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RESEARCH ARTICLE

INFLUENCE OF UTILIZATION OF INFORMATION AND COMMUNICATION TECHNOLOGY TOOLS IN TEACHING PHYSICS ON STUDENT COMPETENCES IN PUBLIC DAY LOWER SECONDARY SCHOOL IN RWANDA

A CASE OF KICUKIRO DISTRICT

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Abstract

The adoptions of ICT tools in education have gained significant attention globally due to their potential to enhance teaching and learning experiences. This study aims to examine the influence of ICT tools in teaching Physics on student competence in public day schools in Kicukiro District, Rwanda. The study has three specific objectives which are to assess the influence of multimedia on students' competences in Physics in lower secondary schools of Kicukiro district, to evaluate the influence of computer based simulation on students' competences in Physics in public lower secondary schools in Kicukiro district and to determine the influence of virtual experiment on students' competence in Physics on lower public secondary school of Kicukiro district. The finding of this study was offered insight to teachers, school administrators, education policies makers and ICT industry for working better in globalized digital age. The study was also provided valuable insights for policymakers and educators to enhance the teaching and learning of Physics in public schools through the effective use of ICT tools. The selection of participants for this study were employed various methods including both simple random and purposive sampling techniques. The study gathered data through questionnaire with Likert scale statements and interview guide. Specifically, thequestionnaire were made for students while interview guides were designed for head teacher and teachers of Physics. The study's population was 11994 people consist of 26 head teachers, 38 teachers of Physics and 11930 Students from all of the Kicukiro District's lower public secondary school. The study utilized descriptive survey design to analyses data and examines relationship between ICT tool and student competence. A sample size of 387were chosen by using Yamane formula. The selection of participants for this study were employed various methods including both simple random for 387 students and purposive sampling techniques for 24 head teachers and 34 teachers of Physics. The analysis procedure involved the use of

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descriptive statistics. Each item from questionnaire and interview were systematically
categorized.Theresultsshowedthatthereisastatisticallysignificantrelation ship(r=.865, p < .01) between use of multimedia and conceptual understanding and retention of knowledge in public lower secondary schoolsofKicukiro District. Furthermore, according to the findings, there is a strong positivecorrelation (r = .802, p < .01) between simulation and engagement in learning experiences. Finally, the results indicate that there is a moderate to strong positive correlation(r = .735, p < .01) use of virtual experiment and improved score in examination. The findings revealed that simulation and multimedia were prevalent with high participation rate among students. Researcher recommend several key included student to utilize simulation and multimedia as new tools especially STEM will enhance engagement and a standardized evaluation framework based on the discoveries that every student felt that ICT tools improved their competence in Physics. This framework would enable a systematic assessment of the impact of utilize ICT tools in teaching. Based on findings that students highly valued their using ICT tools and perceived them as beneficial, organizing a national curriculum can further incentivize schools to invest in high-quality program.

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Introduction:-

In recent years, the use of ICT tools in education has been on the rise, with researchers worldwide exploring the potential benefits of incorporating technology into the teaching and learning process. In the field of Physics education, the use of ICT tools such as computer, interactive simulation, multimedia presentation and online resources has greatly transformed the way Physics is taught and has had a substantial impact on student competences in Physics subject (EI-Atawy, 2016).

The positive influence of ICT tools usage on student competence is evident across various Education systems. In many developed countries, integrating ICT in teaching aimed at enhancing student engagement in United States, various school use simulation, digital tools, online resources and interactive whiteboards to teach Physics concepts effectively (Smith, 2022). United Kingdom, schools in leverages online platform, simulations, education software and digital resources to enhance the teaching and learning of Physics (Anderson, 2019). Moreover, Singapore incorporates ICT tools like virtual lab, simulations and interactive software to teach Physics in secondary schools (Tan, 2020).The e-learning Africa Report 2019 by UNESCO emphasizes the importance of ICT tools in education and their potential to enhance students' competence. The report highlights successful case studies from across Africa, showcasing the positive impact of ICT integration in teaching Physics and improving student outcomes. This report serves as a valuable resource for policy makers, educators and stakeholders to understand the contribution of ICT tools in teaching Physics (Bukowieck, 2019). Furthermore, UNESCO has organized capacity building program for teachers through focusing on integrating ICT tools in teaching Physics. These programs provide teachers with training and support to enhance their pedagogical skills and effectively incorporate ICT tools in their Physics lessons. By improving teacher's competences in using ICT tools, UNESCO aims at enhancing student engagement understanding and achievement in Physics.

