observation requirements in the TPAD was a contributing factor to integration of ITs in teaching. TPAD tool calls for the teacher to use varied methods of teaching, use of appropriate teaching aids, use of appropriate teaching methods, demonstration of innovation and creativity and the ability stimulate learners all which may be realized by integration of instructional technologies in the teaching of Physics (Bett, 2016b; Ravhuhali et al., 2015; Sharan, 2018). An interviewee said that;

**Excerpt 6:** *“There is a great need that principals of the schools we teach in to support integration by providing the materials as it requires funding. The principal controls the use of monies in our institutions”*

Another interviewee lamented that;

**Excerpt 7:** *“Without the infrastructure, the hardware and software, it may not be easy for the teacher to integrate ITs in teaching.”*

According to the Ministry Education, every teacher employed by the TSC is expected to carry out a lesson observation exercise at least once every term. Administrative support is also very crucial as it encourages the teachers to integrate technologies to spice up teaching and learning (Ministry of Education, 2018). Provision of Hardware and software encourages teacher to integrate even more (Bett, 2016a). Government support through in-service training like SMASSE INSETs equip the teachers with integration skills (Ravhuhali et al., 2015).

#### **4.4.4 Factors Which Hinder Integration of Instructional Technologies.**

The fourth objective of the study was to identify factors which hinder integration of instructional technologies in teaching secondary school Physics in Nakuru County. This objective was achieved by the respondents answering the question: Which factors hinder integration of instructional technologies in teaching secondary school Physics in Nakuru County? In order for the respondents to answer this question, the researcher used the questions in section E of the questionnaire. The section had 4 questions on a five level Likert scale which were answered by 49 respondents. Table 4.27 shows the descriptive

statistics on the hindrances to integration of instructional technologies in the sampled public secondary schools in Nakuru County.

**Table 4.27: Descriptive Findings for Factors Hindering Integration of Instructional Technologies**

<b>Factors Hindering Integration of Instructional Technologies</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>Std. Dev</b>
Inadequate staff conversant with use of IT devices	18.4	61.2	6.1	12.2	2.0	3.82	0.950
Inadequate infrastructure such as specialized rooms and electricity.	20.4	46.9	8.2	12.2	12.2	3.51	1.293
Shortage of IT devices such as computers, projectors, and tablets	8.2	46.9	14.3	28.6	2.0	3.31	1.045
Students' abilities and socio-economic background	8.2	42.9	16.3	24.5	8.2	3.18	1.149
<b>Overall</b>						<b>3.46</b>	<b>1.109</b>

It was revealed as shown in Table 4.27 that majority (79.6%) of the teachers believed that there were inadequate staff conversant with the use of IT devices and that there was inadequate infrastructure such as specialized rooms and electricity (67.3%). With regard to the proposition on inadequate staff conversant with IT devices, a mean of 3.82 was achieved and on the proposition on inadequate infrastructure, a mean of 3.51 was obtained. This implied that on average the teachers of physics tended to agree that there was inadequate staff conversant with IT devices and inadequate infrastructure. These findings agree with Rana and Asghar (2015) who identified lack of LANs and lack of staff to guide in the use of technologies in teaching. There is need for trained personnel when it comes to integration of instructional technologies. However, regarding

inadequacy of conversant staff, respondents' views varied insignificantly (std dev. = 0.950) while in respect of inadequate infrastructure, the views of the teachers varied significantly (std dev. = 1.293).

Majority (55.1%) of the sampled teachers agreed that part of hindrances to integration of ITs in pedagogy of Physics included shortage of IT devices such as computers, projectors and tablets. This is further evidenced by a mean score of 3.31. This is in agreement to Perva (2016) who sites inadequacy on the part of technologies as one of the hindrances. However, there was a large spread of responses in answering this question as evidenced by a standard deviation more than 1.00 (standard deviation=1.045). It was concurred by at least half (51.1%) of the teachers that abilities of students and their socio-economic background were a hindrance to the aforementioned integration. Some may have come from homes where they have laptops and smartphones and might be able to use these instructional technologies. If individuals have minimal or no access to technologies, they have less opportunity to use these tools for their personal empowerment (Donkor & Banki, 2017; Rana & Asghar, 2015).

A mean score greater than 3.00 (mean = 3.18) was obtained in regard to this metric. This therefore implied that on average the teachers agreed that abilities of students and their socio-economic background were a hindrance to the instructional technologies' integration in Physics. In addition, the respondents were holding significantly varying views regarding the same due to a standard deviation greater than 1.00 (std dev. = 1.149). Overall mean score of 3.46 implied that the teachers of Physics in public secondary schools in Nakuru County experienced the four stated challenges in integrating instructional technologies in teaching of Physics. The overall standard deviation of 1.109

implied that every school experienced its own unique challenges and thus the lack of consensus among the respondents.

In addition, Science HODs were interviewed with regard to factors which hinder integration of instructional technologies in public secondary schools in Nakuru County. The descriptive results to this effect are presented in Table 4.28.

**Table 4.28: Factors Hindering Integration of Instructional Technologies**

<b>Hindering Factors</b>	<b>Percentage</b>
Inadequate preparation time, slow syllabus coverage, number of lessons, lack of enough manpower	16.6
Teachers' negative attitude, lack of motivation on teachers, lack of proper training, lack of proper materials	16.6
Student's academic abilities, special need students, High student: teachers' ratio, shortage of text books, students' lack of interest	8.3
Lack of resources, lack of IT equipment, lack of exposure, Lack of awareness by some teachers, inadequate staff, lack of students' cooperation,	16.6
Inadequate infrastructure, e.g., electricity, internet; frequent power outages,	24.9
Culture, limited space, knowledge, limited accessibility	8.3
Administrators' procrastination	8.3
<b>Total</b>	<b>100.0</b>

Though there were factors which supported integration of ITs, there were also others which hindered the aforesaid integration in the teaching of Physics in public secondary schools in Nakuru County. According to majority of the HODs, as shown in Table 4.28, the major obstacle at 24.9% was lack of electricity, frequent power outages, and lack of ITs. There are areas in Nakuru County where the schools experience these problems. This was followed closely at 16.6% by negative attitude by the teachers of Physics, lack of proper training, and lack of proper materials. Other impediments include inadequate preparation time (8.3%), teachers' negative attitude towards integration of ITs (16.6%), students' academic abilities and special needs students (8.3%), Financial constraints stood at 8.3%. Culture, limited space Knowledge and limited accessibility accounted for

8.3%. Lastly, 8.3% of the HODs believed that administrator’s procrastination was a hindrance to integration of instructional technologies by the teachers of Physics. These challenges were also cited by Kirimi (2014), Mbarushimana and Kuboja (2016), and Tochukwu and Hocanın (2017) in their diverse studies on challenges of ICT integration which is a part of ITs, in teaching.

#### 4.4.5 Integration of Instructional Technologies in Pedagogy of Physics

The study further examined the opinions of a sample of teachers with regard to integration of instructional technologies in the teaching of Physics in public secondary schools of Nakuru County. The researcher used section F of the questionnaire for teachers of Physics. The section had 4 questions on a five level Likert scale which were answered by 49 respondents. The teachers’ views are descriptively presented in Table 4.29.

**Table 4.29: Descriptive Findings for Integration of Instructional Technologies in Pedagogy of Physics**

<b>Integration of Instructional Technologies</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>Std. Dev</b>
All Physics teachers have fully embraced ITs in teaching Physics.	10.2	53.1	12.2	22.4	2.0	3.47	1.023
ITs are integrated in the teaching of Physics only in selected forms	8.2	30.6	14.3	38.8	8.2	2.92	1.170
The location of our school relative to electricity and internet has been crucial in ITs’ integration.	10.2	30.6	8.2	36.7	14.3	2.86	1.291
Our school has fully embraced ITs in the teaching of Physics.	6.1	20.4	12.2	46.9	14.3	2.57	1.155

According to the descriptive results shown in Table 4.29, it was established that 63.3% of the sampled teachers agreed that they had fully embraced ITs in the teaching of Physics in their respective schools. This was probably encouraged by availability and accessibility of ITs. However, a sizeable number of teachers (24.4%) disputed this argument. A mean score of 3.47 achieved on this metric shows that teachers agreed that they had fully embraced ITs in the teaching of Physics in their respective schools. There were significantly divergent opinions in respect to this metric due to a standard deviation greater than 1.000 (std dev. = 1.023).

More respondents (47.0%) disputed while slightly fewer (38.8%) agreed that ITs were integrated in teaching Physics only in selected forms. This implies that majority of public secondary schools in Nakuru County, integration of instructional technologies in teaching Physics was not biased; rather it was being done in all forms. It was also noted that 40.8% of the teachers of Physics agreed with the assertion that the location of their school relative to electricity and internet was crucial for ITs' integration while 51.0% disputed this assertion. On whether schools in Nakuru County have fully embraced ITs in pedagogy of Physics, only 26.5% agreed while a bigger number (61.2%) disagreed. This might be as a result of factors such as lack of know-how, negative attitude, lack of ITs, limited accessibility among the constrains to integration of ITs. There was uniqueness in integration of the instructional technologies in teaching of Physics in public secondary schools in Nakuru County. This is because all the four statements had a standard deviation of more than 1.000 (1.023, 1.170, 1.291, and 1.155). The overall mean score of

2.96 implies a low level of integration of ITs in the sampled schools and the overall standard deviation of 1.160 implies that there was disparity in the integration. Avgerou et al., (2016) and Tochukwu and TansuHocann (2017) also observed that there was low integration of ICT in the teaching in most public secondary schools.

The views of science HODs in respect of the extent of integration of instructional technologies in pedagogy of Physics are illustrated in Table 4.30.

