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RESEARCH ARTICLE

INSTRUCTIONAL MATERIALS USAGE ON STUDENT ACADEMIC PERFORMANCE IN PHYSICS SUBJECT IN DAY SCHOOLS IN RWANDA A case of Nyarugenge District

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Abstract

Students‟ academic performance in science subjects and physics specifically has always attracted big concern among students, parents, teachers and the entire public community. The main purpose of this research was to assess the instructional materials usage on students' academic performance in Physics subjects in day secondary schools in Nyarugenge District-Rwanda. It had three specific objective such as to identify the instructional materials used in physics subject in day secondary schools in Nyarugenge District, Rwanda, to assess the level of students' academic performance in physics subject in day secondary schools in Nyarugenge district, Rwanda, to examine the challenges faced by teachers in preparation of instructional materials in physics subject in day secondary schools in Nyarugenge District, Rwanda, to determine the relationship between instructional materials and students' academic performance in physics subject in day secondary schools in Nyarugenge district, Rwanda. This research was supported with Socio-cultural theory and attribution theory. The researcher used descriptive research design and correlational research design for data collections. The study employed different respondents including parents, students, teachers, and head teachers. The total number of participants was 520, comprising 100 teachers, 400 students and 20 head teachers. These participants were drawn from 20 selected schools across 10 sectors within Nyarugenge District, Rwanda. The Yamane formula was used to calculate the sample size of 226 respondents from target population of 520.Simple random sampling was used to select students and head teachers from secondary schools in Nyarugenge District. Purposive sampling was employed for selecting teachers based on their pertinent experiences in teaching physics subject. Researcher used questionnaire and interview guide as data collection instruments where questionnaires was designed to gather information from students, while interview guides was tailored for teachers and head teachers selected from secondary schools.The findings, summarized in Table 4.7, reveal a strong and statistically significant correlation between instructional materials and students' academic performance. The Pearson correlation coefficient of 0.911 indicates a very high positive correlation, suggesting that as the quality and availability of instructional materials increase, students' academic performance in physics also tends to

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improve. The strong correlation signifies that well-designed, up-to-date, and diverse instructional resources can significantly enhance students' understanding of the subject matter, leading to better academic outcomes. The implications of this strong correlation for educational practice are considerable. Schools and educators should prioritize the development and provision of high-quality instructional materials, including textbooks, digital resources, laboratory equipment, and supplementary materials. Ensuring that these resources are current, relevant, and accessible can create a more engaging and effective learning environment for students. It reveals a strong positive relationship between instructional materials and academic performance, with an R Square value of 0.829. This indicates that approximately 82.9% of the variance in students' academic performance can be explained by the quality of instructional materials provided. This strong predictive capability underscores the importance of these resources in determining academic success. The Ministry of Education should implement regular and systematic professional development programs for teachers focused on innovative teaching methodologies.

Background: The academic performance of students in science, particularly physics, is a significant concern for various stakeholders. This research aims to assess the impact of instructional materials on students' academic performance in physics at day secondary schools in Nyarugenge District, Rwanda.

Methods: The study utilized descriptive and correlational research designs, involving 520 participants: 100 teachers, 400 students, and 20 head teachers from 20 schools across 10 sectors in Nyarugenge District. A sample of 226 respondents was calculated using the Yamane formula. Simple random sampling was applied for students and head teachers, while purposive sampling was used for teachers. Data were collected through questionnaires for students and interview guides for teachers and head teachers.

Results: Findings indicated a strong, statistically significant correlation (Pearson correlation coefficient of 0.911) between instructional materials and students' academic performance in physics. An R Square value of 0.829 suggests that approximately 82.9% of the variance in academic performance can be explained by the quality of instructional materials.

Conclusion: The study highlights the critical role of high-quality instructional materials in enhancing students' understanding and academic outcomes in physics. It recommends that schools prioritize the development and provision of diverse, current instructional resources and that the Ministry of Education implement regular professional development programs for teachers to promote innovative teaching methodologies.