ICT tools can enhance the teaching and learning process by providing interactive content, simulation and resources that make complex concept more accessible and engaging for students. UNESCO's efforts in promoting the use of ICT tools in education aims to improve student competence in various subject including Physics by providing teachers and students with access to innovative resources and teaching methods (Johnson, 2022). African Union has contributed to the successful integration of ICT tools in education, leading to enhanced teaching and learning outcomes, particularly in subject like Physics. By training educators, providing necessary infrastructure and promoting policy frameworks supportive of ICT integration, the African Union has been instrumental in shaping conduce environment for leveraging technology in education (Abubakar, 2020). Through collaboration and

partnership, the African Union assists in providing necessary resources such as ICT infrastructure and Education content for teaching Physics, contributing to improved learning outcomes in public day schools (Kabore, 2021).

Rwanda government's Vision 2020 places a strong emphasis on ICT integration to address national development challenges, including education. The adoption of ICT tools in teaching Physics aligns with these regional initiatives and can contribute to the overall improvement of education quality in Rwanda.Integrating ICT tools in Physics Education can support students' understanding of complex concepts by engaging them in interactive and immersive learning experiences (Kimaro, 2018). Additionally, the use of ICT tools such as simulations, virtual laboratories and multimedia resources help students visualize abstract Physics Phenomena (Esquembre, 2017).

Rwanda has made significant progress in integrating ICTs in education, particularly through initiatives such as the One Laptop per Child (OLPC) program which is shifted into the Smart Classroom Program for increasing access and equity for promoting preparation, delivery of lessons, assessment and research by using ICT tools (MINEDUC, 2016). Additionally, Rwanda promotes a "Bring Your Own Device" (BYOD) program for teachers and students in order to increase ICT penetration at all levels (MINEDUC, 2016). The government of Rwanda has implemented various initiatives to promote ICT in education, including the deployment of computers in schools, the integration of digital content into the curriculum and the training of teachers in ICT skills.These efforts are aimed at enhancing the quality of education and preparing students for the demands of the 21st century workforce. Technology can be used to improve the quality of teaching and learning materials through the use of digital learning resources. Multimedia interactive digital content can be used to motivate students, improve conceptual understanding and retention of key topics (MINEDUC, 2016).

Kicukiro district locate in the capital city, Kigali has witnessed various advancements in ICT infrastructure and access to technology in schools, setting the stage for the application of ICT tools in teaching physics (National Institute of Statistics Rwanda, 2020). In Kicukiro district, public day schools have also been making strides in integrating ICT tools into the teaching of subjects such as Physics. Teachers for instance have been using interactive simulations, online resources, and multimedia presentations to supplement traditional teaching methods and engage students in the learning process. Using ICT tools in teaching physics can have a positive impact on student competence. Gatera (2018) posits that students who are taught Physics using ICT tools show higher levels of understanding and retention of concepts compared to those who were taught using old approach alone. The collaborative nature of ICT tools permits students to visual nonconcrete concepts, conduct experiments virtually and receive instant feedback which can help deepen their understanding of the subject.However, there is a need to explore the influence of these ICT tools on student competence specifically in the context of Kicukiro district (Gatera, 2018).

Utilization of ICT tools in the teaching of Physics has gained significant attention as a means to enhance students' competence and understanding of the subject. However, despite the efforts made to introduce ICT tools in Physics instruction, there is a need to assess the actual influence of these tools on student competence in Physics in public day lower secondary schools has not been established. Currently, public day secondary schools in Kicukiro district inadequate equipment and laboratories to support Physics instruction. This has necessitated the use of ICT tools such as virtual experiment. By utilization ICT tools, students should learn Physics through visual abstract concepts, simulation, conduct experiment virtually, using online resources and multimedia presentation .This leads to enhanced skill of connecting theoretical concepts and real-world application. This connection to real-world contexts enhances students' understanding of the relevance and applicability of Physics in their lives, increasing their competence in the subject. Traditional teaching methods alone may not adequately address students' learning needs or effectively engage them in the subject matter. Hence, more innovative approaches such as incorporating ICT tools are being explored to improve the teaching and learning experience.

This is an area that has not explored the problem lies in the lack of comprehensive research conducted to evaluate the influence of ICT tools on student competence in Physics within the context of public day secondary schools in Kicukiro District. Although there might be anecdotal evidence or informal observations suggesting positive effects, there is a need for a systematic investigation to gather reliable data and draw valid conclusions. This research aims to bridge the gap in knowledge by examining the influence of utilization ICT tools in teaching Physics and its effect on student competence. It intends to explore the use of various ICT tools such as interactive simulations, virtual laboratories, educational software, and internet resources to enhance instructional delivery and promote active

student engagement. By addressing this problem; the research intends to determine whether the integration of ICT tools in teaching Physics impacts student competence in public day secondary schools in Kicukiro District.