**Table 4.30: The Extent of Integration of ITs in Pedagogy of Physics**

<b>Scale (Out of 10)</b>	<b>Percentage (%)</b>
7 to 9	30.8
4 to 6	38.6
2 to 3	30.8
<b>Total</b>	<b>100.0</b>

In a scale of 1 to 10, from absolutely no integration to maximum possible integration, majority of public secondary schools in Nakuru County (38.6%) had moderately integrated ITs, between the scores of 4 and 6 out of 10 in the teaching of Physics (Table 4.30). It was also found that 30.8% of the schools had integrated ITs to a scale of 7 to 9 and a similar number to a scale of 2 to 3. Notably, there was not a single school where it was reported that there was absolutely no integration (score of 1) or maximum possible integration (score of 10). This meant that the stated schools had various levels of integration with 38.6% of them having moderate integration. This concurs with the findings of Noor-UI-Amin (2017) who noted that ITs integration was still low and only few schools had a moderate integration of the instructional technologies in their schools.

#### 4.4.6 Desirable Outcomes in Physics in KCSE

The desirable outcomes investigated reflected the academic performance of students in KCSE Physics examination. This study used the questionnaire (Section G) to check the effect of the use of instructional technologies in teaching especially on students' performance in KCSE Physics. The opinions of the sampled teachers of Physics are as shown in Table 4.31.

**Table 4.31: Descriptive Statistics for Desirable Outcomes in the KCSE**

<b>Desirable Outcomes in the KCSE</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>	<b>Mean</b>	<b>Std. Dev</b>
The individual students' performance in Physics at KCSE remarkably improved since 2015.	0.0	8.2	0.0	26.5	65.3	1.90	1.159
Significant performance improvement in Physics started being recorded after the integration of instructional technologies in its teaching.	0.0	22.4	0.0	22.4	55.1	1.90	1.212
Performance in Physics at KCSE has consistently improved since 2015	0.0	20.4	0.0	28.6	51.0	1.51	0.869
<b>Overall</b>						<b>1.77</b>	<b>1.080</b>

The descriptive results illustrated in Table 4.31 indicated that there was general disagreement (mean = 1.90) that performance of individual students in Physics had improved remarkably since year 2015. This was supported by the observation that 91.8% of the respondents disagreed that the aforementioned performance had substantively improved since 2015. Similarly, most of the sampled teachers (77.5%) disagreed that significant performance improvement in Physics started being recorded after the integration of technologies in its teaching; and many (79.6%) disagreed that performance

of Physics in KCSE had consistently improved since year 2015. This was also supported by a mean score of 1.90 on the statement that performance of Physics had significantly improved since the integration ITs in teaching of Physics and a mean score of 1.51 on the statement that the improvement had been consistent since 2015. It was also noted that the views of the teachers of Physics varied significantly due to standard deviation of more than 1.00 on the first two statements. It implied that the level of integration of instructional technologies is low. The overall mean was 1.77 and a standard deviation was 1.080 and thus implying that the level of integration of instructional technologies is low. It further implies that the number of teachers trained on the use of ITs was still too low.

In addition to the opinions of Physics teachers, respective HODs were interviewed and expressed their view regarding desirable outcomes as shown in Table 4.32.

**Table 4.32: Schools that have Met Set Targets in Physics since 2015**

<b>Criteria</b>	<b>Percentage</b>
Met/Surpassed	53.8
Not Met/ Not Surpassed	46.2
<b>Total</b>	<b>100.0</b>

According to the interviewed HODs, slightly more than half (53.8%) of the public secondary schools in Nakuru County had either met or surpassed their targets in Physics since year 2015 (Table 4.32). However, almost a similar number of schools (46.2%) had not attained the set target in Physics over the same period of time. According to one of the HODs interviewed on the issue of targets attainment, said that;

**Excerpt 8:** *“There has been a very slight improvement in the results even when technologies are integrated in the teaching of Physics. It seems that this improvement may take some time to be realized.”*

#### 4.5 Inferential Findings of the Study

The influence of various aspects characterizing teacher preparedness to integrate instructional technologies in the teaching of Physics and desirable KCSE outcomes were examined and the results thereof are presented. The inferential statistics guided the testing of the hypotheses. Correlation and regression analysis were used in the testing of the hypotheses. Pearson’s Correlation Coefficient was first used to establish the relationship between teacher preparedness to integrate ITs in pedagogy of Physics and desirable outcomes in KCSE. Desirable KCSE outcomes represent academic performance of students in their KCSE Physics examinations. The correlation results are presented in Table 4.33.

**Table 4.33: Correlation Analysis**

<b>Variables</b>		<b>Desirable Outcome</b>
<b>Instructional Technologies Availability</b>	Pearson Correlation	0.588**
	Sig. (2-tailed)	0.000
	n	49
<b>Level of Preparedness</b>	Pearson Correlation	0.063
	Sig. (2-tailed)	0.666
	n	49
<b>Factors Supporting ITs Integration</b>	Pearson Correlation	0.191
	Sig. (2-tailed)	0.188
	n	49
<b>Hindrances of ITs Integration</b>	Pearson Correlation	-0.141
	Sig. (2-tailed)	0.335
	n	49

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

The results shown in Table 4.33 indicate that the relationship between availability of instructional technologies and desirable KCSE outcomes was positive, moderate and statistically significant ( $r=0.588$ ;  $p < 0.05$ ). The results implied that, increasing the availability of requisite instructional resources such as text books, charts, laptops, desktop computers, Smart phones, tablets, and other teaching aids was likely to raise the academic performance in Physics. Reduction of the aforesaid resources, on the other hand, was bound to occasion a decline in academic performance. Inferentially, public secondary schools should ensure availability of necessary instructional technologies in order for them to possibly realize improved academic performance in Physics. These results are in line with those by Herme (2016) who noted that instructional technological resources improved the performance of students through effective teaching using ICT devices such as laptops, desktop computers, Smart phones, tablets.

However, there existed a positive, weak and statistically not significant relationship between level of preparedness of the teacher to integrate ITs in teaching of Physics and desirable outcomes in the subject ( $r = 0.063$ ;  $p > 0.05$ ). Interpretatively, increasing or reducing the level of preparedness of teachers had little likelihood to result in any change in performance of Physics among students. This means that however much or little teachers were prepared to integrate instructional technologies in the teaching of Physics, the effect on the performance of students in that subject was likely to largely remain almost the same. This is in disagreement to the findings of Chebii et al., (2018) who establish a significant relationship between teacher preparedness to integrate instructional technologies and the academic achievement of students.

Similarly, it was found that there was a positive, weak and statistically not significant relationship between factors supporting integration of instructional technologies and desirable outcomes ( $r = 0.191$ ;  $p > 0.05$ ). Therefore, improving the various factors that support the aforementioned integration such as budgetary allocation and supportive school administration was likely to enhance performance of Physics; but to a small extent. As such, the various factors though important, were not very critical in reference to ensuring that the performance of students in Physics was boosted. Divergent to these findings, Smeets et al., (2018) noted that support factors towards integration of technology in teaching improved the overall student performance.

In addition, the study found that there existed a negative, weak and statistically not significant relationship between hindrances to integration of ITs and desirable outcomes ( $r = -0.141$ ;  $p > 0.05$ ) in public secondary schools in Nakuru County. This was interpreted to mean that increasing various hindrances to the integration of instructional technologies was likely to reduce the performance of students in Physics, though to a minimal extent. Therefore, it was found to be imperative to reduce the existing factors that were likely to hinder the aforesaid integration. This could possibly result in improved performance of students in Physics across public secondary schools in Nakuru County, though to a small extent. On evaluation of the challenges of ICT adoption in teaching, Yunus et al., (2015) found that there were several challenges that hindered the adoption of ICT in schools and this resulted to poor performance among the students.

To test the research hypotheses, multiple linear regression analysis was used to examine the extent to which integration of instructional technologies affected desirable KCSE

outcomes in Physics in public secondary schools in Nakuru County. Table 4.34 represents the regression weights for overall model.

**Table 4.34: Regression Weights for Overall Model**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.589 <sup>a</sup>	0.347	0.288	0.99078

a. Predictors: (Constant), Instructional Materials Availability, Level of Preparedness, Factors Supporting ITs Integration, Hindrances of ITs Integration

The study established that the general relationship between integration of instructional technologies as characterized by instructional technologies availability, level of preparedness, factors supporting integration, and hindrances to integration of ITs with desirable outcomes was positive and moderately strong ( $R = 0.589$ ). This implied that the regression model provided a goodness-of-fit for the data. The results of coefficient of determination (Adjusted  $R^2 = 0.288$ ) achieved indicated that 28.8% of variance in desirable KCSE outcomes (academic performance) in Physics could be explained by the instructional technologies availability, level of preparedness, factors supporting integration, and hindrances to integration of ITs. The remaining proportion (71.2%) of desirable outcomes could be attributed to other factors which were not part of this study. Standard error of estimate of 0.99078 which is less than 1.000 implied that the regression model was accurate in its prediction and thus high precision.

The study further sought to establish whether the regression model as a whole was statistically significant and whose results are shown in Table 4.35.

**Table 4.35: Model Significance**

<b>Model</b>	<b>Sum of Squares</b>	<b>df</b>	<b>Mean Square</b>	<b>F</b>	<b>Sig.</b>
1 Regression	22.952	4	5.738	5.845	0.001 <sup>a</sup>
Residual	43.192	44	0.982		
Total	66.145	48			

a. Predictors: (Constant), Instructional Materials Availability, Level of Preparedness, Factors Supporting Integration of ITs, Hindrances to Integration of ITs

b. Dependent Variable: Desirable Outcome

The results shown in Table 4.35, ( $F_{(4, 44)} = 5.845$ ;  $p < 0.05$ ) indicated that F-test with 4 and 44 degrees of freedom and a value of 5.845, was statistically significant at 0.05 precision level. The results meant that the multiple regression model adopted fitted the sample data used in this study. Thus, the model was found to be suitable in analyzing the effect of integration of instructional technologies on desirable outcomes in the KCSE in public secondary schools in Nakuru County. This further implied that at least one of the predictor variables is statistically significant.