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Introduction:-

On a worldwide scale, the main objective of education at any level is to induce a fundamental transformation in the student[1]. It assists society in shaping individuals to thrive in both their surroundings and academic settings. Boitet, et.al (2022), stated that the aim of education is to empower individuals to transform their community and address disparities. Continuing education plays a crucial role in the progress of both the nation and its people[2]. It has a crucial function in developing a nation's pool of human resources beyond primary education[3] (Achokaet.Al.,2017). The cognitive performance of learners serves as a key indicator of educational quality. Students' academic success is assessed through their results on both standardized and formative assessments administered by teachers[3].

Physics is a fundamental subject in secondary education, essential for shaping students' understanding of natural phenomena and scientific principles. The effectiveness of teaching methods and materials in physics has garnered significant global attention, reflecting a collective effort to enhance academic performance and comprehension[3]. In the Philippine Education System, physics and other science subjects are crucial at both primary and secondary levels. Modern science and chemistry instruction has become a requirement in all schools to equip students with skills necessary for adapting to rapid technological advancements (Al, 2024). Effective teaching and learning are vital for fostering fundamental skills and knowledge, contributing to the socio-economic development of society[1] . As Boitet and colleagues (2022) emphasize, the primary goal of education is to eliminate ignorance and inequality to meet essential societal needs[2].

Teachers' selection of instructional materials is influenced by their beliefs, personal choices, and codes of conduct [4]. Research by Kimani et al. (2023) indicates that inadequate teaching materials lead to lower student success and poorer learning outcomes, highlighting the importance of quality resources[5]. In the United States, Hake (2018) emphasizes that active learning strategies significantly enhance students' conceptual understanding and academic achievement in physics, with interactive and hands-on activities proving effective in fostering engagement[5].

In Europe, educational initiatives focus on integrating technology-enhanced tools, with Dori and [6] (2024) noting the positive impact of multimedia resources and virtual simulations on students' learning experiences. In Asia, countries like Japan and South Korea prioritize academic rigor, leading to the development of comprehensive instructional materials aligned with national standards, as demonstrated by Hwang and Jang (2019), who found that structured programs improve problem-solving skills and content mastery[7].

In Africa, where quality education access is often limited, initiatives to enhance physics instruction utilize locally relevant materials, with Okebukola (2019) emphasizing culturally responsive teaching approaches[8]. In Nigeria, [9]Yazachew (2015) notes that traditional teaching methods dominate, but these have been criticized for fostering a passive learning environment. Educators are exploring dynamic learning environments and promoting teacher-student interaction to improve engagement and outcomes.

Rwanda is focused on strengthening its secondary education system, particularly in science subjects like physics, which are essential for students' academic and career readiness in science and technology. Instructional materials, including digital simulations, multimedia, and traditional resources, aim to enhance understanding of complex concepts. However, academic performance in physics remains a concern, as evidenced by low scores and high failure rates, particularly in Nyarugenge District[9] [10].

While the overall pass rates improved in 2021 and 2022, with private schools consistently outperforming government-aided and public schools, many students still struggle, showing signs of disengagement and lack of understanding [4]. Research indicates that the quality of instructional materials significantly impacts learning outcomes (Tebabal&Kahssay, 2021), prompting this study to assess the effectiveness of teaching resources in day secondary schools in Nyarugenge District[1]. The goal is to determine how well these materials support students' academic performance in physics, contributing to the broader aim of enhancing education quality in Rwanda.

The main objective of this research was to assess the instructional materials usage on students' academic performance in Physics subjects in day secondary schools in Nyarugenge District-Rwanda.

Materialsand Methods:-

Research Design

This research used descriptive and correlational research designs to achieve its goals. The descriptive research design allowed the researcher to discuss of environmental education and environmental sustainability in Rwanda. This study involved gathering detailed information about the environmental education and environmental sustainability, simultaneously; the correlational research design enabled the researcher to assess the correlation of all variables.