The study was directed by the following specific objectives:

1. To assess the influence of multimedia on students' competences in Physics in lower secondary schools in Kicukiro district.
2. To evaluate the influence of computer based simulation on students' competence in Physics in public lower secondary schools in Kicukiro district
3. To determine the influences of virtual experiment on students' competences in Physics on lower pubic secondary schools in Kicukiro district.

Literature Review:-

Theoretical literature

This section discloses the review of literature which is relevant to the research questions. It discusses various academic issues that have been addressed and pertinent to the research topic such as the influence of ICT tools in teaching Physics on student competence in public day lower secondary schools in Kicukiro district, Rwanda

ICT Tools in Teaching Physics

Physics is regarded as an abstract subject by many people. This may be due to the way the teacher teaches it. If concepts in Physics are taught very well with the aid of ICTs nobody would call it abstract subject again; it is true some mechanism may be complex to explain but technology has solved the problem through educational software. Educational software can be used to teach difficult concepts or observe difficult skills in Physics (Yusuf, 2019). Effective utilizing multimedia in teaching will develop student competences in Physics in lower secondary schools in Kicukiro district.

The science of Physics is experimental and requires demonstration. In a modern Physics classroom, demonstration experiments require the use of not only a variety of gadgets but also computers equipped with a multimedia projector or display screen (Muzapharovna, 2023). By utilizing computer based simulation will develop student competences in Public lower secondary schools.

Student Competences

According to Suharyono (2021) a dichotomy model was employed in the Physics Subject physical competency exam instrument. When it comes to observing student replies, a dichotomy model is a more objective and dependable kind of multiple choices because it isn't impacted by the subjective opinions of the raters**.** This means Competences of student in Physics vary based on their understanding and application of fundamental concepts in the subject. Student should have knowledge and understanding of Physics concepts and principles, student should be able to apply their knowledge for solving a variety problems and use appropriate formula to arrive correct solutions. Competent student have ability to engage in scientific inquiry and investigation. They are curious, observant, and capable of formulating hypothesis, designing experiments and interpreting data in order (Suhariyono, 2021).

According to Kuswanto (2018) the use of technology could enhance students' comprehension of scientific concept; the incorporation of local wisdom into the learning process can enhance the quality of Physics education and make it more meaningful for students. Additionally, active learning grounded in local wisdom enhances student learning outcomes. The media can be used as Physics learning resources both inside and outside of the classroom (Kuswanto, 2018).

According to Ravil (2020) Physics teacher must master the system of special competencies related to ICT. The competencies include acquiring and using new knowledge in Physics using modern ICT, using electronic educational resources, creating databases, and using internet resources for teaching physics, developing elements of the educational complex, developing electronic resources, and creating and processing textual, as well as graphical information on Physics (Ravil, 2020).

Theoretical Framework

This research is grounded in Social Cognitive Theory

Social Cognitive Theory (SCT)

According to the Social Cognitive Theory by Albert Bandura, learning occur through a continuous interaction between a person's behavior, environment and cognition, In context of using ICT tools in teaching Physics, the theory suggests that students can observe and imitate the behaviors of peers or teachers which can enhance their understanding. Through observation, students can learn from experiences and successes of others which influence their own behaviors and performances in Physics. Moreover, social cognitive theory emphasis the importance of self-efficacy which refer to an individual belief in their ability to accomplish specific tasks. When students successfully use ICT tools to engage in Physics related activities and achieve positive outcomes, their self-efficacy in Physics can be strengthened. This increased confidence can lead to higher levels of motivation and engagement in the subject, ultimately improving their competences in Physics.

According to Song (2016) the use of simulation and virtual labs in Physics instruction leads to improved student understanding of complex concepts and increase in engagement in learning process. The interactive nature of these tools allows students to explore Physics phenomena in a hands-on way, leading to deeper comprehension and retention of information (Song, 2016).

Research by Rana (2017) indicates that the use of ICT tools in Physics teaching can help students develop critical thinking skills and problem-solving abilities. By providing access to digital resources and online learning platform, students are able to collaborate, experiment and explore real world applications of Physics principles, leading to higher levels of competence in subject (Rana, 2017).

Conceptual Framework

The association between ICT tools involvement and student competences in lower public secondary school is the main emphasis of this study's conceptual framework. Figure 2.1 illustrates that students competence is the dependent variables and ICT tools is independent variables. Additional, intervening variables are presented. Conceptual framework emphasized the pathways through which ICT tools influence directly or indirectly student competence as well as the contextual factors that could mediate this relationship. This framework is intended to offer direction for research endeavors for enhancing the effectiveness of Physics teaching in public lower secondary school.