The study further sought to establish which predictor variables were statistically significant predictors of desired KCSE outcomes in Physics Diagnostic statistics as shown in Table 4.36.

**Table 4.36: Model Coefficients**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics		
	B	Std. Error	Beta			Toleranc	e	VIF
1 (Constant)	0.283	1.500		0.189	0.851			
Instructional Technologies Availability	0.865	0.192	0.586	4.507	0.000	0.877	1.141	
Level of Preparedness	-0.047	0.227	-0.029	-0.207	0.837	0.749	1.335	
Factors Supporting ITs Integration	0.076	0.299	0.038	0.255	0.800	0.660	1.516	
Hindrances of ITs Integration	0.044	0.251	0.023	0.178	0.860	0.877	1.141	

a. Dependent Variable: Desirable Outcome

The study established that there was no multicollinearity problem in the model in which the predictor variables were highly correlated among themselves resulting to inflated model coefficient. This is because the Variance Inflation Factors (VIF) values were within acceptable threshold of less than 10 and the Tolerance level (T) were greater than 0.1. It was revealed that the independent variables, that is, instructional technologies' availability (VIF = 1.141), level of preparedness (VIF = 1.335), factors supporting integration of ITs (VIF = 1.516), and hindrances to integration of ITs (VIF = 1.141), did not have much multicollinearity problems since all of them returned VIF less than 10.

Focusing on the t-statistics and its p-value, it was found that only instructional technologies availability had a statically significant influence on the desirable KCSE outcome ( $t = 4.057$ ;  $p < 0.05$ ).

The findings indicated in Table 4.39 were used to substitute the following regression model.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

Where;

Y = Desirable KCSE outcomes

X<sub>1</sub> = Instructional materials availability

X<sub>2</sub> = Level of preparedness of the teachers of Physics

X<sub>3</sub> = Factors supporting integration of ITs

X<sub>4</sub> = Hindrances to integration of ITs

β<sub>0</sub> = Constant

β<sub>1</sub> – β<sub>4</sub> = Regression coefficients

ε = Error term when there is assumption of normal distribution

Using the beta coefficients shown in Table 4.39, the regression model was substituted as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

$$Y = 0.283 + 0.865X_1 - 0.047X_2 + 0.076X_3 + 0.044X_4$$

It was found in this respect that for every unit increase desirable KCSE outcome, instructional technologies availability increased by 0.865 units with other factors held constant due to unstandardized beta coefficient of 0.865 ( $\beta_1 = 0.865$ ). It is evident from the foregoing results that, availability of instructional technologies ( $\beta_1 = 0.865$ ) was the most critical factor with regard to having the desired KCSE outcomes in Physics. The rest, that is, level of preparedness ( $t = -0.207$ ;  $p > 0.05$ ), factors supporting ITs integration

( $t = 0.255$ ;  $p > 0.05$ ), and hindrances of ITs integration ( $t = 0.178$ ;  $p > 0.05$ ) had statistically no significant influence on desirable KCSE outcomes in Physics.

Therefore, the first hypothesis stating that  $H_{O1}$ : There is no statistically significant influence of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya was rejected at 5% significance level. The alternative hypothesis that there is statistically significant influence of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya was therefore adopted. The study failed to reject second hypothesis stating that  $H_{O2}$ : There is no statistically significant influence of teacher preparedness to integrate instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya, at 5% significance level.

Similarly, the third hypothesis stating that  $H_{O3}$ : There is no statistically significant influence of factors supporting integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya, was not rejected at 5% significance level. The fourth hypothesis stating that  $H_{O4}$ : There is no statistically significant influence of factors hindering integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya, was also not rejected at 5% significance level. Therefore, it is recommendable for public secondary schools to put more emphasis on availing adequate instructional technologies as part of integration in public secondary schools in order to enhance performance of students in KCSE Physics examinations.

These results are in line with those by Herme (2016) who noted that the instructional technological resources improved the performance of students through effective teaching using resources such as laptops, desktop computers, Smart phones, tablets. This is in disagreement to the findings of Chebii et al., (2018) who establish a significant relationship between teacher preparedness to integrate instructional technologies and the academic achievement of students. Divergent to these findings, Smeets et al., (2018) noted that support factors towards integration of technology in teaching improved the overall student performance. Yunus et al., (2015) found that there were several challenges that hindered the adoption of ICT adoption in schools and this resulted to poor performance among students.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **5.1 Introduction**

This chapter presents a summary of major findings of the study in regard to the integration of instructional technologies in the teaching of Physics and its influence on the desired KCSE outcomes. This is followed by conclusions drawn from the key findings. Recommendations based on the conclusions are outlined. Moreover, areas for further research are duly suggested.

#### **5.2 Summary of Findings**

The study established that most (87.8%) of the teachers of Physics working with public secondary schools in Nakuru County were male. Majority (71.4%) of these teachers had acquired the first degree. It was also noted that most (85.8%) of these teachers were drawn from the sub-County schools. Most (30.6%) of the teachers of Physics had less than 5 years teaching experience with most of these teachers (57.1%) having been working with their present schools for a period of between 1 and 5 years. Most (46.7%) of the heads of science department had held that position for a period of less than 5 years. The surveyed schools had modest ratio of teachers to students which is within the recommended ratio of 1:40.

##### **5.2.1 Availability of Instructional Technologies and Desirable KCSE Outcomes**

Most (89.8%) of the public secondary schools in Nakuru County had sufficient instructional technologies. Conventional and modern/digital media resources were regularly employed in teaching Physics at 81.6%. Majority of the teachers (85.7%) were

not provided with modern instructional technologies such as tablets and laptops to facilitate teaching of Physics. It was found that 76.9% of science HODs were mainly involved in checking availability of pertinent resources, making follow-ups on the procurement of the same, and also inspecting the delivered instructional materials. It was further revealed that most of the public secondary schools in Nakuru County had unreliable internet connectivity.

The results further indicated that the relationship between availability of instructional technologies and desirable KCSE outcomes was positive, moderate and statistically significant ( $r=0.588$ ;  $p < 0.05$ ). Focusing on the t-statistics and its p-value, it was found that only instructional technologies availability had a statistically significant influence on the desirable KCSE outcome ( $t = 4.057$ ;  $p < 0.05$ ). It was found in this respect that for every unit increase in desirable KCSE outcome, instructional technologies availability, increased by 0.865 units with other factors held constant due to unstandardized beta coefficient of 0.865 ( $\beta_1 = 0.865$ ). Therefore, the first hypothesis stating that  $H_{01}$ : There is no statistically significant influence of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya was rejected at 5% significance level.

### **5.2.2 Level of Preparedness to Integrate ITs and Desirable KCSE Outcomes**

It was found that 81.6% of Physics teachers working with public secondary schools in Nakuru County used ITs in preparing schemes of work, lesson plans and mark sheets. Among them, 79.6% said that they had learnt technology education when in their respective colleges and universities. In addition, 69.4% frequently used ITs in teaching Physics and HODs opined that 69.2% of the public secondary schools in the County had

their Physics teachers attend in-service training. All the HODs (100%) further ensured that the teachers of Physics in their respective schools prepared necessary professional documents with respect to teaching of Physics.

However, there existed a positive, weak and statistically not significant relationship between level of preparedness to integrate ITs in teaching of Physics and desirable outcomes in the subject ( $r = 0.063$ ;  $p > 0.05$ ). The study further found that the level of preparedness had statistically not significant influence on desirable outcomes in Physics ( $t = -0.207$ ;  $p > 0.05$ ). The study failed to reject second hypothesis stating that  $H_{02}$ : There is no statistically significant influence of teacher preparedness to integrate instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya, at 5% significance level.

### **5.2.3 Factors that Support ITs Integration and Desirable KCSE Outcomes**

The study observed that it was a TPAD requirement that teachers should integrate ITs in the teaching of Physics. It was also found that 77.5% of the administrators of schools were always supportive to teachers on integration of instructional technologies in teaching Physics. The respondents were indifferent on whether budgetary allocation was sufficient or insufficient in sourcing instructional technologies. There was also indifference (mean =2.98) with regard to support of governmental and non-governmental agencies towards integration of ITs in teaching of Physics, and there being a clear vote head for procurement of ITs in the aforementioned schools (mean =2.94). According to most of the science HODs (48.5%), the crucial factors that supported the aforementioned integration included availability of ITs such as computer laboratories, computers, laptops, projectors, TV sets, CDs, white boards, and internet connectivity.

It was further found that there was a positive, weak and statistically not significant relationship between factors supporting integration of instructional technologies and desirable outcomes ( $r = 0.191$ ;  $p > 0.05$ ). The study also found that factors supporting ITs integration had statistically not significant influence on desirable KCSE outcomes in Physics. The third hypothesis stating that  $H_{03}$ : There is no statistically significant influence of factors supporting integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya, was not rejected at 5% significance level.

#### **5.2.4 Factors Hindering Integration of Its and Desirable KCSE Outcomes**

Several factors were found to be a hindrance to the integration of ITs in teaching of Physics in public secondary schools of Nakuru County. The study found that 79.6% of the schools had inadequate staff conversant with the use of digital devices. Moreover, to 51.1% of the teachers of Physics, abilities of students and their socio-economic background were a hindrance to the aforementioned integration. According to 16.6% of HODs working with public secondary schools in the County, the major obstacles included negative attitude of teachers of Physics, lack of proper training, and lack of appropriate IT materials. Other hindrances (24.9%) were lack of electricity and frequent power outages.

