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Education Technology Management Practices And Students' Skills Acquisition In Physics Subject In Public Lower Secondary Schools In Rwanda.

A Case Study Of Rulindo District

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Abstract: This study aimed to assess the influence of education technology management practices on students' skills acquisition in the physics subject in public lower secondary schools in Rulindo District, Rwanda. The study was guided by four specific objectives, which were: to examine the influence of ICT infrastructure planning on students' skills acquisition in physics, to assess the influence of physics teacher training on students' skills acquisition, to evaluate the influence of monitoring digital content integration on students' skills acquisition, and to analyze the influence of stakeholder collaboration on students' skills acquisition in public lower secondary schools in Rulindo District, Rwanda. The theoretical framework consisted of the Technology Acceptance Model and Constructivist Learning Theory. The study adopted a descriptive survey design with a mixed-methods approach, integrating both quantitative and qualitative methods to gather perceptions from a total population of 3,637, from which a sample size of 360 respondents. Data collection tools involved questionnaires to gather data from teachers, interview guides for head teachers and deputy head teachers, and focus group discussions for S3 students. A reliability index of at least 0.7 was used as the benchmark to determine the reliability of the questionnaire, and a validity test was conducted with an acceptable threshold of 0.6. Data were analyzed using IBM Statistical Package for the Social Sciences (IBM SPSS) to calculate the mean, standard deviation, and frequency distribution, while regression analysis was employed to assess the influence between variables. Qualitative data were analyzed through thematic coding. After data have been gathered, findings were summarized, general conclusions were drawn and recommendations formulated.

Key words: ICT infrastructures, Physics teachers

Introduction

The global education landscape has increasingly embraced Education Technology (EdTech) to enhance learner-centered pedagogy, interactive content delivery, and competency-based learning, particularly in science subjects such as physics, where abstract concepts benefit from visual simulations and experimental engagement (UNESCO, 2023). Countries such as Finland, Singapore, and the United States demonstrate that effective EdTech use requires sound management practices, including strategic planning, infrastructure deployment, and continuous teacher training (OECD, 2022). However, many low- and middle-income countries continue to face challenges related to uneven digital infrastructure, limited professional capacity, and inconsistent implementation of technology policies (World Bank, 2022).

In Rwanda, the Ministry of Education has made notable strides through the Competence-Based Curriculum (CBC), the Smart Classroom Program, and continuous teacher ICT training initiatives to integrate digital tools into learning, particularly in STEM subjects like physics (MINEDUC, 2022). Nevertheless, disparities in EdTech utilization persist across districts. Urban schools generally benefit from regular teacher training, structured ICT integration, and consistent equipment maintenance, while rural districts such as Rulindo face challenges including inconsistent planning, limited teacher support, and inadequate monitoring of digital resource use (REB, 2023). As a result, students often fail to develop the expected conceptual understanding, problem-solving, and practical skills in physics.

According to the Rwanda Education Board's (REB) 2023 National Learning Assessment, only 39% of lower secondary students in rural public schools demonstrated proficiency in basic physics experiments, compared to 64% in urban schools. The 2022 Education Sector Strategic Plan (ESSP) reported that less than 30% of public lower secondary schools in Rulindo District are adequately equipped with functioning smart classroom technology, and only 25% of physics teachers reported having received recent ICT-related pedagogical training. Moreover, the 2023 Annual Education Statistics by MINEDUC indicated that fewer than 20% of schools in Rulindo regularly use educational software or simulations during physics lessons.

Without foundational scientific skills, students are less likely to succeed in national exams, pursue science-based careers, or contribute meaningfully to Rwanda's vision of a knowledge-based economy (Vision 2050). Poor EdTech management limits students' exposure to innovative and interactive learning, diminishing their motivation and confidence in scientific subjects. This ultimately widens the rural-urban performance gap, exacerbates educational inequality, and undermines national efforts to promote STEM education and digital literacy. If the current trends continue unaddressed, students in Rulindo and similar rural districts will remain at a disadvantage, threatening Rwanda's broader goals of inclusive, equitable, and quality education for all.

The purpose of this study was to examine the influence of education technology management practices on students 'skills acquisition in physics subject in public lower secondary schools in Rulindo district, Rwanda.
The specific objectives of the study were:

i. To examine the influence of ICT infrastructure planning on students 'skills acquisition in physics subject in public lower secondary schools in Rulindo district, Rwanda.
ii. To assess the influence of Physics teacher training on students 'skills acquisition in physics subject in public lower secondary schools in Rulindo district, Rwanda.
iii. To evaluate the influence of monitoring of digital content integration on students 'skills acquisition in physics subject in public lower secondary schools in Rulindo district, Rwanda.
iv. To analyse the influence of stakeholders collaboration on students 'skills acquisition in physics subject in public lower secondary schools in Rulindo district, Rwanda.

Review of related literature

Empirical Literature:

This empirical review examines studies on education technology management practices and their influence on students' skills acquisition in the physics subject, with a specific focus on the following dimensions: monitoring of digital content integration, stakeholder collaboration, ICT infrastructure planning, and physics teacher training. The reviewed studies span various countries and educational contexts, offering empirical insights into how technology integration, supervision, collaboration, and professional capacity building affect the development of students' analytical, problem-solving, and practical skills in physics. The insights gained from these studies are critically relevant to public lower secondary schools in Rulindo District, Rwanda, where the use and management of education technology in science education are increasingly prioritized as part of national educational reforms.

ICT Infrastructure Planning and Students' Skills Acquisition in Physics Subject

Mwangi and Waweru (2023) conducted a comprehensive mixed-methods study in Kenyan secondary schools to evaluate the impact of ICT infrastructure planning on students' physics acquisition. Their research demonstrated that schools equipped with well-planned ICT resources, including computer labs, high-speed internet, and interactive physics software, exhibited significantly higher levels of student understanding of complex physics concepts such as electromagnetism and mechanics. The study emphasized the necessity of strategic investment and regular maintenance of ICT infrastructure to prevent obsolescence and ensure sustainability. These findings highlight that effective ICT infrastructure planning is a fundamental prerequisite for promoting meaningful physics skills acquisition among learners.

Al-Khalifa and Garcia (2022) utilized a large-scale quantitative study in Saudi Arabian secondary schools to explore how the quality and availability of ICT infrastructure influence STEM learning outcomes. Their results showed that schools with consistent internet connectivity, sufficient digital devices per student, and access to virtual physics labs reported marked improvements in students' skills acquisition, particularly in practical physics exercises. The study urged policymakers to enact measures guaranteeing equitable ICT resource distribution, especially targeting under-resourced rural schools. These results reinforce the need for equitable ICT access as a catalyst for developing applied physics skills in secondary education.