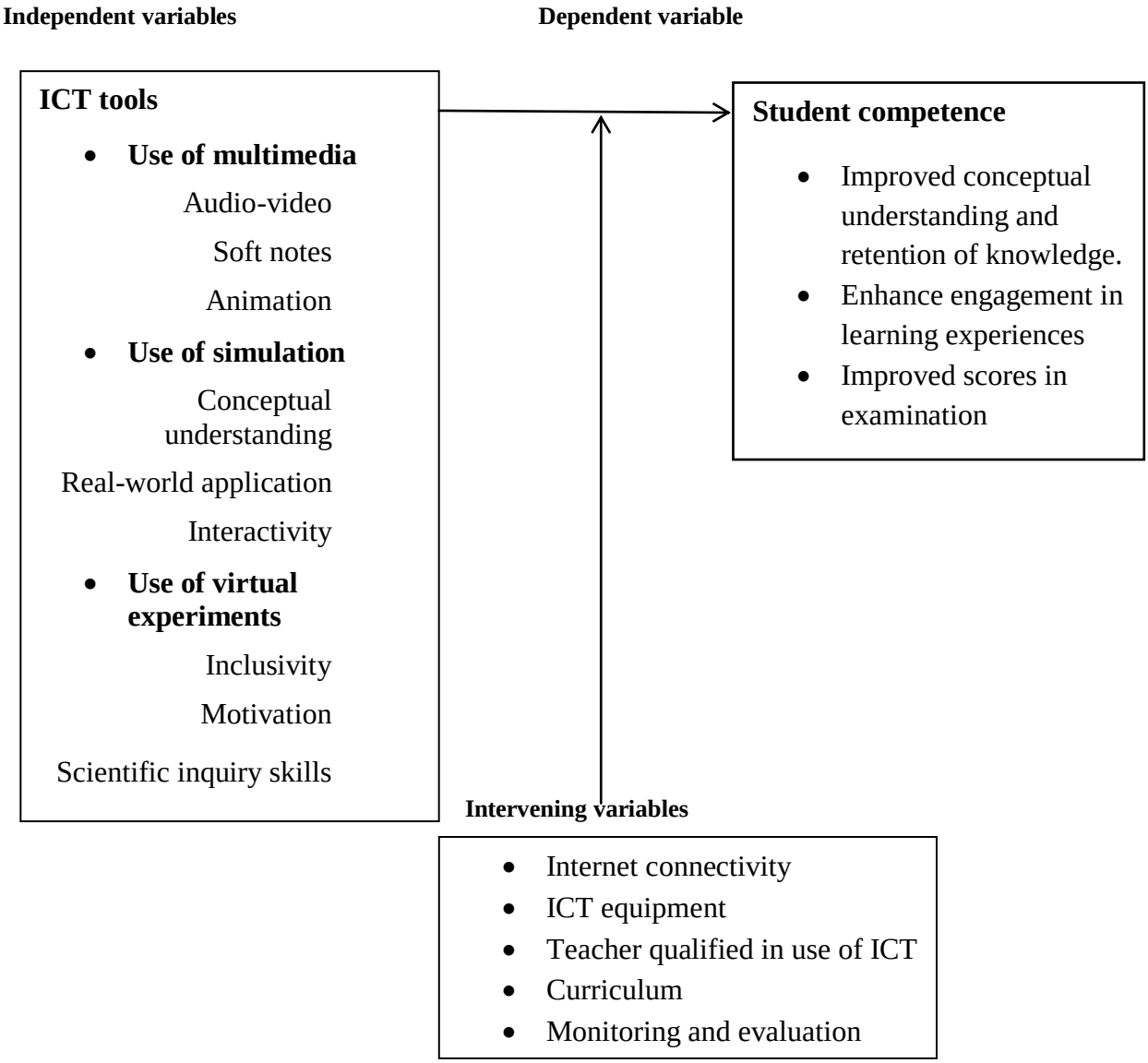

Figure 2. 1 Conceptual Framework

Research Methodology:-

Research Design

This study utilizeddescriptive survey design to investigate influence of ICT tools in teaching Physics on students' competences in public day secondary schools in Kicukiro district. Surveys appropriate as it enable researcher to study a large target population by sampling a small representative population as well as it will allow the researcher to gather numerical (Loeb, 2017). This it possible for the researcher to produce statistical information in different influence for utilizing ICT tools in teaching on student competences in Public lower secondary schools in Kicukiro district.