In addition, the study found that there existed a negative, weak and statistically not significant relationship between hindrances to integration of ITs and desirable outcomes ( $r = -0.141$ ;  $p > 0.05$ ) in public secondary schools in Nakuru County. This was interpreted to mean that increasing various hindrances to the integration of instructional technologies

was likely to reduce the performance of students in Physics, though to a minimal extent. It was also found that hindrances of ITs integration had statistically not significant influence on desirable KCSE outcomes (performance) in Physics ( $t = 0.178$ ;  $p > 0.05$ ). The fourth hypothesis stating that HO4: There is no statistically significant influence of factors hindering integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya, was also not rejected at 5% significance level.

#### **5.2.6 Integration of ITs in Pedagogy of Physics and Desired KCSE Outcomes**

Most (63.3%) of teachers of Physics working with public secondary schools in Nakuru County had fully embraced ITs in teaching Physics in their respective schools. However, it was noted that 64.2% of the schools had not fully integrated ITs in pedagogy of Physics. It was also found that 47.0% of the teachers disagreed that ITs are integrated in teaching of Physics only in selected forms. Focusing on desirable KCSE outcomes, 91.8% of the teachers of Physics indicated that performance of individual students in Physics had not improved remarkably since year 2015. Similarly, 77.5% of the teachers held the opinion that integration of instructional technologies did not result in significant performance improvement in Physics.

Also, 79.6% alluded that performance in Physics at KCSE level had not consistently improved since the year 2015. It was also found that 53.8% of schools had met or surpassed their set targets in Physics performance since year 2015 while 46.2% failed to meet the target. There was a significantly close association between integration of ITs in the teaching of Physics and performance of students in the subject. In respect to this, the findings meant that the more instructional technologies were integrated in teaching of

Physics, the more likely it was for the performance of students in the subject to improve. Furthermore, 28.8% of variance in desirable outcomes in Physics at KCSE could be explained by the integration of the aforesaid instructional technologies. Availability of instructional materials was established to be the most critical factor with regard to having the desired outcomes in Physics.

### **5.3 Conclusion of the Study**

Several conclusions were drawn from the summarized findings and in tandem with the objectives of the study.

#### **5.3.1 Conclusion on Availability of Instructional Technologies and Desirable KCSE Outcomes**

This study set out to establish the influence of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya. The study concluded that most of the public secondary schools in Nakuru County had sufficient instructional technologies, regularly employed conventional and digital media resources in teaching Physics and had unreliable internet connectivity. It was also concluded that majority of the teachers are not provided with modern instructional technologies such as tablets and laptops to facilitate teaching of Physics and most of the science HODs were mainly involved in checking availability of pertinent resources, making follow-ups on the procurement of the same, and also inspecting the delivered instructional materials. The study further concluded that the relationship between availability of instructional technologies and desirable KCSE outcomes was positive, moderate and statistically significant. It was also concluded that there is statistically

significant influence of instructional technologies for teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

### **5.3.2 Conclusion on Level of Preparedness to Integrate ITs and Desirable KCSE**

#### **Outcomes**

The study sought to determine the influence of teacher preparedness to integrate instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya. The study concluded that majority of Physics teachers used ITs in teaching as well as preparing schemes of work, lesson plans and mark sheets which they had learnt technology education when in their respective colleges and universities. It was also concluded that most of the public secondary schools in the County had their Physics teachers attend in-service training and ensured that the teachers prepared necessary professional documents with respect to teaching of Physics. The study further concluded that there existed a positive, weak and statistically not significant relationship between level of preparedness to integrate ITs in teaching of Physics and desirable outcomes in the subject. It was further concluded that there is no statistically significant influence of teacher preparedness to integrate instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

### **5.3.3 Conclusion on Factors Supporting Integration of ITs and Desirable KCSE**

#### **Outcomes**

The study sought to establish the influence of factors supporting integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public

secondary schools in Nakuru County, Kenya. The study concluded teachers were aware that it was a TPAD requirement that teachers should integrate ITs in the teaching of Physics. It was also concluded that the administrators of schools were always supportive to teachers on integration of instructional technologies in teaching Physics. The study further concluded that the crucial factors that supported the integration of ITs included availability of IT resources such as computer laboratories, computers, laptops, projectors, TV sets, CDs, white boards, and internet connectivity. It was further concluded that there was a positive, weak and statistically not significant relationship between factors supporting integration of instructional technologies and desirable outcomes. Lastly, it was concluded that there is no statistically significant influence of factors supporting integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

#### **5.3.4 Conclusion on Factors Hindering Integration of ITs and Desirable KCSE**

##### **Outcomes**

The last objective sought to determine the influence of factors hindering integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya. The study concluded that most of the schools had inadequate staff conversant with the use of digital devices. It was further concluded that negative attitude of teachers of Physics, lack of proper training, lack of appropriate IT materials, lack of electricity and frequent power outages, low abilities of students and their poor socio-economic background were a hindrance to the integration of ITs. In addition, the study concluded that there existed a negative, weak and statistically not significant relationship between hindrances to integration of ITs and desirable

outcomes in public secondary schools in Nakuru County. It was further concluded that there is no statistically significant influence of factors hindering integration of instructional technologies in teaching Physics on desirable KCSE outcomes in public secondary schools in Nakuru County, Kenya.

#### **5.4 Recommendations of the Study**

The recommendations made are in tandem with the conclusions drawn from the study findings. Moreover, they are in line with the objectives of the study.

##### **5.4.1 Recommendations on Availability of Instructional Resources**

The study recommends that the relevant stakeholders should ensure that all public secondary schools in Nakuru County and Kenya at large should be provided with relevant instructional technologies proportionate to the students' enrolment. To improve students' performance in Physics, the study recommends that all the concerned teachers be provided with modern instructional technologies such as laptops and tablets. The study also recommends teachers to be more innovative and creative in respect to their teaching methods in Physics. It is also recommended that teachers of Physics should also be involved in the procurement process of instructional technologies. This would enable more effective way of addressing the probable gaps on the availability of instructional technologies.

##### **5.4.2 Recommendations on Level of Preparedness to Integrate ITs in Pedagogy of Physics**

This study recommends teachers of Physics to adopt digital ways of preparing professional documents such as schemes of work, lesson plans, lesson notes and mark

sheets among others. The study also recommends the administration of public secondary schools to encourage teachers to always integrate instructional technologies in the teaching of Physics. It is further recommended that for those teachers of Physics who are not exposed to ITs, they should attend in-service training to equip themselves with requisite skills to handle instructional technologies in teaching Physics. The study further recommends teamwork within the department so that the teachers who are well versed with the use of ITs may induct their colleagues. It is also recommended that school administration should ensure that instructional technologies are available at all times for teachers to prepare well and use ITs frequently.

#### **5.4.3 Recommendations on Factors Supporting Integration of ITs**

The study recommends that the administrators of public secondary schools should give these teachers the necessary support and enlighten them on the importance of the aforesaid integration. This could be done by giving them a chance to attend seminars and workshops on integration of ITs. It is also recommended that there should be adequate budgetary allocation for procurement of instructional technologies in public secondary schools. The study further recommends that the school administrators should provide a reliable to enable teachers navigate through the internet and download learning materials that will improve learning.

#### **5.4.4 Recommendations on Factors Hindering the Integration of ITs**

Given that inadequate infrastructure constrained integration of instructional technologies in teaching of Physics in public secondary schools, the study recommends the managements of respective schools to ensure availability of such facilities as computer laboratories or ICT resource rooms, digital materials like computers, laptops, projectors,

and tablets, in addition to ensuring that there is reliable internet connectivity. The study further recommends the administration of each school to ensure that their teachers are trained on how to integrate instructional technologies in classroom teaching. This may be done through relevant workshops and seminars on integration of ITs in the teaching of Physics to improve students' performance in the subject.

### **5.5 Suggestions for Further Studies**

The study established the level of preparedness of teachers of Physics to integrate instructional technologies in pedagogy of Physics and how that influences desirable KCSE outcomes in Physics in public secondary schools of Nakuru County, Kenya. However, due to the limitations that faced in the current study, the following areas for further studies are suggested;

- i. A study can be done to examine the effect of specific instructional technologies such as digital devices on the performance of students in Physics in the Kenya Certificate of Secondary Education.
- ii. A further study can also be done on the relationship between internet connectivity and performance of students in Physics in public secondary schools in Kenya.
- iii. A comparative study can be done on the integration of instructional technologies in the teaching of Physics between public secondary schools and private secondary schools in Kenya; or between rural public secondary schools and urban public secondary schools in Kenya.
- iv. A further study is also suggested to explore the impact of integration of instructional technologies in other subjects like English, Christian Religious Education, History, Mathematics, Biology, Geography and Chemistry.