Njeri et al. (2021) employed surveys, interviews, and classroom observations across several Ugandan secondary schools to assess the role of ICT infrastructure in facilitating physics practical skills acquisition. Their findings revealed that inadequate availability of computers, unstable electricity supply, and limited internet access severely constrained the use of simulations, virtual labs, and other digital physics resources that promote hands-on learning. The study recommended holistic ICT infrastructure planning integrated with teacher capacity-building programs and policy support to foster a conducive digital learning environment. Such evidence strengthens the argument that infrastructure gaps must be addressed simultaneously with pedagogical support for digital integration in physics.

Smith and Lee (2020) conducted multiple case studies in Australian secondary schools to understand how ICT infrastructure supports science education, including physics. Their qualitative research highlighted the critical role of technologies such as interactive whiteboards, physics-specific simulation software, and stable wireless networks in enabling student-centered, inquiry-based learning. Teachers reported increased student engagement and conceptual understanding when these technologies were available and functioning optimally. These findings substantiate the claim that strategic ICT deployment aligned with subject-specific instructional needs significantly enhances student competency in physics.

Chibwana and Mzumara (2019) explored ICT infrastructure challenges and their effects on physics learning outcomes in Malawian secondary schools through interviews with teachers and education officials. They found that widespread infrastructural deficits, including lack of adequate computer labs and unreliable internet, led to low student engagement and subpar physics practical skills. The study urged government-driven initiatives to address these infrastructural deficits as part of broader educational development strategies. This reinforces the idea that systemic investments in ICT infrastructure are instrumental in promoting student engagement and practical skill development in science subjects.

Hernandez et al. (2018) implemented an experimental design in Mexican secondary schools to test the effect of upgraded ICT infrastructure on students' problem-solving skills in physics. Schools that received significant ICT enhancements, such as modern computer labs and access to digital physics learning platforms, showed notable improvements in students' ability to solve complex physics problems, especially those requiring application of theory to practical scenarios. The researchers advocated for sustained ICT investment coupled with teacher training to maximize benefits. This provides empirical justification for prioritizing infrastructure development in efforts to improve physics skill acquisition.

Physics Teacher Trainings and Students' Skills Acquisition in Physics Subject

Adeyemi and Afolabi (2023) examined the effects of ICT-focused teacher training on students' performance in physics within Nigerian secondary schools. Using pre- and post-training evaluation of teaching practices and student outcomes, they found that teachers who received comprehensive ICT integration training adopted innovative digital pedagogies, such as interactive simulations and online assessments, which significantly enhanced students' conceptual understanding and problem-solving skills. The study recommended that continuous professional development programs be institutionalized, focusing on equipping physics teachers with ICT competencies. This finding is especially applicable to Rulindo District, where physics teachers often lack formal ICT training, limiting their ability to deliver technology-enriched lessons.

Lee et al. (2022) investigated the professional development of physics teachers in South Korea through a mixed-methods design, combining surveys and in-depth interviews. Their research highlighted that ICT training increased teachers' confidence and competence in integrating digital resources like virtual labs and educational apps into their teaching. This integration improved students' analytical and experimental skills in physics. The study recommended that national education authorities institutionalize regular ICT training modules within teacher development frameworks. Such recommendations are crucial for Rwanda, particularly in districts like Rulindo, where boosting teacher capacity is key to enhancing students' physics skills.

Mugisha and Kintu (2021) conducted a quasi-experimental study in Uganda assessing the impact of ICT teacher training programs on students' physics acquisition. Their results indicated that students taught by teachers who had undergone ICT training performed significantly better on practical and theoretical assessments compared to those taught by untrained teachers. The researchers called for the integration of ICT pedagogical skills in pre-service and in-service teacher training programs to improve physics education. This resonates with the current study's objective to evaluate how teacher trainings in Rulindo can affect students' skills acquisition in physics.

Robinson and Patel (2020) focused on the impact of digital content training on secondary school physics teachers in the United Kingdom. Through classroom observations and teacher surveys, they found that teachers' mastery of digital teaching tools, such as interactive simulations, video demonstrations, and online formative assessments, enhanced student engagement and critical thinking. The study recommended sustained support through refresher courses and mentoring for physics teachers using technology. This evidence underscores the need for ongoing capacity building of physics teachers in Rulindo to maximize the benefits of digital content in enhancing student skills.

Fernandez et al. (2019) carried out a longitudinal study in Chile examining the sustained effects of ICT training on science teachers, including physics educators. Over two years, they observed consistent improvements in teachers' instructional methods and students' academic outcomes, particularly in applying physics concepts practically. Their recommendations emphasized the inclusion of ICT skills development in national teacher certification and professional standards. This long-term perspective is important for Rulindo, where teacher professional development could yield significant improvements in students' physics skills over time.

Mwangi (2018) performed a correlational study in Kenya linking physics teachers' ICT competencies with students' practical physics acquisition. The findings demonstrated a strong positive correlation between teachers' ability to use ICT tools effectively and students' mastery of physics experiments and problem-solving tasks. The study advocated for policy support to improve teacher ICT skills through systematic training programs. These findings are directly relevant to the Rulindo context, supporting the need to enhance teacher ICT capacities as a pathway to improving students' physics skills.

Theoretical Literature

Education technology management has become a critical factor influencing the quality of education worldwide, especially in science subjects like physics that require practical and conceptual understanding enhanced by digital tools. Globally, governments and international organizations emphasize integrating ICT in education to improve students' competencies and skills relevant to the 21st century labor market (UNESCO, 2021). Effective education technology management encompasses careful planning of ICT infrastructure, teacher capacity building, monitoring digital content integration, and engaging stakeholders to foster an enabling environment for learning (World Bank, 2022). In Rwanda, the Ministry of Education through its strategic plans such as the Education Sector Strategic Plan (ESSP 2018-2024) highlights the integration of ICT in teaching and learning as a priority to improve STEM education outcomes. This study, focusing on Rulindo District, examines how these management practices influence students' skills acquisition in physics, a subject critical to Rwanda's industrialization and innovation agenda.

ICT Infrastructure Planning

Globally, effective ICT infrastructure planning is seen as the backbone of integrating technology into education systems. **International Telecommunication Union (ITU, 2021)** advocates for comprehensive planning that includes electricity, internet connectivity, and device provision as part of education infrastructure strategies. Countries with strong ICT education outcomes, such as Finland and South Korea, attribute their success to long-term, government-funded digital infrastructure plans that prioritize equitable access in both urban and rural settings (UNESCO, 2022).

Continental Education Strategy for Africa (CESA 16–25) encourages member states to prioritize investment in ICT resources and connectivity in all schools, with a focus on underprivileged and rural areas (African Union, 2021). Despite growing internet penetration across East Africa, reports by **EAC Education Sector Review (2022)** indicate that over 40% of schools in rural regions still lack basic ICT infrastructure such as stable electricity, computer labs, and internet access.