Target Population

The participants in this study are head teacher, teacher of Physics and students from all public lower secondary school, including students, teachers and head teachers in Kicukiro District. According to the demographic figures for the Kicukiro district, there are a total of 26 public lower secondary schools in the Kicukiro district with 26 head teachers, 38 teachers of Physics and 11930 students of public lower secondary schools (Kicukiro District figures,

July 2024). The target population for this study was cover all 26 head teachers, 38 teachers of Physics and 11930 students to make a total of 11994 respondents.

Sample Design
This section consist technique of sampling and sample size.

Sampling Techniques
Schools were sampled through simple random sampling. Stratified simple random sampling was used to select students according to their classes. Class level was strata. Teacher of Physics and head teacher was selected using purposive sampling.

Sample Size
Yamane formula was used to calculate the right sample size for this study.
Yamane(1967) calculated that 96 samples are needed when the population size is 2200.

$n = \frac{N}{1+N(e^2)}$ where **n** represent size of simple

N represents the population size

e is the level of precision desired

1 stands constant value that is the total variance of the population

$n = \frac{11994}{1+11994(0.05)^2} = 387$

A sample of respondent will be selected .The sample will be drawn from different categories of respondent as illustrated in table 3.

Table 3.1:- Target Population and Sample Size.

Group of respondents	Target population	Sample size
Head teachers	26	24
Teachers of Physics	38	34
Students	11 930	387
Total:	**11994**	**445**

Source: Kicukiro District Education Office (July 2024)

Research Findings and Discussion:-

Demographic Characteristics of the Respondents and Presentation of Findings
Thedemographic information of 387students participants such as Age group, gender class level and disability involved in the study to assess how utilize ICT tools in teaching Physics influence student competence is provided in the next session.

Age group respondents
The maturity of respondents is a considerable variable as it helped the current researcher to ensure the maturityof responses and information credibilitythat is vital in the current study. The age group of lower public secondary school students of Kicukiro District was very necessary in analyzing their perspectives

Table4.1:- AgeGroupofRespondents.

Age Group	Frequency	Percentage
11-15	354	91.5
16-20	33	8.5
Total	**387**	**100.0**

Source: PrimaryData (2024)

The data reveal a clear age distribution among the surveyed individuals. The majority, comprising 91.5% of the sample falls within the 11-15 age groups. Meanwhile, individuals' aged16-20 constitutes 8.5% of the sample, suggesting significant presence of old students' participant.

Class level of respondent
The current researcher through questionnaire has requested respondent to indicate their class level.

Table 4.2:- Class level of respondents.

Class level	Frequency	Percentage
Senior 1	179	46.3
Senior 2	116	29.9
Senior 3	92	23.8
Total	**387**	**100.0**

Source: PrimaryData (2024)

In terms of class level, the data illustrates almost equal distribution, student in S1 make up a quite largest portion, accounting for 46.3% of the sample. Following closely, S2 and S3 student represent 29.9% and 23.8%of the sample respectively. The data indicates that nearly half (46.3%) of the students are in Senior 1. This could reflect a successful entry year for new students, but it also suggests that resources and support systems are particularly critical at this stage to maintain engagement in Physics as students' progress. The significant decrease in student numbers from Senior 1 to Senior 2 (from 179 to 116) and Senior 2 to Senior 3 (from 116 to 92) raises concerns about student retention. This trend may point to challenges such as academic difficulties, lack of engagement, or external factors affecting students' ability to continue. The disparity in class sizes may indicate a need for differentiated curriculum approaches. Senior 3 may require more tailored academic support or enrichment programs to address the lower enrollment and potentially lower performance. Understanding the reasons behind the declining numbers may lead to insights that could improve the educational environment, enhance student satisfaction, and ultimately boost retention rates across all senior classes.

Gender of Respondent
The current researcher through questionnaires has requested respondents to indicate their gender

Table. 4.3:- GenderofRespondents.

Gender	Frequency	Percentage
Female	212	54.7
Male	175	45.3
Total	**387**	**100.0**

Source: PrimaryData (2024)

Regarding Gender, the sample exhibits an even split with males constituting 45.3% and females representing 54.7% of the total. This balanced gender distribution indicate that the study aims to capture the perspectives and experiences of both males and females students

Influence of multimedia on student competences in Physics

The first objective of this research was to assess the influence of multimedia on students' competences in Physics in public lower secondary schools in Kicukiro district. The researcher required the respondents to show their views by filling out the questionnaireto achieve this objective.

Table4.4:-Influence of multimedia on student competences in Physics.