## REFERENCES

- Adeniran, M.A. (2006). Strategies and Utilization of Improvised Biology Instructional Materials and Students' Achievement and Attitude in Ekiti Secondary Schools, Nigeria. *International Journal of Research in Education*, 3(2), 91-96.
- Adeyinka-Ojo, S., Nair, V., & Khoo-Lattimore, C. (2014). Case Studies Approach in Tourism Destination Branding Research. *4Th International Conference on Tourism Research (4Ictr)*, 12(2), 1–8.
- Agyei, D.D. (2013). Analysis of Technology Integration in Teacher Education in Ghana. *Journal of Global Initiatives*, 8(2), 69-86.
- Aina, J. K. (2013). Instructional Materials and Improvisation in Physics Class: Implications for Teaching and Learning: *Journal of Research and Methods in Education* 2(5), 1-15.
- Aina, J.K. (2012). *Teaching Aids Improvisation in the Teaching and Learning of Physics in Secondary Schools*. Retrieved from <http://www.articlesbase.com/science-articles/teaching-aids-improvisation-in-the-teaching-and-learning-of-Physics-in-secondary-schools-5675240.html>
- Altun, S. (2015). The Effect of Cooperative Learning on Students' Achievement and Views on the Science and Technology Course. *International Electronic Journal of Elementary Education*, 7(3), 451–468.
- Andoh, C. B. (2012). Factors Influencing Teacher Adoption and Integration of Information and Communication Technology into Teaching: *International*

- Journal of Education Development using ICT* 8(1), 136-155.  
<https://www.jstor.org/stable/23368980>. Accessed: 20/12/2013 10:40
- Avgerou, C., Hayes, N., & La Rovere, R. L. (2016). Growth in ICT Uptake in Developing Countries: New Users, New Uses, New Challenges. *Journal of Information Technology*, 31(4), 329–333. <https://doi.org/10.1057/s41265-016-0022-6>
- Awusabo-Asare, K., Doku, D. T., Kumi-Kyereme, A., & Esia-Donkoh, K. (2017). From Paper to Practice: Sexuality Education Policies and Their Implementation in Ghana. *Sexuality Education*, 1(April), 93.
- Ayoti, C. & Poipoi M.W. (2013). Challenges Facing Teachers in Preparation and Utilization of Instructional Media in Teaching Kiswahili in Selected Secondary Schools in Kenya: *International Journal of Advanced Research*, 1(3), 201-207.
- Ayotola, A., & Morenikeji, E. A. (2011). Teacher Readiness to Intergrate Information Technology into Teaching and Learning Process in Nigeria Secondary Schools: A Case Study. *An International Multidisciplinary Journal, Ethiopia*, 5(4), 178-190.
- Barde, M. (2017). *Teachers' Readiness for Intergration of Information Communication and Technology in the Teaching of Biology in Secondary Schools of Bauchi State, Nigeria*. Unpublished Master of Education, Kenyatta University.
- Baya'a, N., & Deher, W. (2013). Mathematics Teachers' Readiness to Integrate ICT in the Classroom: The Case of Elementary and Middle School Arab Teachers in Israel. *International Journal of Emerging Technologies in Learning*, 8(1), 46-52.
- Bett, H. K. (2016a). The cascade model of teachers' continuing professional development in Kenya: A time for change? *Cogent Education*, 3(1), 1–10.

<https://doi.org/10.1080/2331186X.2016.1139439>

Bett, H. K. (2016b). The Cascade Model of Teachers' Continuing Professional Development in Kenya: A Time for Change? *Cogent Education*, 3(1).

<https://doi.org/10.1080/2331186X.2016.1139439>

Bilgin, Y. (2017). *Qualitative Method Versus Quantitative Method in Marketing Research: An Application*. Sage Publications.

Brewer, L. (2013). *Enhancing Youth Employability: What? Why? and How? Guide to Core Work Skills*. ILO. Geneva.

[https://www.ilo.org/wcmsp5/groups/public/ed...skills/.../wcms\\_213452.pdf](https://www.ilo.org/wcmsp5/groups/public/ed...skills/.../wcms_213452.pdf)

Bridwell-Mitchell. (2015). Theorizing Teacher Agency and Reform: How Institutionalized Instructional Practices Change and Persist. *Sociology of Education*, 88(2), 140–159. <https://doi.org/10.1177/0038040715575559>

Bryman, A. (2012). *Social Research Methods: Using IBM SPSS for Windows*. Taylor & Francis.

Cennamo, K., Ross, J & Ertmer, P. (2013). *Technology Integration for Meaningful Classroom Use: A Standards-Based Approach*. (2<sup>nd</sup> Ed). Cengage Learning.

Changeiywo, J. M & Wambugu, P.W. (2008). Effects of Mastery Learning Approach on Secondary School Students' Physics Achievement: *Eurasia Journal of Mathematics, Science and Technology Education*, 4(3), 293-302.

Chebii, R., Wachanga, S. W., & Anditi, Z. O. (2018). Effects of Cooperative E-Learning Approach on Students' Chemistry Achievement in Koibatek Sub-County, Kenya. *Creative Education*, 09(12), 1872–1880. <https://doi.org/10.4236/ce.2018.912137>

Chepkuto, W. K., Sang, J., & Chumba, S. (2018). Influence of Continuous Professional

- Development Programmes on Curriculum Implementation in Selected North Rift Counties Public Secondary Schools, Kenya. *International Journal of Education and Research*, 6(6), 169–182.
- Chukwudi, A., Collins, C., Obiageli, S., & Anibueze, M. (2018). Status of Teachers on Gender-Sensitive Instructional Materials at the Basic Education Level. *International Journal of Advanced Academic and Educational Research*, 13(3), 11–18.
- Clements, D. H., & Sarama, J. (2016). *Handbook of Research Methods in Early Childhood Education: Methods for Developing Scientific Education*. Infonnalion Age Publishing.
- Cox, M., Preston, C & Cox, K. (2000). *Factors that Support Integration of Instructional Technologies*. Sage Publications.
- Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative and Mixed Methods Approaches* (3rd ed.). Sage Publications.
- Donkor, D. A. K., & Banki, R. D. (2017). Assessing the Impact of In-service Training Programmes on Basic School Teachers of China in the Kassena Nankana West District of Ghana. *Journal of Education and Human Development*, 6(4), 64–76.  
<https://doi.org/10.15640/jehd.v6n4a8>
- Doyle, T. (2010). *Learner Centered Teaching: Putting the Research on Learning into Practice*. Stylus Publishing, LLC. USA.
- Ertmer, P. A. ( 2005).Teacher Pedagogical Beliefs: the Final Frontier in our Quest for Technology Integration. *Educational Technology Research and Development* 53(4), 25-39
- Fischer, C. T. (2016). Qualitative Research Methods for Psychologists. In *Qualitative*

*Research Methods for Psychologists*. <https://doi.org/10.1016/B978-0-12-088470-4.X5000-5>

Ganyaupfu, E. M. (2014). *Teaching Methods and Students ' Academic Performance Teaching Methods a nd Students ' Academic Performance*. July.

Gathii, K. J., Wamukuru, D. K., Karanja, D., Muriithi, W., & Maina, K. (2019). *Research Methods, Data Analysis & Defences (Building Competences in Education and Social Sciences)* (1st ed.). Education and Social Sciences Research Association of Kenya (ESSRAK).

Ghavifekr, S., & Rosdy, W. A. (2016). Teaching and Learning with Technology: Effectiveness of ICT Intergration in Schools. *International Journal of Research In Education and Science*, 1(2), 175-191.

Guzey, S. S & Roehrig, G. H. (2009). Teaching Science with Technology: Case studies of Science Teachers' Development of Technology, Pedagogy, and Content Knowledge. *Contemporary Issues in Technology and Teacher Education*, 9(1), 1-16.

Hall, G. (2015). Research Methods for LLE. *Literature in Language Education*, 2(1), 1–187. <https://doi.org/10.1057/9781137331847.0016>

Hartwig, R. (2015). *Introduction to Quantitative Research Methods for Development*. University of Passau.

Herme, J. M. (2016). A Case Study of Learning Materials Used to Deliver Knowledge and Skills – or Competency – Based Curricula ( in Tanzania). *Triennale on Education and Trainng in Africa*, 1(2), 1–60.

- International Telecommunication Union. (2009). *Measuring the Information Society - The ICT Development Index*. Geneva, Switzerland: International Telecommunication Union.
- Jacovina, M.E., Johnson, A.M., Russel, D.E., & Soto, C.M. (2016). Challenges and Solutions when using Technologies in the Classroom. *Adaptive Educational Technologies for literacy Instruction* 1(1), 13-29.
- Jennings, Z. (2012). Resource and Technology: A Beacon for Change in the Reform of Jamaica's Secondary Education System: *International Review of Education* 58(2), 247-269.
- Jobo, M. (2016). The Effectiveness of Instructional Strategies Employed at Large Class Setting of the Four Selected Universities of Ethiopia. *International Journal of Learning, Teaching and Educational Research*, 15(3), 161–172.
- Kaptum C. S., Mailu S. N., & Koech P.K. (2018). Relationship between Learning Strategies and Students' Performance in Physics in Public Secondary Schools in Nakuru East Sub-County, Kenya: *European Journal of Social Science Studies* 3(3), 1-14
- Kini, T., & Podolsky, A. (2016). Research Report: Does Teaching Experience Increase Teacher Effectiveness? A Review of the Research. *Learning Policy Institute*, 4(6), 1–64. <https://doi.org/10.1016/j.tplants.2013.09.008>
- Kirimi, K. J. (2014). Impact of Information Communication Technology on Education-Kenya. *Journal of Educational and Social Research*, 1(12), 1–13. <https://doi.org/10.5901/jesr.2014.v4n1p435>

- Kober, N. (2015) Reaching Students: What Research Says about Effective Instruction in Undergraduate Science and Engineering. *The National Academic Press* 2019(5), 153-174.
- Kotrlik, J. W. Redmann, D. H & Douglas, B. B. (2003). Technology Integration by Agriscience Teachers in the Teaching/Learning Process: *Journal of Agricultural Education* 44(3), 78-90.
- Lee, M & Winzenried, A. (2009). *The Use of Instructional Technology in Schools: Lessons to be Learnt*. Acer Press, Australia
- Lin, C., & Jeng, W. (2015). Using Content Analysis in LIS Research: Experiences with Coding Schemes Construction and Reliability Measures. *Qualitative and Quantitative Methods in Libraries (QQML)*, 4(1), 87–95.
- Mbarushimana, N., & Kuboja, J. M. (2016). A Paradigm Shift Towards Competence Based Curriculum: The Experience of Rwanda. *Saudi Journal of Business and Management Studies*, 1(1), 6–17.
- Mikre, F. (2011). The Roles of Information Communication Technologies in Education Review Article with Emphasis to the Computer and Internet. *Ethiopian Journal of Education and Sciences*, 6(2), 109–126.
- Miller, R. R. (2017). Is Teaching Enough ? The Impact of Effective Teachers on Student Performance in High Poverty-Schools in New Jersey. *The Journal of School & Society*, 4(2), 85–97.
- Ministry of Education. (2018). Kemya National Education Sector Strategic Plan for the Period 2018 - 2022. *Government Reports*, 1(1), 1–281.
- Mugenda, O. (2003). *Research Methods: Quantitative and Qualitative Approaches*. Acts

Press.