Participants

The study focused on a diverse group of respondents, including parents, students, teachers, and head teachers, totaling 520 participants. This group comprised 100 teachers, 400 students, and 20 head teachers, drawn from 20 selected schools across 10 sectors within Nyarugenge District, Rwanda.

Due to constraints related to availability and time, as recommended by Kothari (2020), the research utilized a sample instead of the entire population. The sample design established the sample size and sampling techniques for all respondents[11].

The sample size was determined using Yamane's formula (1970), which calculates a representative sample size from a given population[12]. For this study, the sample size was calculated as 226 from the total population of 520. The simplified formula for determining the sample size, as proposed by Yamane (1970), is as follows:

$$\mathbf{n} = \frac{\mathbf{N}}{\mathbf{1} + \mathbf{N}(\mathbf{e^2})}$$

Where:

n= sample size
N= total population
e= margin of error (typically set at 0.05)

Instruments

The study aim was to assess the usage of instructional materials and its impact on students' academic performance in Physics at day secondary schools in Nyarugenge District, Rwanda. The study employed two sampling methods: simple random sampling and purposive sampling. Simple random sampling was utilized to select students and headteachers from secondary schools, while purposive sampling was used to select teachers based on their relevant experiences in teaching Physics.

Data collection employed both quantitative and qualitative methods to comprehensively address the research goals, utilizing questionnaires for students and interview guides for teachers and head teachers. The researcher personally administered the questionnaires to students, ensuring direct interaction for accurate responses, while conducting interviews with teachers and head teachers in selected schools using the prepared guides. During these interactions, the researcher discussed the data collection procedures and addressed ethical considerations with the respondents. The administration of the questionnaires was carefully managed; the researcher distributed the items, observing respondents' reactions and emotions throughout the process. Collaborative timelines for completing and returning the questionnaires were established, allowing sufficient time for thoughtful responses. After collection, the researcher interpreted the data to ensure clarity and accuracy in the findings.

Data analysis procedure

Qualitative and quantitative data collection tools was condensed using descriptive statistics, including frequencies, means, and percentages. For quantitative data analysis, SPSS version 22.0 was utilized. SPSS organized and summarize the numerical data, facilitating the calculation of statistical measures like means, percentages, standard deviations, and correlation coefficients.

Ethical considerations

The researcher obtained permission from Mount Kenya University and the Lord Mayor of Kigali to conduct the study, ensuring compliance with institutional and local regulations. Participants were informed about the research's academic purpose, assured of confidentiality, and encouraged to ask questions about the questionnaire.

Limitations

Obtaining valid information from participants was challenging due to concerns about confidentiality and the tendency of schools to present a positive image while downplaying weaknesses in instructional materials. Logistical limitations arose from the large number of schools in the district, straining financial and temporal resources. Some respondents were hesitant to engage, prompting the researcher to provide an introductory letter to clarify the study's academic purpose. Additionally, busy schedules made participation difficult for teachers. To navigate these issues, the researcher used sampling methods to ensure representation from various segments and addressed language barriers by conducting interviews in Kinyarwanda, facilitating effective communication.

Results and Discussion:-

Instructional materials used in physics subject

The first objective of the study was based on the investigation of to examine the instructional materials used in physics subject in day secondary schools in Nyarugenge District, Rwanda. To achieve this objective, researchers drafted a questionnaire and interview guide for different respondents such as students. Here, respondents were required to show their perceptions by indicating the extent to which they agreed with the statements given as; SA (1) for Strongly Agree, A (2) for Agree, N (3) for Neutral, D (4) for Disagree and SD (5) for strongly Disagree. Several items in the questionnaire were presented to the respondents to rate their availability and the findings are shown in Table 4.5.

Table 1:- Instructional materials used in physics subject.