In Rwanda, ICT infrastructure development in schools is supported by **Smart Classroom Initiative** and the **ICT in Education Policy (MINEDUC, 2019),** which aim to equip all schools with basic digital tools and connectivity. However, **Education Sector Strategic Plan (ESSP 2020–2025)** notes that only 58% of public lower secondary schools nationwide have access to adequate digital infrastructure, with even lower figures in rural districts (MINEDUC, 2022).

Specifically in Rulindo District, challenges persist in equipping schools with necessary ICT infrastructure. According to **Rulindo District Development Plan (RDDP, 2022–2026),** only 46% of public lower secondary schools have access to functional ICT labs, and electricity supply remains unreliable in several rural sectors. **District Education Office Report (2023)** also highlights poor maintenance of existing ICT equipment, often due to a lack of technical personnel and budgetary constraints.

The government's decentralization approach requires district education leaders to actively participate in ICT planning; however, limited capacity at the district level often hampers the successful implementation of infrastructure projects (MINALOC, 2022). Poor coordination between district planners, school leaders, and national agencies has led to gaps in needs assessment and resource distribution. Therefore, for education technology to impact students' skills acquisition in physics, Rulindo District must adopt more strategic and inclusive infrastructure planning processes. Strengthening partnerships with private ICT service providers and leveraging community resources are also essential strategies mentioned in the **National Strategy for Transformation (NST1, 2017–2024).**

Physics Teacher Training:

Internationally, ongoing teacher training in educational technology is increasingly recognized as a cornerstone of effective digital education, particularly in science subjects where conceptual understanding often relies on interactive and practical tools. According to the OECD's Teaching and Learning International Survey (TALIS, 2021), teachers who receive continuous professional development in ICT not only report significantly higher levels of confidence and competence in using digital tools, but also demonstrate improved instructional practices that align with 21st-century learning goals. The survey highlights that sustained ICT training enhances teachers' ability to create engaging, inquiry-based learning environments, especially in subjects like physics that benefit from simulations, virtual experiments, and real-time data analysis. Furthermore, education systems with structured and recurrent ICT training programs, such as those in Singapore, Finland, and South Korea, tend to show stronger integration of educational technology across curricula and improved student outcomes in STEM disciplines. This underscores the importance of investing in teacher capacity-building as a key management practice in the digital transformation of education.

At the continental level, the African Union Digital Education Strategy (2021) underscores the critical role of continuous teacher professional development through structured workshops, peer learning initiatives, and accredited certification programs aimed at enhancing digital teaching capacity. However, the World Bank's EdTech Africa Report (2022) reveals that only about 30% of science teachers in Sub-Saharan Africa have received formal training in digital pedagogy. This lack of widespread, quality training contributes to the uneven adoption and inconsistent integration of educational technologies in science classrooms. As a result, many students are denied meaningful engagement with ICT tools that could enhance their understanding of complex scientific concepts.

In Rwanda, **National ICT in Education Policy** mandates that all science teachers be trained in digital content delivery and learning management systems (MINEDUC, 2019). **REB** through partnerships with institutions such as the **Carnegie Mellon University Africa** and **Teacher Training Colleges,** run ICT capacity-building programs under the **Technology Enhanced Learning (TEL)** initiative. However, **ESSP 2020–2025** reports that only 55% of teachers in public schools have undergone ICT-focused professional development.

Within Rulindo District, data from **District Education Inspectorate Report (2023)** indicate that less than half of physics teachers have received specialized training in the use of digital platforms, simulations, and e-labs. Moreover, the absence of localized training programs and lack of incentives have demotivated teachers from participating in available digital learning opportunities. Most teacher training conducted in Rulindo is centralized in urban areas like Byumba or Kigali, leaving rural-based teachers with limited access due to transportation and scheduling conflicts (RDDP, 2022). **Rwanda Education Sector ICT Integration Review (2022)** suggests that district-level planning must support decentralized and school-based training models to enhance access.

Students' Skills Acquisition in Physics Subject

Globally, enhancing students' skills acquisition in physics is a priority within the STEM education agenda due to the subject's critical role in technological and scientific advancement. The OECD's Programme for International Student Assessment (PISA) identifies science literacy and practical skills as key competencies for the 21st century and encourages integrating technology-based instructional strategies to improve conceptual understanding and problem-solving abilities in physics (OECD, 2018). Moreover, UNESCO's Science Report (2021) emphasizes that technology-enabled learning environments promote active engagement and experimentation, which are essential for developing physics skills such as analysis, application, and inquiry.

Within the African context, regional education strategies have highlighted the low proficiency levels in physics and related sciences as a barrier to socio-economic development. African Union's Science, Technology, and Innovation Strategy for Africa (STISA 2024) stresses the importance of improving physics education through enhanced teacher training, provision of technological tools, and student-centered pedagogy (African Union, 2014). East African Community initiatives also advocate for harmonizing science curricula and leveraging technology to improve practical skills acquisition among secondary school students (EAC, 2019).

Rwanda has made considerable strides in addressing skills gaps in physics through national education reforms and investments in ICT infrastructure. Education Sector Strategic Plan (ESSP 2018-2024) prioritizes improving STEM education quality, with a focus on hands-on learning and skills development in physics supported by digital learning resources (MINEDUC, 2018). The Rwanda Basic Education Statistics (MINEDUC, 2022) reveal that despite progress, students' skills

acquisition in physics remains below national targets, especially in rural districts such as Rulindo where limited access to modern laboratory equipment and digital tools persists.

In Rulindo District, education performance reports indicate a skills gap in physics among lower secondary students due to challenges such as insufficient use of educational technology, limited teacher training, and inadequate supervision (Rulindo District Education Report, 2023). The Ministry of Education's ICT in Education Policy calls for targeted interventions to improve technology management practices by school leaders and physics teachers to boost student engagement and practical skills in physics (MINEDUC, 2020).

Improved education technology management practices, including integrating digital simulations, virtual labs, and interactive learning platforms, have been shown to enhance students' practical understanding and problem-solving skills in physics (World Bank, 2022). Rulindo's ongoing efforts to strengthen school ICT capacity and teacher professional development highlight the potential of technology-driven approaches to improve physics skills acquisition in the district (Rulindo ICT Education Pilot Report, 2022).