- Mugo, B. C. (2007). *Instructional Technology in the Facilitation of Learning by Visually Impaired Learners in Upper primary Classes in Kenya*. M.Ed. Thesis of Kenyatta University.
- Mugo, B.C. (2013). *Assistive Technology and Access to Quality Instruction for the Blind and Visually Impaired Students Comparative Study of Kenyatta University, Kenya and Syracuse University, USA*. PhD Thesis of Kenyatta University
- Mulambe, S. O. (2017). Teacher-Factors Influencing the Adoption of Physics SMASSE Teaching Skills by Physics Teachers in Secondary Schools in Kenya. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 8(27), 274–283.
- Mwai, S. W. (2015). *Application of Instructional Technologies in Teaching and Learning in Public Secondary Schools in Kiambu Sub-County*. Unpublished Master of Arts in Communication Studies, University of Nairobi, Nairobi.
- Mwai, J., & Muchanje, P. N. (2018). Compliance to Performance Appraisal in Public Primary Schools in Golgi Sub-County in Kenya. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 8(2), 91–97. <https://doi.org/10.9790/7388-0802019197>
- Mwangi, B. W., & Njuguna, R. (2019). Performance Appraisal Strategies on Performance of Teachers in Public Secondary Schools in Kiambu County, Kenya. *International Journal of Current Aspects*, 3(II), 218–230.

<https://doi.org/10.35942/ijcab.v3iii.19>

- Nangabo, R. (2014). *Evaluation of SMASSE Training on Teachers' Sourcing and Usage of Instructional Materials for Teaching Chemistry in Bungoma East District, Kenya*. Doctoral Dissertation, Kenyatta University.
- Nassiuma D. K. (2008). *Survey sampling: Theory and methods*. Njoro, Kenya. Egerton University Press.
- Nderitu M. K. (2009). *Determinants of Enrolment and Performance in Physics in Selected Secondary Schools in Murang'a District, Kenya*. M.Ed. Thesis of Kenyatta University, Nairobi.
- Neuendorf, K. A. (2011). Content Analysis-A Methodological Primer for Gender Research. *Sex Roles*, 64(3), 276–289. <https://doi.org/10.1007/s11199-010-9893-0>
- Ngatia, P. K. (2015). *Preparedness of Public Secondary Schools on the Use of Information Communication Technology in Teaching and Learning in Mukurweini, Nyeri County-Kenya*. Unpublished Master of Education Thesis, Kenyatta University, Nairobi.
- Ngatia, D. G., Changeiywo, J., & Wambugu, P. W. (2019). Impact of Interactive Multimedia Simulations Advance Organizers Teaching Approach on Students' Achievement in. *International Journal of Education and Research*, 7(1), 279–290.
- Ngeze, L. (2017). ICT Intergration in Teaching and Learning in Secondary Schools in Tanzania: Readiness and Way Forward. *International Journal of Information and Education Technology*, 7(6), 424-427.
- Nicholson, H. (2011). Research Methods in Theatre and Performance. *Research Methods*

*for the Arts and the Humanities*, 3(4), 1–33.

- Noor-Ul-Amin, S. (2017). An Effective use of ICT for Education and Learning by Drawing on Worldwide Knowledge , Research , and Experience : ICT as a Change Agent for Education Abstract : *Department Of Education, University Of Kashmir Reports*, 1(1), 1–13.
- Omariba, A. (2016). *Teachers' Preparedness in Integrating Information Communication Technology in Training Teachers in Public Primary Teacher Training Colleges in Central Region Kenya*. Unpublished PhD Thesis, Kenyatta University, Nairobi.
- Omariba, A. (2012). *Challenges Facing Teachers and Students in the Use of Instructional Technologies: A case of Selected Secondary Schools in Kisii County, Kenya*. Med Thesis of Kenyatta University, Nairobi.
- Osika, E. R., Rochelle Y. J & Buteau, R. (2009). Factors Influencing Faculty Use of Technology in Online Instruction: *Online Journal of Distance Learning Administration* 12(1), 1-11
- Otieno, J.G. (2019). Mechanisms for Improving Enrolment in Physics in Public Secondary Schools of Masaba South Sub-County, Kisii County, Kenya. Med. Thesis of Catholic University of East Africa
- Perry, W. G. (2019). *Forms of Ethical and Intellectual Development in the College Years*. San Francisco: Jossey-Bass publishers.
- Perva, D. (2016). Impact Of School Facilities On Students' Academic Performances In Public Secondary Schools In Giwa And Zaria Education Zones, Kaduna State, Nigeria. *Journal of Education and Policy Making*, 4(9), 16–29.
- Piaget, J. (1968). *Six Psychological Studies*. New York.

- Pitter, H., Hubbell, E & Kuhn, M. (2012). *Using Technology with Classroom Instruction that Works*. ASCD Publication, USA.
- Ramorala, M.Z. (2014). *Challenge of Effective Technology Integration into Teaching and Learning*. Pretoria. University of South Africa Press.
- Rana, N. A., & Asghar, T. (2015). Diffusing ICT to Enhance Students' Academic writing Skills: An experimental Study at a Business Institute in Karachi, Pakistan. *International Journal of English and Education*, 4(3), 1–18.
- Ravhuhali, F., Kutame, A. P., & Mutshaeni, H. N. (2015). Teachers' Perceptions of the Impact of Continuing Professional Development on Promoting Quality Teaching and Learning. *International Journal of Educational Sciences*, 10(1), 1–7. <https://doi.org/10.1080/09751122.2015.11890332>
- Rogelberg, S. G. (2014). *Handbook of Research Methods in Industrial and Organizational Psychology*. Mackwell Publishing.
- Ruijuan, Z., Xiuxia, L., Shenghao, W., Zhongjun, J., Jinjie, H., & Dongmei, G. (2016). Research hotspots analysis of psychological nursing by PubMed. *Proceedings - 2015 7th International Conference on Information Technology in Medicine and Education, ITME 2015*, 6(5), 193–197. <https://doi.org/10.1109/ITME.2015.150>
- Sale, M. (2016). The Place of Instructional Materials in Quality Teaching at Primary School Level in Katsina Metropolis , Katsina State. *International Journal of Humanities and Management Sciences*, 4(2), 4–7.
- Sariah, S., Hassan, S., & Ibrahim, A. A. (2018). The Art of Teaching Science in Secondary Schools: A Meta Analysis. *TOJET: The Turkish Online Journal of Educational Technology*, 17(1), 183–191.

- Sengottuvel, A., & Aktharsha, U. S. (2015). Teacher Effectiveness and Professional Competency in School Education. *International Journal of Management*, 6(1), 181–190.
- Sharan, Y. (2018). Cooperative Learning for Academic and Social Gains: Valued Pedagogy, Problematic Practice. *European Journal of Education*, 45(2), 300–313. <https://doi.org/10.1111/j.1465-3435.2010.01430.x>
- Sharp, J. H., & Sharp, L. A. (2017). A Comparison of Student Academic Performance with Traditional, Online, and Flipped Instructional Approaches. *Journal of Information Technology Education: Innovations in Practice*, 16(2), 215–231.
- Silla, J., Muema, Mulwa, D. M., & Mailu, S. N. (2018). Relationship Between Teaching Method And Students ' Performance in Mathematics in Public Secondary Schools in Dadaab Sub County , Garissa County ; Kenya. *IOSR Journal of Research & Method in Education (IOSR-JRME)*, 8(5), 59–63. <https://doi.org/10.9790/7388-0805055963>
- Sloan, L., & Quan-Haase, A. (2017). *Social Media Research Methods*. SAGE Publications Inc.
- Smeets, E., Mooij, T., Bamps, H., Bartolome, A., Lowyck, J., Redmond, D., & Steffens, K. (2018). The impact of information and communication technology on the teacher. *European Research Studies Journal*, 21(4), 60–73.
- Suleman, Q., Aslam, H. D., Javed, T., & Hussain, I. (2011). Barriers to the Successful Intergration of Educational Technology in the Teaching Learning Process at Secondary School Level in Khyber Pukhtunkhwa Pakistan. *International Journal of Research in IT & Management*, 1(8), 97-119.