Statements	SD		D		N		A		SA	
	Fr	%	Fr	%	Fr	%	Fr	%	Fr	%
The physics textbooks provided by the school are sufficient for understanding the physics subject and	13	6.0	43	19.8	20	9.2	30	13.8	111	51.2
The content in the physics textbooks is up-to-date and relevant to the curriculum.	5	2.3	10	4.6	4	1.8	178	82.0	20	9.2
The school provides adequate digital resources (e.g., online textbooks, simulations) for learning physics.	0	0	1	0.5	21	9.7	138	63.6	57	26.3
Digital resources enhance my understanding of physics concepts better than traditional textbooks.	15	6.9	31	14.3	3	1.4	86	39.6	82	37.8
The school's physics laboratory is well-equipped with the necessary tools and materials of physics.	7	3.2	15	6.9	25	11.5	110	50.7	60	27.6
Teachers provide useful handouts and worksheets that aid in learning physics	12	5.5	15	6.9	9	4.1	138	63.6	43	19.8
Audio-visual aids (e.g., videos, animations) are frequently used in physics lessons	27	12.4	13	6.0	10	4.6	98	45.2	69	31.8
The assignments and homework given in physics are well-structured and helpful.	14	6.5	15	6.9	20	9.2	75	34.6	93	42.9
Group work and discussions are encouraged and effectively facilitated in physics classes.	13	6.0	43	19.8	20	9.2	30	13.8	111	51.2
The Assessment and Evaluation Materials used for tests and exams in physics accurately reflect the content taught	5	2.3	10	4.6	4	1.8	178	82.0	20	9.2

Field data(2024)

Table 1 presents students' perceptions of instructional materials in Physics, highlighting their importance for evaluating teaching effectiveness. While 51.2% of students found textbooks adequate, 19.8% disagreed, suggesting a need for supplementary resources. A strong 82.0% affirmed that textbook content aligns with the curriculum, enhancing learning outcomes. Responses regarding digital resources were mixed; 63.6% found them sufficient, yet some remained uncertain about their utility. Varied opinions on digital tools' effectiveness emphasize the need for proper training. Students positively perceived the physics laboratory, but some felt improvements were needed. Furthermore, 63.6% valued handouts and worksheets, which support diverse learning styles. Audio-visual aids received moderate approval, indicating potential inconsistencies in their use. Overall, while feedback is largely positive, areas for improvement, particularly in resource adequacy and digital integration, are evident. Addressing these concerns can foster a more effective learning environment in Nyarugenge District[11].

Level of Students' Academic Performance

This study investigated students' academic performance in physics at day secondary schools in Nyarugenge District, Rwanda, using a questionnaire and interviews to gauge perceptions on various factors affecting learning. Responses

were categorized into five levels of agreement; revealing insights into self-reported engagement, homework completion, and resource utilization (see Table 2). A majority (59.4%) of students felt engaged in class discussions, but a notable minority (11.5%) did not, indicating a need for strategies to enhance participation.

Most students (86.2%) completed homework on time, suggesting they recognize its importance for academic success. However, mixed feedback on review sessions highlights varying perceptions of their effectiveness, suggesting schools could refine these based on student input. While 46.1% felt assessments reflected their understanding, others expressed uncertainty, signaling a need for clearer evaluation guidelines.

Despite 74.2% regularly utilizing available resources, some students still do not engage fully, pointing to potential gaps in resource promotion. Overall, while many students feel equipped for learning, ongoing evaluations of resource availability and structured study sessions could further enhance academic performance[11].

Table 2:- Level of Students' Academic Performance.

	SD		D		N		A		SA	
Statements	**Fr**	**%**	**Fr**	**%**	**Fr**	**%**	**Fr**	**%**	**Fr**	**%**
I actively participate in physics class discussions and activities.	7	3.2	18	8.3	3	1.4	129	59.4	60	27.6
I complete my physics homework and assignments on time.	6	2.8	7	3.2	4	1.8	187	86.2	13	6.0
The review materials and sessions before tests and exams are helpful for the preparation.	16	7.4	28	12.9	15	6.9	81	37.3	77	35.5
The test and exam results reflect understanding of the physics material.	12	5.5	36	16.6	13	6.0	100	46.1	56	25.8
I am able to solve physics problems and exercises with ease.	17	7.8	11	5.1	56	25.8	102	47.0	31	14.3
I regularly use the physics resources available to me (e.g., textbooks, online materials, library)	28	12.9	15	6.9	9	4.1	161	74.2	4	1.8
The resources provided by the school are sufficient to support my learning in physics.	8	3.7	2	0.9	27	12.4	23	10.6	157	72.4
I review physics notes and materials regularly to stay on top of the subject.	3	1.4	13	6.0	30	13.8	110	50.7	61	28.1