Conceptual Framework

Independent Variables

Education Technology Management Practices

i) ICT Infrastructure Planning

- Adequate computers and devices

- Reliable internet connectivity

- Budget allocated for ICT

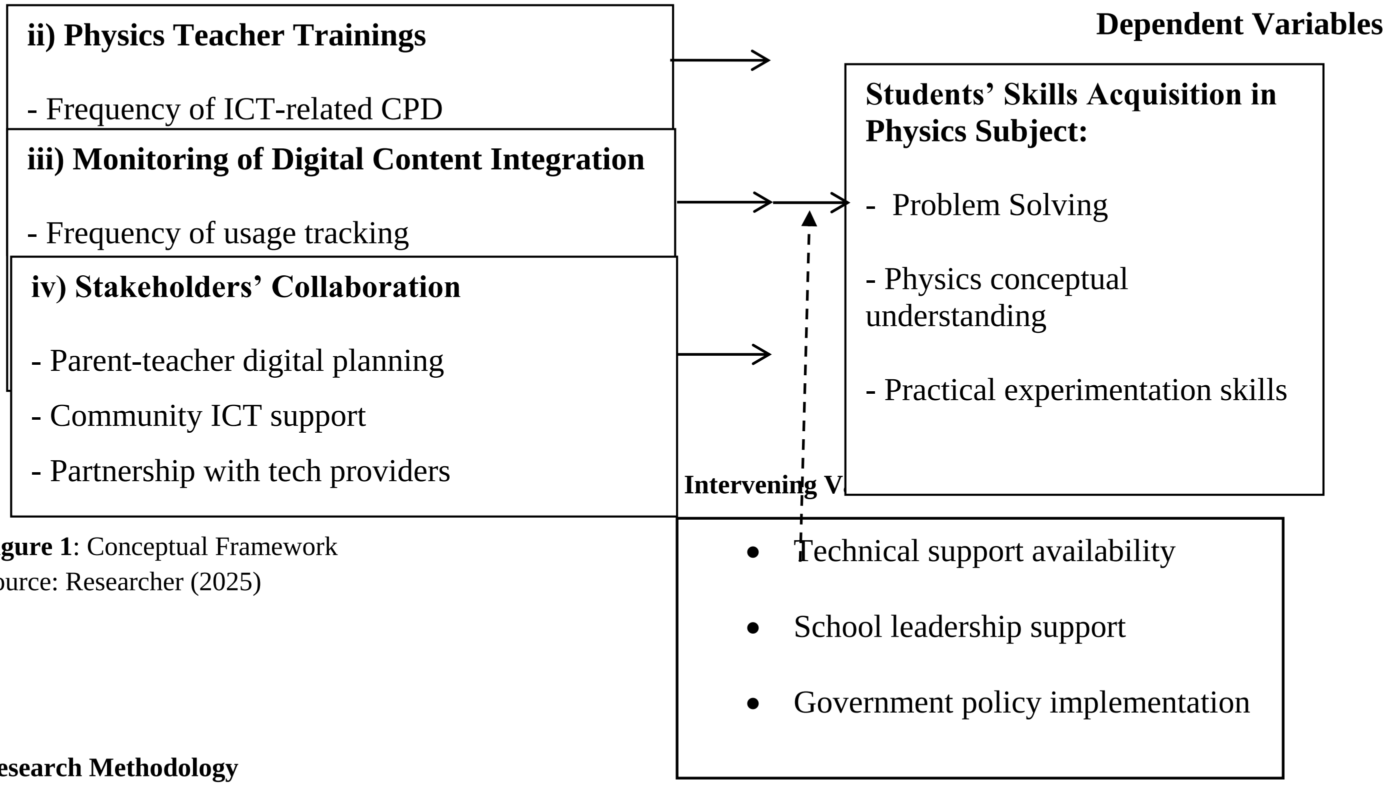

Figure 1: Conceptual Framework
Source: Researcher (2025)

Research Methodology

Research Design

The study adopted a **descriptive design**. This design was suitable because it allowed the researcher to collect both numerical data and explanatory narratives regarding technology management practices in the selected schools.

Location of the Study

This study was conducted in **Rulindo District,** located in the Northern Province of Rwanda. Rulindo District is bordered by Gicumbi District to the north, Gasabo District to the south, Gatsibo District to the east, and Gakenke District to the west.

Target Population

This study focused on a total target population of 3,637 participants drawn from public lower secondary schools in Rulindo District. The population included 43 head teachers, 43 deputy head teachers in charge of studies, 68 physics teachers, and 3,483 S3 students.

Sample Size Determination

Solvin's formula was used to determine the sample size.

The formula is as follows:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = Required sample size
N = Total population size
e = Margin of error

Since the study targets a total population of 3637 individuals, the sample size was calculated as follows:

$$n = \frac{3637}{1 + 3637(0.05)^2}$$

$$n = \frac{3637}{1 + 3637(0.0025)}$$

$$n = \frac{3637}{10.0925} = 360$$

Thus, the required sample size for the study was 360 respondents. Table 3.1 outlined sample sizes for each population category.

Table 1: Sample Size

Population Category	Target Population	Sample Size
Head teachers	43	4
Deputy head teachers in charge of studies	43	4
Physics teachers	68	7
S3 students	3483	345
Total	**3637**	**360**

Source: Researcher (2025)

Research Findings and Discussion

Response Rates

The researcher distributed 7 questionnaires and all of them were filled returned. This means that the response rate was 100%, this rate is relevant since in the context of Mugenda and Mugenda (2018) confirmed that if the response rate is more than 90.0%, it is sufficient for the researcher to generalize the findings.

Demographic Characteristics

Information on respondent's characteristics including gender, age group and level of education were considered as aspects which might have significant influence on study findings. Thus, the demographic distribution of respondents' analysis included all aspects needed in order to collect useful information.

Gender of Respondents

In order to evaluate the influence of education technology management practices and students' skills acquisition in physics subject in public lower secondary schools in Rulindo district, Rwanda, the study set out to determine the gender profile of respondents.

Table 2: Gender of Respondents

Gender	Teachers	
Males	3	42.8
Females	4	57.1
Total	**7**	**100**

Source: Primary Data (2025)

The results in Table 3 indicate that among the sampled physics teachers in public lower secondary schools, 42.8% were male while 57.1% were female, showing a slightly higher representation of female teachers.

Respondents' Age Distribution

The maturity was a considerable research construct as it helped to ensure the maturity of responses enabled the researcher to ensure data credibility that is vital in the current study.

Table 3: Age of Respondents

	Teachers	
Age range	Frequency	Percentage
21-30	2	28.5
31-40	5	1.4
Total	**7**	**100**

Source: Primary Data (2025)

The results in Table 4 indicate that the majority of respondents were aged between 31 and 40 years (5 teachers, 71.5%), while a smaller proportion fell within the 21–30 age range (2 teachers, 28.5%).

Education Level of Respondents

The researcher through questionnaires has requested respondents to indicate their higher level of qualification.

Table 4: Education Level of Teachers

Level of Education	Teachers	
	N	%
Bachelor in Education	3	42.8
Advanced degree in Education	4	5.1
Total	**7**	**100**

Source: Primary Data (2025)

The results in Table 5 indicate that the majority of physics teachers in the surveyed public lower secondary schools hold a Bachelor's degree in Education (42.8%), while a smaller proportion possess advanced degrees (5.1%).