- Surry, D. W., Stefurak, J., Grey R. M. (2010). *Technology Integration in Higher Education: Social and Organizational Effects*. Information Science Reference, New York.
- Tochukwu, I. U., & Hocann, F. (2017). Awareness of Students on the Usefulness of ICT Toolsin Education: Case of EMU. *IOSR Journal of Research & Method in Education (IOSRJRME)*, 07(02), 96–106.
- Tochukwu, I. U., & TansuHocann, F. (2017). Awareness of Students on the Usefulness of ICT Toolsin Education: Case of EMU. *IOSR Journal of Research & Method in Education (IOSRJRME)*, 07(02), 96–106. <https://doi.org/10.9790/7388-07020396106>
- UNESCO. (2005). *Education for All: Toward the Knowledge Society: UNESCO World Report*. UNESCO. Paris. Available online, [www.unesco.org/en/worldreport](http://www.unesco.org/en/worldreport)
- UNESCO. (2004). *Education for All: Is the World on Track? UNESCO World Report*. UNESCO Paris. Available online, [www.unesco.org/en/worldreport](http://www.unesco.org/en/worldreport)
- Wambugu, P., Changeiywo, J., & Ndiritu, F. (2014). Effects of Experiential Cooperative Concept Mapping Instructional Approach on Secondary School Students ' Motivation in Physics in Nyeri County , Kenya. *Journal of Education and Practice*, 5(15), 74–84.
- Wambugu, P. W., & Changeiywo, J. M. (2018). Effects of mastery learning approach on secondary school students' physics achievement. *Eurasia Journal of Mathematics, Science and Technology Education*, 4(3), 293–302. <https://doi.org/10.12973/ejmste/75352>
- Wanjala, G., Osendo, L. P., & Okoth, U. (2019). Influence of Teacher Performance

Appraisal on Job Performance in Public Primary Schools in Mumias East Sub-County, Kenya. *International Journal of Scientific and Research and Innovative Technology*, 6(5), 45–59.

Wanjohi, A. M. (2014). *Social Research Methods Series Proposal Writing Guide*. Acts Press.

Weimer, M. (2013). *Learner-Centered Teaching: Five Key Changes to Practice*. Jossey Bass, USA.

Yunus, M., Salehi, H., Sun, C. H., Embi, M. A., & Nordin, N. (2015). Pros and Cons of Using ICT in Teaching ESL Reading and Writing. *International Education Studies*, 6(7), 1–8.

## APPENDICES

### APPENDIX A: RESEARCH QUESTIONNAIRE FOR PHYSICS TEACHERS

I am postgraduate student at Kenyatta University carrying out research on “Teacher preparedness to integration of instructional technologies in teaching Physics in Nakuru County”. It is important that you answer each question honestly so that the information you provide reflects your situation as accurately as possible. Do **NOT** write your name(s) anywhere on this questionnaire.

#### Section A: General Information

1. Gender:            Male [  ]    Female    [  ]
  
2. Highest level of academic qualifications  
Diploma    [  ]            Undergraduate [  ]  
Postgraduate [  ]
  
3. School category  
National school    [  ]    Extra-County school    [  ]  
County school    [  ]    Sub-County school    [  ]
  
4. Experience of teaching Physics in years  
Less than 5 [  ]    5-9            [  ]  
10-14        [  ]    At least 15    [  ]
  
5. To what extent has technologies been integrated in teaching of Physics at your school?  
Large extent, 61% and above    [  ]    Moderate extent, 31 to 60%    [  ]  
Small extent, 1 to 30%    [  ]    No integration at all, 9% and below    [  ]

**Section B: Availability of Instructional Materials/Resources**

Kindly indicate your level of agreement/disagreement with regard to the stated propositions using the following 5-point Likert scale: Strongly Agree (**SA**), Agree (**A**), Not Sure (**NS**), Disagree (**D**), and Strongly Disagree (**SD**)

<b>It is true to state that:</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>
6. There are enough Physics textbooks in my class at a ratio of 1 book to 1 student.					
7. In my class conventional media resources (e.g., photographs, charts, real objects, and white boards) are regularly used in teaching Physics.					
8. There is regular use of modern/digital media resources (e.g., computers, laptops, Smart phone and CDs) in teaching Physics lessons.					
9. Our school has sufficient resources which may help ensure quality education is given to learners.					
10. There is uninterrupted Internet access in our school.					
11. Internet is completely integrated in teaching of Physics.					
12. Students are often allowed to use the Internet during Physics lessons.					
13. As a teacher of Physics, I have been given a tablet by the school to facilitate my teaching.					

14. Which category of media would you recommend to ensure quality education in a Physics classroom?

Audio [ ]      Visual [ ]      Audio-visual [ ]      Interactive media [ ]

**Section C: Level of Preparedness to Integrate Instructional Technologies**

Kindly indicate your level of agreement/disagreement with regard to the stated propositions using the following 5-point Likert scale: Strongly Agree (SA), Agree (A), Not Sure (NS), Disagree (D), and Strongly Disagree (SD)

<b>It is true to state that:</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>
15. When in college/university, I learnt technology education.					
16. I currently use ITs in preparing schemes of work, lesson plans and mark sheets					
17. Over the last three years I have participated in professional development related to integration of ITs in the teaching of Physics					
18. I frequently use ITs in-teaching Physics					

**Section D: Factors That Support Integration of Instructional Technologies**

Kindly indicate your level of agreement/disagreement with regard to the stated propositions using the following 5-point Likert scale: Strongly Agree (SA), Agree (A), Not Sure (NS), Disagree (D), and Strongly Disagree (SD)

<b>It is true to state that:</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>
19. It is a TPAD requirement that teachers integrate ITs in teaching Physics					
20. The administration of our school has always been supportive in my mission to integrate ITs in teaching Physics.					
21. The budgetary allocation to our school is sufficient in sourcing instructional technologies.					
22. Governmental and non-governmental agencies support integration of ITs in teaching of Physics in our school.					
23. There is a clear vote head for procurement of ITs					

**Section E: Factors That Hinder Integration of Instructional Technologies**

Using the options, Strongly Agree (**SA**), Agree (**A**), Undecided (**UD**), Disagree (**D**), and Strongly Disagree (**SD**), it is true to state that the following factors negatively affect the quality of instructions when instructional technologies:

<b>Statements</b>	<b>SA</b>	<b>A</b>	<b>UD</b>	<b>D</b>	<b>SD</b>
24. Inadequate staff conversant with use of IT devices					
25. Inadequate infrastructure such as specialized rooms and electricity.					
26. Shortage of support for using computers e.g., technicians					
27. Students' abilities and socio-economic background					

#### **Section F: Integration of ITs in Pedagogy of Physics**

Kindly indicate your level of agreement/disagreement with regard to the stated propositions using the following 5-point Likert scale: Strongly Agree (**SA**), Agree (**A**), Not Sure (**NS**), Disagree (**D**), and Strongly Disagree (**SD**)

<b>It is true to state that:</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>
28. All Physics teachers have fully embraced ITs in teaching Physics.					
29. ITs are integrated in the teaching of Physics only in selected forms.					
30. The location of our school relative to electricity and internet has been crucial in ITs' integration.					
31. Our school has fully embraced ITs in the teaching of Physics.					

#### **Section G: Desirable Outcomes**

Kindly indicate your level of agreement/disagreement with regard to the stated propositions using the following 5-point Likert scale: Strongly Agree (**SA**), Agree (**A**), Not Sure (**NS**), Disagree (**D**), and Strongly Disagree (**SD**)

<b>It is true to state that:</b>	<b>SA</b>	<b>A</b>	<b>NS</b>	<b>D</b>	<b>SD</b>
32. Significant performance improvement in Physics started being recorded after the integration of instructional technologies in its teaching.					
33. The individual students' performance in Physics at KCSE remarkably improved since 2015.					
34. Performance in Physics at KCSE has consistently improved since 2015.					

**Thank You for completing this questionnaire.**

## **APPENDIX B: INTERVIEW GUIDE FOR HEADS OF DEPARTMENT**

### **General Information**

1. For how long have you been working in the school as a HOD?
2. What is the number of students who enrolled for Physics KCSE exam in the years?  
2015.....  
2016.....  
2017.....?
3. What is the current average number of students per candidate class?

### **Availability of Instructional Materials/Resources**

4. Is the ratio of Physics books to students adequate?
5. Which resources do you have in your department that may be used in raising the mean standard score in Physics?
6. Apart from using the laboratory, which other ways do the teachers deal with the experiments outlined in the course book?
7. When there are materials required to be bought for teaching of Physics in your department/school, which part do you play?
8. Does your school have reliable internet connectivity?
9. Do Physics teachers have access to digital teaching materials such as laptops and tablets?

10. Are students allowed to use the Internet while in school?
11. If so, are there any limitations with regard to the Internet use by students?

**Level of Preparedness to Integrate Instructional Technologies**

12. Do Physics teachers in your school go for in-service training?
13. Does the in-service training equip teachers with skills requisite in integration of instructional technologies?
14. How do you ensure that Physics teachers prepare well for lessons?
15. Do you ensure that teachers prepare schemes of work, lesson plans and records of work covered?
16. How does the school's administration ensure the teachers use instructional technologies while teaching?

**Factors That Support Integration of Instructional Technologies**

17. Kindly state five key factors which support integration of instructional technologies by Physics teachers in your school.
  - (i).
  - (ii)
  - (iii)
  - (iv)
  - (v)

### **Factors That Hinder Integration of Instructional Technologies**

18. Kindly state five key factors which hinder integration of instructional technologies by Physics teachers in your school.