Statements	SI		D		N		A		SA		Mean	Std
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
Learning Physics with audio-video has increased my understanding of Physics concept	4	1.0	9	2.4	34	8.8	122	31.4	218	56.3	4.39	0.825

.Learning Physics with soft notes help me to access figures accurately.	4	1.0	9	2.3	34	8.8	132	34.0	208	53.6	4.37	0.821
I understand application of Physics principles, when teacher displays a video.	11	2.8	23	5.9	47	12.1	114	29.4	192	49.7	4.25	0.819
Learning Physics with animation help me to understand Physics content well	4	1.0	9	2.3	34	8.8	128	33.0	212	54.6	4.38	0.823

Source: PrimaryData (2024

The result as indicated in the table 4.4 reveals high positive sentiments among the respondents. A significant majority (87.7%) either agrees or strongly agrees that learning lessons with audio-video has increased understanding of Physics concept. This high level of agreement is reflected in the average score of 4.9, indicating a positive influence on improve conceptual understanding with relatively low variation (SD of 0.825).Similar to learning through access soft notes, help learner to access physics figures accurately, the majority (87.6%) agrees or strong agree that ICT tool have enhanced their retention of knowledge and enhance engagement in learning experience. The average score of 4.9 suggests a positive impact with a slightly lower standard deviation (0.821) compare audio-video tools.An overwhelming majority (79.1%) agree or strongly agree that involvement in usage of video tool has positive impacted their conceptual understanding and understand application of physics principle. The high agreement level is reflected in the average score of 4.7, indicating a strong influence on competence of student with low variation (SD of 0.819).

A vast majority (87.6%) agrees or strongly agrees that learning Physics with animation help them to understand Physics content well. The average score of 4.8 suggest a substantial positive influence with minimal standard deviation (0.823).

The recent research conducted the Influence of multimedia on student competences in Physics in public lower secondary schools in Kicukiro district through interview with Head teacher of Kicukiro district. They answered as follows: Head teacher said: “I have noticed that that students who learn through multimedia such as audio-video ,they improve understanding of concept and retention of knowledge”. Another headteacher pointed out that “It is true that Learning Physics with soft notes help students .This result of use in improving understanding of figures, graph and instrument within content of Physics.”

Teacher through interview which enabled researcher to gain useful information. The following are answer s provided by teacher about contribution of multimedia in developing student competences in Physics

Physics concepts often involve abstract ideas that can be difficult to grasp. Multimedia tools like animations, and videos help visualize these concepts, making them more tangible and easier to understand.

Multimedia caters to various learning styles like visual, auditory, and kinesthetic allowing students to engage with content in ways that suit them best. This inclusivity can enhance comprehension and retention. Multimedia resources showcase real-world applications of Physics, helping students understand the relevance of what they’re learning. This connection can motivate students and spark interest in the subject. Multimedia projects encourage collaboration among students, promoting teamwork and communication skills. Group activities that involve creating presentations or videos can enhance social learning. Online resources and multimedia tools can make learning more accessible, allowing students to review materials at their own pace. This can be particularly beneficial for those who need additional support or wish to explore topics more deeply. Multimedia can also be used in formative assessments,

where students create videos or digital presentations to demonstrate their understanding. This method provides immediate feedback and encourages reflection on their learning process.

Influence of computer based simulation on student competence in Physics

The second objective of this research was to evaluate the influence of computer based simulation on students' competence in Physics in public lower secondary schools in Kicukiro district. To achieve this objective the researcher required the respondents to show their views by filling the questionnaire

Table4.5:- Influence of computer based simulation on student competence in Physics.

Statements	SD		D		N		A		SA		Mean	Std
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
Simulation has helped me connect Physics principles and real world application	6	1.5	10	2.6	39	10.1	140	36.2	192	49.5	4.45	0.868
Simulation explains clearly conceptual understanding with concrete examples	4	1.0	9	2.3	34	8.8	129	33.2	211	54.4	4.37	0.823
Computer based simulation has developed interaction with others	5	1.3	10	2.6	36	9.3	132	34.0204		52.6	4.34	0.851

Source: PrimaryData(2024)

A substantial majority (85.7%) agrees or strongly agrees thatsimulation has helped student to connect Physics principles and real world application. The average score of 4.9 suggests a significant influence competence of student with low standard deviation (0.868).

Virtually all respondent (87.6%) agree or strongly agree thatsimulation explains clearly application of Physics in our daily life. The average score of 4.9 highlights the value of these ICT tools on developing competences of student with minimal standard deviation (0.823).

Nearly all respondents (86.6%) agree or strongly agree that computer based simulation has developed students attitude in Physics. The average score of 4.9 indicates a remarkable improvement in score of examination with low relative standard deviation (0.851).