The Influence of ICT Infrastructure Planning on Students' Skills Acquisition in Physics

In order to assess the influence of ICT infrastructure planning on students' skills acquisition in physics, participants were asked to provide responses via a questionnaire. This was achieved through using a five-point Likert scale, ranging from strongly agree to strongly disagree, to quantify the perceptions of respondents.

Table 5: Teachers Responses on the ICT Infrastructure Planning on Students' Skills Acquisition in Physics

Statements	SD (N, %)	D (N, %)	N (N, %)	A (N, %)	SA (N, %)	Mean	Std. Dev
My school has reliable internet connectivity that supports the teaching of physics.	0 (0.0)	170 (53.6)	97 (30.6)	27 (8.5)	23 (7.3)	2.6940	0.90589
ICT facilities (e.g., laptops, projectors, smart boards) are readily available for physics classes.	0 (0.0)	239 (75.4)	22 (6.9)	25 (7.9)	31 (9.8)	2.5205	0.99860
The existing ICT infrastructure is adequately maintained for uninterrupted use in physics lessons.	0 (0.0)	28 (8.8)	238 (75.1)	47 (14.8)	4 (1.3)	3.0852	0.52981
Physics lessons are supported by classrooms that are well-equipped with digital tools.	99 (31.2)	193 (60.9)	0 (0.0)	25 (7.9)	0 (0.0)	1.8454	0.77832
The school has a clear technology plan that includes the integration of ICT in physics teaching.	0 (0.0)	0 (0.0)	0 (0.0)	317 (100.0)	0 (0.0)	4.0000	0.00000
Technical support is available when ICT tools fail during physics instruction.	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	317 (100.0)	5.0000	0.00000

Source: Researcher (2025

The results indicate that the majority of schools face challenges with reliable internet connectivity and the availability of ICT facilities for physics teaching, with 53.6% and 75.4% of respondents, respectively, disagreeing with the adequacy of these resources, reflected in low means of 2.694 and 2.521. Maintenance of existing ICT infrastructure appears moderately satisfactory, as 75.1% were neutral, giving a mean of 3.085, while classrooms equipped with digital tools for physics are largely inadequate, indicated by 60.9% disagreement and a mean of 1.845. Conversely, all respondents agreed that schools have a clear technology plan (mean = 4.000) and that technical support is available for ICT failures during instruction (mean = 5.000). These findings suggest that while strategic planning and support mechanisms exist, actual ICT resources and classroom integration are insufficient, aligning with the literature which emphasizes that well-planned infrastructure and teacher capacity are essential for effective technology use in physics (Mwangi & Waweru, 2023; Adeyemi & Afolabi, 2023; Johnson et al., 2021). The gap between planning and resource availability reflects similar challenges identified in rural contexts, highlighting that strategic policies alone are not sufficient without adequate investment in digital tools and connectivity to enhance students' physics skills acquisition. In addition, the study tested the null hypothesis H0.1 at 0.05 level of significance and results are shown below:

Table 6: Model Summary for Influence of ICT Infrastructure Planning on Students' Skills Acquisition in Physics Transition Rates

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.018[a]	.000	-.003	.53465

Source: Researcher (2025)

The results in Table 7 indicate that ICT infrastructure planning has a negligible influence on students' skills acquisition in physics, with a very low correlation coefficient (R = 0.018) and an R^2 value of 0.000, suggesting that less than 1% of the variation in physics skills acquisition is explained by ICT infrastructure planning.

The negative adjusted R^2 (-0.003) further implies that the model does not significantly predict students' performance, and the standard error of 0.53465 shows considerable variability in the data. This finding suggests that merely having ICT infrastructure in place, without complementary practices such as teacher training, active monitoring, and stakeholder collaboration, may not suffice to enhance physics skills, aligning with empirical literature which emphasizes that effective ICT planning must be integrated with teacher capacity building, digital content supervision, and supportive management practices to positively impact students' practical and analytical competencies in physics (Mwangi & Waweru, 2023; Hernandez et al., 2018; Adeyemi & Afolabi, 2023).

Table 7: ANOVA table for Teachers Responses on the Influence of ICT Infrastructure Planning on Students' Skills Acquisition in Physics Transition Rates

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.029	1	.029	.101	.750[b]
	Residual	90.044	315	.286		
	Total	90.073	316			

Source: Researcher (2025)

The ANOVA results for teachers' responses on the influence of ICT infrastructure planning on students' skills acquisition in physics indicate an F-value of 0.101 with a significance level of 0.750, suggesting that the model is not statistically significant. This implies that, based on the teachers' perceptions, variations in ICT infrastructure planning do not significantly explain differences in

students' physics transition rates in the sampled schools. The findings align with the literature highlighting that while ICT infrastructure is important for enhancing physics skills (Mwangi & Waweru, 2023; Al-Khalifa & Garcia, 2022), its effectiveness depends on complementary factors such as teacher training, digital content monitoring, and stakeholder collaboration. In the Rwandan context, particularly in Rulindo District, the lack of significant impact may reflect challenges in infrastructure utilization, limited teacher ICT competencies, and inadequate supervision of digital tools, emphasizing that infrastructure alone is insufficient to improve students' skills acquisition in physics without integrated management practices.

Table 8: Regression Coefficients for Influence of ICT Infrastructure Planning on Students' Skills Acquisition in Physics

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.736	.324		11.524	.000
ICT Infrastructure Planning	.032	.101	.018	.319	.750

a. Dependent Variable: Students' Skills Acquisition in Physics

The regression results indicate that ICT infrastructure planning has a positive but statistically insignificant effect on students' skills acquisition in physics (B = 0.032, β = 0.018, t = 0.319, p =
0.750). This suggests that variations in ICT infrastructure planning, as measured in this study, do not meaningfully predict improvements in students' physics skills in the sampled public lower secondary schools in Rwanda. While previous empirical studies (Mwangi & Waweru, 2023; Al-Khalifa & Garcia, 2022; Njeri et al., 2021) emphasize the importance of well-planned ICT infrastructure for enhancing conceptual understanding and practical skills in physics, the current findings suggest that merely having infrastructure planning in place may not be sufficient in the

Rwandan context. Factors such as inadequate implementation, poor maintenance, limited teacher competence in using ICT, and weak monitoring systems, as highlighted in the Rulindo District reports (RDDP, 2022; District Education Office, 2023), may explain why infrastructure planning alone does not translate into measurable gains in students' skills. This aligns with the literature emphasizing that ICT infrastructure must be complemented by effective teacher training, active monitoring of digital content, and stakeholder engagement to meaningfully impact students' learning outcomes in physics.

4.4 The Influence of physics teacher training on students' skills acquisition

In order to assess the influence of physics teacher training on students' skills acquisition, participants were asked to provide responses by filling in a questionnaire. This was achieved through using a five-point Likert scale, ranging from strongly agree to strongly disagree, to quantify the perceptions of respondents.