(i)

(ii)

(iii)

(iv)

(v)

### **Integration of ITs in Pedagogy of Physics**

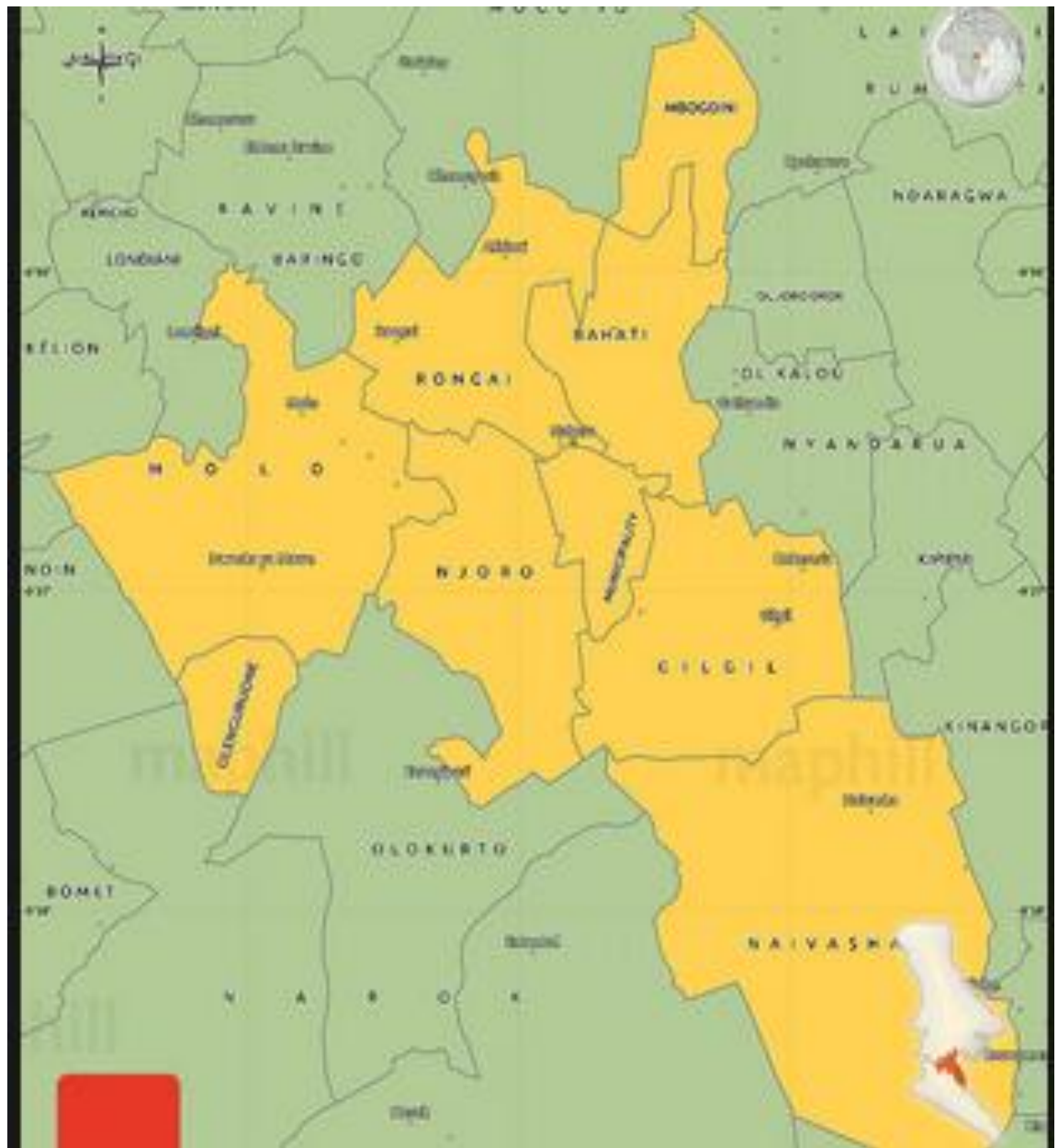
19. In a scale of 1 to 10, what is the extent of integration of IT in pedagogy of Physics with 1 representing **absolutely no integration** and 10 representing **maximum possible level of integration of ITs**?

### **Desirable Outcomes**

20. Has the performance of Physics in all forms been satisfactory since 2015? Satisfactory in that, the set targets are met or surpassed.

**Thank you for answering the questions.**

## APPENDIX C: A MAP OF NAKURU COUNTY



**APPENDIX D: RESEARCH AUTHORIZATION LETTER**



**KENYATTA UNIVERSITY  
GRADUATE SCHOOL**

E-mail: [dean-graduate@ku.ac.ke](mailto:dean-graduate@ku.ac.ke)

Website: [www.ku.ac.ke](http://www.ku.ac.ke)

P.O. Box 43844, 00100  
NAIROBI, KENYA  
Tel. 020-8704150

**Our Ref: E55/CE/21296/12**

**DATE: 3<sup>rd</sup> September, 2018**

Director General,  
National Commission for Science, Technology  
and Innovation  
P.O. Box 30623-00100  
**NAIROBI**

Dear Sir/Madam,

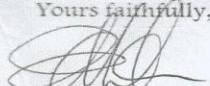
**RE: RESEARCH AUTHORIZATION FOR MR. NDIRANGU JAMES MBURU –  
REG. NO. E55/CE/21296/12**

I write to introduce Mr. Ndirangu James Mburu who is a Postgraduate Student of this University. He is registered for M.Ed. degree programme in the **Department of Educational Communication & Technology**.

Mr. Ndirangu intends to conduct research for a M.Ed. thesis Proposal entitled, **“Teacher Preparedness to Integrate Instructional Technologies in Teaching Physics in Public Secondary Schools of Nakuru County, Kenya.”**

Any assistance given will be highly appreciated.

Yours faithfully,

  
**PROF. PAUL OKEMO  
DEAN, GRADUATE SCHOOL**



**APPENDIX E: RESEARCH AUTHORIZATION FROM NATIONAL  
COMMISSION OF SCIENCE, TECHNOLOGY AND INNOVATION**



**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/18/18086/25635**

Date: **9<sup>th</sup> October, 2018**

James Mburu Ndirangu  
Kenyatta University  
P.O. Box 43844-00100  
**NAIROBI**

**RE: RESEARCH AUTHORIZATION**

Following your application for authority to carry out research on *“Teacher preparedness to integrate instructional technologies in teaching physics in public secondary schools of Nakuru County, Kenya”* I am pleased to inform you that you have been authorized to undertake research in **Nakuru County** for the period ending **9<sup>th</sup> October, 2019**.

You are advised to report to **the County Commissioner and the County Director of Education, Nakuru 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.

  
**BONIFACE WANYAMA**  
**FOR: DIRECTOR-GENERAL/CEO**

Copy to:

The County Commissioner  
Nakuru County.

The County Director of Education  
Nakuru County.

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


## APPENDIX F: RESEARCH PERMIT

**THIS IS TO CERTIFY THAT:**  
**MR. JAMES MBURU NDIRANGU**  
**of KENYATTA UNIVERSITY, 0-20100**  
**NAKURU, has been permitted to conduct**  
**research in Nakuru County**

**Permit No : NACOSTI/P/18/18086/25635**  
**Date Of Issue : 9th -October,2018**  
**Fee Relieved :Ksh 1000**

**on the topic: **TEACHER PREPAREDNESS****  
**TO INTEGRATE INSTRUCTIONAL**  
**TECHNOLOGIES IN TEACHING PHYSICS**  
**IN PUBLIC SECONDARY SCHOOLS OF**  
**NAKURU COUNTY, KENYA.**

**for the period ending:**  
**9th October,2019**



**Signature**  
**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 7800, 0713 788787, 0735 404245**  
Email: [dg@nacosti.go.ke](mailto:dg@nacosti.go.ke), [registry@nacosti.go.ke](mailto:registry@nacosti.go.ke)  
Website: [www.nacosti.go.ke](http://www.nacosti.go.ke)



**REPUBLIC OF KENYA**



**National Commission for Science,**  
**Technology and Innovation**

**RESEARCH LICENSE**

**Serial No.A 21020**

**CONDITIONS: see back page**

**APPENDIX G: RESEARCH AUTHORIZATION FROM THE COUNTY  
COMMISSIONER, NAKURU COUNTY**



**THE PRESIDENCY  
MINISTRY OF INTERIOR AND  
CO-ORDINATION OF NATIONAL GOVERNMENT**

Telegram: "DISTRICTER" Nakuru  
Telephone: Nakuru 051-2212515  
When replying please quote

COUNTY COMMISSIONER  
NAKURU COUNTY  
P.O. BOX 81  
NAKURU.

Ref No. CC. SR .EDU 12/1/2 VOL.IV/38

4<sup>th</sup> March 2019

TO WHOM IT MAY CONCERN

**RE:- RESEARCH AUTHORIZATION – JAMES MBURU NDIRANGU**

The above named from Kenyatta University has been authorized to carry out research on **"teacher preparedness to integrate instructional technologies in teaching physics in public secondary schools"** in Nakuru County for a period ending 9<sup>th</sup> October, 2019

Please accord him all the necessary support to facilitate the success of his research.

**J. B. KICHWEN  
FOR COUNTY COMMISSIONER  
NAKURU COUNTY**

**APPENDIX H: RESEARCH AUTHORIZATION FROM THE DIRECTOR OF  
EDUCATION, NAKURU COUNTY**

**MINISTRY OF EDUCATION**

STATE DEPARTMENT OF EARLY LEARNING OF BASIC EDUCATION

Telegrams: "EDUCATION",  
Telephone: 051-2216917  
When replying please quote



COUNTY DIRECTOR OF EDUCATION  
NAKURU COUNTY  
P. O. BOX 259,  
NAKURU.

Ref.CDE/NKU/GEN/4/21/VOL.VIX/34

4<sup>th</sup> March, 2019

TO WHOM IT MAY CONCERN

**RE: RESEARCH AUTHORIZATION -JAMES MBURU NDIRANGU**  
**PERMIT NO. NACOSTI/P/18/18086/25635**

Reference is made to the letter NACOSTI/P/18/18086/25635  
dated 9<sup>th</sup> October, 2018.

Authority is hereby granted to the above named to carry out research on  
*"Teacher preparedness to integrate instructional technologies in teaching  
physics in public secondary schools of Nakuru County, Kenya"* for a period  
ending 9<sup>th</sup> October, 2019.

Kindly accord him the necessary assistance.



**G. M. ONTIRI**  
**FOR: COUNTY DIRECTOR OF EDUCATION**  
**NAKURU**

Copy to:

✓ - Kenyatta University  
P.O Box 43844 - 00100  
**NAIROBI**