Teacher through interview which enabled researcher to gain useful information. The following are answers provided by teacher and head teacher about influences of computer based simulation on student competences in Physics;

Computer-based simulations have a profound influence on student competencies in Physics, particularly in the following ways: Simulations allow students to visualize complex concepts, such as forces, motion, and energy transformations. By manipulating variables and observing outcomes, students gain a clearer understanding of theoretical principles Engaging with simulations promotes active learning. Students are not just passive recipients of information; they interact with the content, experiment, and draw conclusions, which deepens their comprehension and retention of knowledge. Simulations provide a risk-free environment for experimentation. Students can explore scenarios that would be difficult, dangerous, or impossible to replicate in a classroom setting, such as high-speed collisions or atomic interactions. Many simulations offer instant feedback, allowing students to see the consequences of their actions in real time. This immediate reinforcement helps them identify misconceptions and adjust their understanding accordingly. By engaging with simulations, students learn to approach problems systematically. They can experiment with different strategies and observe the results, fostering critical thinking and problem-solving abilities. Simulations can facilitate group work, encouraging collaboration among students. Working together to solve problems or conduct virtual experiments promotes teamwork and communication skills. Computer-based simulations can be accessed outside the classroom, allowing students to revisit concepts at their own pace. This flexibility supports diverse learning needs and encourages independent study.The interactive and often gamified nature of simulations can increase student motivation. Engaged students are more likely to persist in challenging

tasks and develop a positive attitude toward learning Physics. Using simulations helps students develop essential technology skills, preparing them for future academic and career opportunities in an increasingly digital world.

Influence of virtual experiment on student competences in Physics

The study sought to establish the findings are presented to determine the influences of virtual experiment on students' competences in Physics on lower pubic secondary schools in Kicukiro district. Toachieve this objective the researcher required the respondents to show their views by filling the questionnaire.

Table4.6:- Influence of virtual experiment on student competences in Physics.

Statements	SD		D		N		A		SA		Mean	Std
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%		
Accessing virtual experiment has provides scientific inquiry skills	7	1.8	14	3.6	42	10.8	153	39.5	171	44.1	4.2	0.904
Virtual experiment has provides instant feedback opportunities and inclusivity	4	1.0	9	2.3	37	9.5	134	34.5	203	52.8	4.35	0.827
Learning through virtual experiment has helped develops favorable attitude toward Physics	6	1.5	10	2.6	39	10.1	127	32.7	205	52.8	4.33	0.875

Source: PrimaryData(2024)

Majority (83.6%) agree and strongly agree that accessing virtual experiment has provided clear perspective on complicated content in Physics with 0.904 of standard deviation.

87.3% agree and strongly agree that virtual experiment provide instant feedback opportunities with standard deviation of 0.827.Lastly, majority 85.5% agree and strongly agree that virtual experiment has helped student to develop favorable attitude toward Physics. The average score of 4.9 indicate a remarkable improvement of score in examination with relative low standard deviation (0.875).

Teacher and Head teacher through interview which enabled researcher to gain useful information. The following are answers provided by teacher and head teacher about contribution of virtual experiment in developing student competences in Physics;Virtual experiments simulate real-life laboratory conditions, allowing students to conduct experiments without the constraints of physical equipment. This hands-on approach helps reinforce theoretical concepts through practical application.

Complex Physics concepts, such as waves, electromagnetism, or quantum mechanics, can be difficult to visualize. Virtual experiments offer dynamic visualizations, making these concepts more accessible and easier to understand. Students can safely explore potentially hazardous experiments in a virtual environment. This encourages them to take risks in their learning without the fear of accidents or equipment damage.

Many virtual experiments provide immediate feedback on student inputs and outcomes. This allows learners to analyze data in real time, promoting critical thinking and helping them understand the scientific method. Virtual experiments often encourage students to formulate hypotheses, test them, and draw conclusions. This inquiry-based approach nurtures curiosity and develops problem-solving skills. Students conduct virtual experiments at their own pace, enabling them to revisit concepts and explore areas of interest more deeply. This personalized approach supports diverse learning styles and needs. Virtual experiments facilitate group work and discussions among students. Collaborating on virtual experiments fosters teamwork, communication skills, and collective problem-solving.

Engaging with virtual experiments enhances students' technological proficiency, which is increasingly important in the modern educational landscape and future careers.

Virtual platforms often provide access to a broader array of experiments than what might be feasible in a traditional classroom setting. This variety exposes students to different areas of Physics and encourages exploration.The interactive and often gamified nature of virtual experiments can enhance student motivation and engagement, making learning more enjoyable and inspiring a positive attitude toward the subject.

Table 4.7:- Correlation between ICT toolsand Student's Competencein Physics in Rwanda.