Table 9: Teachers Responses on the Influence of physics teacher training on students' skills acquisition

Statements	SD (N, %)	D (N, %)	N (N, %)	A (N, %)	SA (N, %)	Mean	Std
I have received formal training on how to use ICT tools in teaching physics.	0 (0.0)	13 (4.1)	0 (0.0)	146 (46.1)	158 (49.8)	4.42	0.70
The training I received improved my ability to integrate ICT into my physics lessons.	0 (0.0)	0 (0.0)	0 (0.0)	124 (39.1)	193 (60.9)	4.61	0.49
I feel confident using digital teaching methods in my physics classroom.	9 (2.8)	26 (8.2)	0 (0.0)	136 (42.9)	146 (46.1)	4.21	1.00
I regularly attend workshops or seminars on digital teaching strategies in science subjects.	0 (0.0)	11 (3.5)	0 (0.0)	147 (46.4)	159 (50.2)	4.43	0.67
The ICT training aligns with the national physics curriculum objectives.	0 (0.0)	13 (4.1)	0 (0.0)	146 (46.1)	158 (49.8)	4.42	0.70
I have access to continuous professional development on technology use in science education.	0 (0.0)	26 (8.2)	0 (0.0)	145 (45.7)	146 (46.1)	4.30	0.84

Source : Researcher (2025)

The results indicate that the majority of physics teachers in public lower secondary schools in Rwanda have received formal ICT training, with 49.8% strongly agreeing and 46.1% agreeing, yielding a high mean of 4.42. Similarly, 60.9% strongly agreed that the training improved their ability to integrate ICT into physics lessons, reflected in the highest mean of 4.61. Teachers also reported confidence in using digital teaching methods, with 46.1% strongly agreeing and 42.9% agreeing (mean = 4.21), and active participation in workshops or seminars was affirmed by 50.2% strongly agreeing and 46.4% agreeing (mean = 4.43). Alignment of ICT training with the national curriculum received strong support (49.8% SA, 46.1% A; mean = 4.42), while access to continuous professional development was slightly lower but still positive (46.1% SA, 45.7% A; mean = 4.30).

These findings suggest that teacher training and ongoing professional development in ICT are well-established and effective, consistent with the literature reviewed, which emphasizes that teacher capacity building through formal ICT training enhances confidence, integration of digital tools, and students' skills acquisition in physics (Adeyemi & Afolabi, 2023; Lee et al., 2022; Mugisha & Kintu, 2021). The high agreement levels align with evidence that sustained teacher training and alignment with curriculum objectives are critical for improving analytical, problem-solving, and experimental competencies among learners. In addition, the study tested the null hypothesis H0.2 at 0.05 level of significance and results are shown below:

Table 10: **Model Summary on the Influence of physics teacher training on students' skills acquisition**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.027[a]	.001	-.002	.53454

Source: Researcher (2025)

The results in Table 11 indicate that physics teacher training has a very minimal influence on students' skills acquisition in physics, with an R value of 0.027, an R^2 of 0.001, and an adjusted R^2 of -0.002, suggesting that less than 0.1% of the variance in students' skills acquisition can be explained by teacher training alone. The standard error of 0.53454 further indicates a relatively high variability in students' skills outcomes irrespective of training. This implies that, in the context of public lower secondary schools in Rwanda, teacher training in ICT or digital content alone may not be sufficient to significantly enhance students' physics skills. These findings align with the empirical literature reviewed, which emphasizes that teacher training must be complemented by adequate ICT infrastructure, structured digital content integration, and active stakeholder collaboration (Adeyemi & Afolabi, 2023; Mwangi & Waweru, 2023; Uwizeyimana & Niyonsenga, 2022). The minimal effect observed in Rulindo District may reflect limitations in the accessibility, quality, and practical relevance of training programs, as well as the broader systemic constraints highlighted in the literature, such as inadequate ICT resources, poor supervision of digital content, and limited community support for technology-enabled physics instruction.

Table 11: ANOVA table for Influence of physics teacher training on students' skills acquisition

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.067	1	.067	.233	.630[b]
	Residual	90.006	315	.286		
	Total	90.073	316			

Source : Researcher (2025)

The results of the ANOVA (Table 12) indicate that physics teacher training has no statistically significant influence on students' skills acquisition in physics, as evidenced by an F-value of 0.233 and a p-value of 0.630, which is above the conventional significance threshold of 0.05. This suggests that variations in students' physics skills cannot be attributed to differences in teacher training alone within the sampled schools. These findings contrast with several empirical studies that highlight the positive impact of ICT-focused teacher training on students' conceptual understanding and problem-solving skills in physics (Adeyemi & Afolabi, 2023; Lee et al., 2022; Mugisha & Kintu, 2021), implying that in the Rwandan context, particularly in Rulindo District, teacher training programs may be insufficiently targeted, irregular, or poorly integrated with practical digital teaching tools. The result underscores the need for more comprehensive, sustained, and context-specific professional development that aligns ICT competencies with physics instruction, complementing infrastructure, content monitoring, and stakeholder collaboration to effectively enhance students' skills acquisition.

Table 12: Regression Coefficients for Influence of physics teacher training on students' skills acquisition

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.940	.212		18.621	.000
Physics teacher training	-.023	.048	-.027	-.483	.630

a. Dependent Variable: Students' skills acquisition

The regression results indicate that physics teacher training has a negative but non-significant effect on students' skills acquisition in physics ($B = -0.023$, $\beta = -0.027$, $t = -0.483$, $p = 0.630$). This suggests that, in the sampled public lower secondary schools in Rwanda, variations in teacher training did not significantly predict improvements in students' physics skills. The non-significant finding may reflect contextual challenges identified in the literature, such as limited access to ICT-focused training in rural districts like Rulindo, lack of localized or school-based training programs, and inadequate follow-up on digital pedagogy implementation (Adeyemi & Afolabi, 2023; Mwangi & Kintu, 2021; Uwizeyimana & Niyonsenga, 2022). While global studies underscore the positive impact of continuous professional development on physics skills (Lee et al., 2022; Fernandez et al., 2019), the current result implies that without supportive infrastructure, monitoring, and stakeholder collaboration, teacher training alone may be insufficient to enhance students' practical and analytical competencies in physics.

4.5 The Influence of Monitoring Digital Content Integration on Students' Skills Acquisition

In order to assess the influence of monitoring digital content integration on students' skills acquisition, participants were asked to provide responses via a questionnaire. **Table 13: Teachers Responses on the influence of monitoring digital content integration on students' skills acquisition**

Statements / Items	SD (N, %)	D (N, %)	N (N, %)	A (N, %)	SA (N, %)	Mean	Std. Deviation
The digital content I use for teaching physics is regularly evaluated for relevance and quality.	0 (0.0%)	161 (50.8%)	0 (0.0%)	138 (43.5%)	18 (5.7%)	3.0410	1.08276
There is a monitoring system to assess the effectiveness of digital resources in physics teaching.	0 (0.0%)	0 (0.0%)	0 (0.0%)	138 (43.5%)	179 (56.5%)	4.5647	0.49658
Students' engagement with digital physics materials is actively tracked.	0 (0.0%)	28 (8.8%)	0 (0.0%)	118 (37.2%)	171 (53.9%)	4.3628	0.87381
I receive feedback on the performance of ICT tools and content used in my physics lessons.	0 (0.0%)	0 (0.0%)	0 (0.0%)	146 (46.1%)	171 (53.9%)	4.5394	0.49923
The school ensures that digital materials comply with the national science education standards.	6 (1.9%)	9 (2.8%)	0 (0.0%)	139 (43.8%)	163 (51.4%)	4.4006	0.79976
Monitoring results are used to improve teaching and learning resources in physics.	9 (2.8%)	0 (0.0%)	0 (0.0%)	145 (45.7%)	163 (51.4%)	4.4574	0.64796

Source : Researcher (2025)

The results indicate that the majority of respondents strongly agree or agree that monitoring mechanisms for digital resources in physics are effectively implemented in their schools. Specifically, over 43% of teachers agreed and 56.5% strongly agreed that there is a system to assess the effectiveness of digital resources, while students' engagement with digital physics materials is actively tracked by 37.2% agreeing and 53.9% strongly agreeing. Feedback on ICT tool performance and compliance of digital materials with national science standards were similarly high, with mean scores above 4.3, indicating overall positive perceptions. Only the evaluation of digital content relevance and quality had a lower mean (3.0410), suggesting some gaps in systematic content appraisal. These findings align with empirical studies highlighting the importance of monitoring digital content to enhance physics skills acquisition (Johnson et al., 2021; Lee & Tan, 2021; Okafor et al., 2023). Effective monitoring ensures alignment of digital tools with curriculum goals, informs instructional adjustments, and supports student engagement and problem-solving, confirming that structured oversight is a critical component of education technology management in fostering students' analytical, experimental, and conceptual physics competencies.

Table 14: Model Summary for monitoring digital content integration on students' skills acquisition

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.303[a]	.092	.089	.50962

Source: Researcher (2025)

The results in Table 15 indicate that monitoring digital content integration has a positive but modest relationship with students' skills acquisition in physics, with a correlation coefficient (R) of 0.303 and an R^2 of 0.092, suggesting that approximately 9.2% of the variance in students' skills

acquisition can be explained by digital content monitoring. The adjusted R^2 of 0.089 and the standard error of 0.50962 reflect a reasonably consistent but limited predictive ability of the model. This finding aligns with the empirical literature reviewed, which emphasizes that structured monitoring of digital resources enhances student engagement, conceptual understanding, and practical problem-solving in physics (Johnson et al., 2021; Mwangi & Wanjiku, 2020; Lee & Tan, 2021). The relatively low R^2 highlights that while monitoring is important, it operates alongside other factors such as ICT infrastructure planning, teacher training, and stakeholder collaboration, which collectively influence students' skills acquisition, supporting the need for an integrated education technology management approach in Rwandan lower secondary schools.

Table 15: ANOVA table for Teachers Responses on the influence of monitoring digital content integration on students' skills acquisition

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.263	1	8.263	31.814	.000[b]
	Residual	81.810	315	.260		
	Total	90.073	316			

Source: Researcher (2025)

The ANOVA results indicate a statistically significant effect of monitoring digital content integration on students' skills acquisition in physics, $F(1, 315) = 31.814$, $p < 0.001$. This suggests that teachers' practices in systematically overseeing the use of digital resources significantly contribute to students' conceptual understanding, problem-solving, and practical skills in physics. The relatively large F-value and highly significant p-value demonstrate that variations in students' skills can be meaningfully explained by the degree of digital content monitoring by teachers. These findings align with the empirical literature, which emphasizes that structured supervision of digital tools, such as e-learning platforms, virtual labs, and simulations, enhances instructional quality and learning outcomes (Johnson et al., 2021; Mwangi & Wanjiku, 2020; Lee & Tan, 2021). In the Rwandan context, particularly in public lower secondary schools in Rulindo District, this underscores the importance of institutionalized monitoring frameworks, teacher accountability, and data-driven feedback mechanisms to ensure that ICT integration effectively supports physics skill acquisition, echoing recommendations for holistic education technology management practices.

Table 16: Regression Coefficients for monitoring digital content integration on students' skills acquisition

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.058	.317		6.490	.000
Monitoring digital content integration	.421	.075	.303	5.640	.000

a. Dependent Variable: students' skills acquisition

The regression results indicate that monitoring digital content integration has a positive and statistically significant effect on students' skills acquisition in physics ($B = 0.421$, $\beta = 0.303$, $t = 5.640$, $p < 0.001$). This suggests that for every unit increase in the effective monitoring of digital resources, students' skills acquisition improves by 0.421 units, demonstrating a moderate impact. The significance of the coefficient implies that structured oversight of digital content is a key predictor of physics learning outcomes. This finding aligns with the empirical literature reviewed, where studies by Johnson et al. (2021), Mwangi and Wanjiku (2020), and Okafor et al. (2023) emphasize that schools with systematic monitoring frameworks exhibit higher student engagement, conceptual understanding, and problem-solving skills in science subjects. In the Rwandan context, particularly in public lower secondary schools in Rulindo District, these results reinforce the importance of implementing structured digital monitoring mechanisms to ensure that technology use translates into measurable improvements in students' analytical, experimental, and practical competencies in physics, consistent with the constructivist approach to active and interactive learning.

4.6 Influence of stakeholder collaboration on students' skills acquisition

In order to assess the influence of stakeholder collaboration on students' skills acquisition, participants were asked to provide responses via a questionnaire. This was achieved through using a five-point Likert scale, ranging from strongly agree to strongly disagree, to quantify the perceptions of respondents.