		Conceptual understanding and retention of knowledge	Engagement in learning experience	Score in Examination
Use of Multimedia	Correlation Coefficient	865**		
	Sig.(2-tailed)	.000.		
	N	302		
Use of simulation	Correlation Coefficient	.	.802**	.
	Sig.(2-tailed)		.000	
	N		302	
Use of virtual experiment	Correlation Coefficient	.		.735**
	Sig.(2-tailed)			.000.
	N			302

**.Correlationissignificantatthe0.01level(2-tailed).

Source: PrimaryData(2024)

The Findings from Table 4.7 indicate that there is a statistically significant positive correlation (r= .865, p < .01) between use of multimedia and conceptual understanding and retention of knowledge in public lower secondary schools of Kicukiro District. This also implies an association between teaching Physics and student's competences in public lower secondary schools of Kicukiro District. Furthermore, according to the findings, there isastrong positivecorrelation(r =.802, p <.01) betweenuse of simulation and engagement in learning experiences. Finally, the results indicate that there is a moderate to strong positive correlation (r = .735, p < .01) between virtual experiment and score in examination. This suggest that students who engaged in social studies simulation exercises exhibited higher level of critical thinking and creative problem solving activities (Kebritchi, 2016).

Regression analysis between ICT tools and student competences in Physics

Table4.8:- ModelSummary.

Model	R	RSquare	AdjustedRSquare	Std.Errorofthe Estimate
1	.874[a]	.764	.763	.522

a.Predictors:(Constant),ICT tools

Source:PrimaryData(2024)

From the Table 4.8.the regression model suggests that there is a strong positive relationship between independent variable (use of multimedia, use of simulation, and use of virtual experiment) and the dependent variable(conceptual understanding and retention of knowledge, engagement in learning experiences and improved score in examination). Approximately76.4%ofthevariabilityinthedependentvariablecanbeexplained variations in independent variable. The model appears to be a reasonably good fit for the data, as indicated by the relatively low standard error of the estimate.

Table4.9:-AnalysisofVariance(ANOVA).

Model		SumofSquares	Df	MeanSquare	F	Sig.
1	Regression	264.336	1	264.336	970.448	.000[b]
	Residual	81.716	300	.272		
	Total	346.052	301			

a.DependentVariable:student competences

b.Predictors:(Constant),ICTtools

Source: PrimaryData(2024)

Table 4.9 indicates that the model is significant. The p-value of .000 is less than the alpha level of .05, suggesting that there is a statistically significant relationship between ICT tools and student competences. This implies that ICT tools significantly influence student competence public lower secondary schools in the KicukiroDistrict

Table4.10:- RegressionCoefficient.

Model		UnstandardizedCoefficients		Standardized Coefficients	t	Sig.
	B		Std. Error	Beta		
1	(Constant)	.193	.109		1.767	.078
	ICT tools	.947	.030	.874	31.152	.000

a.DependentVariable:Student competences

Source: PrimaryData2024

The findings in Table 4.10 from the respondents of this study indicated that the regression equation ($y = ax + b + c$) thus y: dependent variable as student competence, x: independent variable as ICT tools. Therefore, $y= .947x + .193 +\varepsilon$. This slope is highly significant since the significance value is .000which is less thanthe conventionalalpha level of 0.5. This implies that ICT tools have significant influence on student competences in public lower secondary schools of the Kicukiro District.

Conclusion and Recommendation:-

Conclusion

This study so sought to determine how ICT tools influence student competence in teaching Physics in public lower secondary schools in Rwanda's Kicukiro area. Determining the utilization level characterizing the kinds of ICT tools and investigating their impact on student competences were particular goals. The findings revealed that simulation and multimedia were prevalent with high participation rate among students. Importantly, all respondents stated that involvement in utilize ICT tools improved their competences ability considerably. This highlights the potential advantages of diversifying ICT tools offerings, emphasizing the importance of student utilization and recognizing the role of such activities in enhancing engagement in learning experience and competences.

Recommendations:-

The following are recommended regarding the results of the study:

To secondary school:

This recommendation is based on the findings that the majority of students utilized in simulation and multimedia. By introducing new tools in area like STEM, schools can cater to a broad range of student interest, enhancing overall utilization and engagement.

Given high percentages of students agreed that ICT tools positively impacted their enhancing engagement in learning experience .By allowing students with skills, schools can create a supportive and motivating atmosphere that encourages even more student to participate actively.

To the ministry of education:

The recommendation for a standardized evaluation framework is based on the discoveries that every student felt that ICT tools improved their competence in Physics. This framework would enable a systematic assessment of the impact of utilize ICT tools in teaching, allowing for data-driven decisions on resource allocation and program

improvement. Based on findings that students highly valued their using ICT tools and perceived them as beneficial, organizing a national curriculum can further incentivize schools to invest in high-quality program**.**

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