Table 17: Responses on the Influence of stakeholder collaboration on students' skills acquisition

Statements	SD (N, %)	D (N, %)	N (N, %)	A (N, %)	SA (N, %)	Mean	Std
Parents are involved in supporting students' access to ICT tools for physics learning at home	0 (0.0)	0 (0.0)	0 (0.0)	158 (49.8)	159 (50.2)	4.50	0.57
My school partners with NGOs or education providers to enhance technology use in physics	32 (10.1)	48 (15.1)	0 (0.0)	237 (74.8)	0 (0.0)	3.60	0.84
Government agencies provide guidance and support for integrating ICT into physics teaching	1 (0.3)	4 (1.3)	0 (0.0)	42 (13.2)	270 (85.2)	4.79	0.58
The community contributes to maintaining and improving school ICT infrastructure	12 (3.8)	28 (8.8)	14 (4.4)	128 (40.4)	135 (42.6)	4.20	1.05
Students are encouraged to provide feedback on their experience with ICT in physics learning	107 (33.8)	188 (59.3)	0 (0.0)	22 (6.9)	0 (0.0)	2.12	0.78

Source: Researcher (2025)

The results indicate that parents play a highly supportive role in facilitating students' access to ICT tools for physics learning at home, with nearly all respondents agreeing or strongly agreeing (Mean = 4.50, SD = 0.57). Similarly, government agencies provide strong guidance for integrating ICT into physics teaching, as reflected by the very high agreement (Mean = 4.79, SD = 0.58). Schools' partnerships with NGOs or education providers show moderately high support for technology use in physics (Mean = 3.60, SD = 0.84), while community contributions to maintaining and improving ICT infrastructure are also positively recognized (Mean = 4.20, SD = 1.05). However, student involvement in providing feedback on ICT usage is notably low, with most respondents disagreeing (Mean = 2.12, SD = 0.78). These findings align with the reviewed literature emphasizing the critical role of stakeholder collaboration and support in enhancing students' skills acquisition in physics. For example, studies by Uwizeyimana and Niyonsenga (2022) and Adebayo and Adewale (2021) highlight how parental engagement, government support, and community partnerships facilitate resource availability and effective ICT integration. Conversely, the low student feedback aligns with gaps noted in the literature, where monitoring and participatory mechanisms for learners are often underutilized, suggesting that schools in Rulindo could further enhance physics learning outcomes by actively incorporating student voices in ICT-based instruction.

Table 18: Model Summary for Influence of stakeholder collaboration on students' skills acquisition

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.389[a]	.151	.148	.49271

Source: Researcher (2025)

The results in Table 19 indicate that stakeholder collaboration has a moderate positive relationship with students' skills acquisition in physics, with an R value of 0.389. The R^2 value of 0.151 suggests that approximately 15.1% of the variance in students' skills acquisition can be explained by stakeholder collaboration, while the adjusted R^2 of 0.148 confirms the model's modest predictive power. The standard error of 0.49271 reflects reasonable precision in estimating students' performance. These findings imply that active engagement of parents, teachers, school leaders, and community members contributes meaningfully to students' acquisition of analytical, problem-solving, and practical physics skills. This aligns with empirical literature indicating that collaborative partnerships enhance resource mobilization, digital learning support, and teacher motivation, thereby improving physics learning outcomes (Adebayo & Adewale, 2021; Kamau & Njoroge, 2020; Uwizeyimana & Niyonsenga, 2022). In the context of Rwandan public lower secondary schools, particularly in Rulindo District, fostering structured stakeholder collaboration can thus play a critical role in strengthening ICT-supported teaching and promoting effective skills development in physics.

Table 19: ANOVA table for Teachers Responses on the Influence of stakeholder collaboration on students' skills acquisition

Model	Sum of Squares	df	Mean Square	F	Sig.

1	Regression	13.603	1	13.603	56.034	.000[b]
	Residual	76.470	315	.243		
	Total	90.073	316			

Source: Researcher (2025)

The ANOVA results in Table 20 indicate a statistically significant relationship between stakeholder collaboration and students' skills acquisition in physics, $F(1, 315) = 56.034$, $p < 0.001$. This shows that variations in stakeholder collaboration significantly explain differences in students' physics skills outcomes. The high F-value and very low p-value suggest a strong predictive effect, implying that schools with active engagement of parents, teachers, and community members experience better student performance. These findings align with the empirical literature reviewed, where studies by Uwizeyimana and Niyonsenga (2022), Adebayo and Adewale (2021), and Kamau and Njoroge (2020) highlighted that collaborative partnerships enhance resource availability, facilitate technology integration, and improve practical and conceptual learning in science subjects. In the context of Rwandan public lower secondary schools, such collaboration appears crucial for mobilizing support for digital tools, guiding teacher practices, and ultimately promoting the acquisition of essential physics skills among students.

Table 20: Regression Coefficients for Influence of stakeholder collaboration on students' skills acquisition

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	1.891	.262		7.224	.000
Stakeholder collaboration	.567	.076	.389	7.486	.000

a. Dependent Variable: students' skills acquisition

The regression results in Table 20 show that stakeholder collaboration has a positive and statistically significant influence on students' skills acquisition in physics ($B = 0.567$, $\beta = 0.389$, $t = 7.486$, $p < 0.001$). The constant value of 1.891 indicates the baseline level of students' skills acquisition when stakeholder collaboration is absent. This implies that as schools strengthen collaboration among teachers, parents, school leaders, and community members, students' analytical, problem-solving, and practical skills in physics improve. These findings align with the empirical literature, where studies such as Uwizeyimana and Niyonsenga (2022) in Rwanda and Adebayo and Adewale (2021) in Nigeria highlight that inclusive stakeholder engagement enhances resource mobilization, instructional support, and effective integration of digital tools, ultimately boosting physics learning outcomes. The result underscores the importance of multi-stakeholder participation as a critical component of education technology management practices in fostering students' competencies in physics.

Conclusion and recommendations

Conclusion: The study concludes that ICT infrastructure planning in public lower secondary schools in Rulindo District, while formally established, has a negligible influence on students' skills acquisition in physics. Despite the presence of clear technology plans and full technical support, most schools lack reliable internet, sufficient ICT facilities, and well-equipped classrooms.

Recommendations:

The Ministry of Education should strengthen policies that promote effective management and integration of educational technology in physics instruction.

Policies should emphasize systematic monitoring of digital content, structured stakeholder collaboration, and clear ICT infrastructure planning to enhance students' skills acquisition. Guidelines should encourage school leaders to adopt evidence-based supervisory practices, provide timely interventions, and foster multi-stakeholder engagement, including parents, government agencies, and community partners.

School leaders and teachers should actively enhance physics teaching by implementing structured monitoring of digital content and fostering stakeholder collaboration.

Head teachers should ensure regular oversight of ICT usage, provide constructive feedback to teachers, and coordinate engagement with parents and community members to support students' access to technology.

Teachers should participate in collaborative planning, integrate digital resources effectively into lessons, and use feedback from both supervisors and learners to improve instructional delivery.

Suggestions for Further Research:

Examine the long-term impact of systematic monitoring of digital content on students' skills acquisition in physics.

Investigate how stakeholder collaboration influences the sustainability of ICT integration and its effect on student learning outcomes.

Assess the role of ICT infrastructure planning and teacher training in improving practical, analytical, and problem-solving skills among physics learners.

Explore strategies for incorporating student feedback in ICT-based physics instruction to further enhance learning effectiveness.

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