Field data(2024)

Table 2 presents positive trends in students' academic performance in physics, particularly in homework completion and resource utilization, while also highlighting areas for improvement, such as class engagement and the effectiveness of review materials. By addressing these challenges and promoting active participation, schools can enhance the learning environment and improve students' understanding of physics.

As headteachers in Nyarugenge District, observe significant variations in academic performance across different schools. Students' grasp of physics concepts is influenced by factors like instructional quality, resource availability, and motivation. Notably, students perform well in hands-on experiments but struggle with abstract concepts like mechanics and thermodynamics, often due to insufficient foundational knowledge in mathematics. This gap affects problem-solving skills and overall performance.

Performance disparities among schools correlate with the availability of instructional materials and teacher professional development. Schools with well-equipped labs and trained teachers report higher achievement, while those with fewer resources face challenges in student engagement. To address these issues, we aim to implement enhanced teacher training, resource sharing, and tutoring initiatives, fostering an environment that promotes academic excellence and student engagement in physics [11].

Instructional materials and students' academic performance

The third objective of this research project aimed to to determine the relationship between instructional materials and students' academic performance in physics subject in day secondary schools in Nyarugenge district, Rwanda.All results are summarised in the table 3.This research focused on two variables: independent variables, represented by instructional materials, and dependent variables, represented by students' academic performance. The main aim was to understand the correlation between these two variables and establish a regression analysis model.

Table 3:- Correlations of variables.

Statements		Instructional materials	students' academic performance
Instructional materials	Pearson Correlation	1	.911**
	Sig. (2-tailed)		.000
	N	217	217
students' academic performance	Pearson Correlation	.911**	1
	Sig. (2-tailed)	.000	
	N	217	217

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

Primary data(2024)

Table 3 demonstrates a strong and statistically significant correlation between instructional materials and students' academic performance, with a Pearson correlation coefficient of 0.911. This high positive correlation indicates that improved quality and availability of instructional materials are associated with better academic outcomes in subjects like physics. The correlation coefficient, ranging from -1 to +1, signifies that 0.911 reflects a strong positive relationship, meaning well-designed and diverse instructional resources significantly enhance students' understanding and performance.

These findings imply that schools should prioritize developing high-quality instructional materials textbooks, digital resources, and laboratory equipment to create an engaging learning environment. The data emphasizes the essential role of instructional materials in improving academic performance, urging educators and policymakers to enhance resource quality and availability as a strategy for boosting student success in physics and other subjects. By fostering a resource-rich environment, schools can support students in achieving better academic outcomes and mastering complex concepts.

Conclusions:-

This study assessed the relationship between instructional materials and students' academic performance in Physics at day secondary schools in Nyarugenge District, Rwanda, highlighting the essential role of well-designed resources in enhancing students' understanding of complex concepts. The findings reveal a significant correlation between the frequency and quality of instructional materials—such as textbooks, laboratory equipment, and digital tools and overall academic performance. Students exposed to diverse materials demonstrated improved analytical and problem-solving skills, underscoring the importance of strategic resource integration. However, the study also identified disparities in access to these materials, with better-equipped schools achieving higher student performance, emphasizing the need for equitable resource distribution to foster an inclusive learning environment.

Given these insights, it is crucial for educational stakeholders including policymakers, administrators, and teachers to prioritize investments in high-quality instructional materials and effective training for educators. Such initiatives can significantly enhance academic performance in Physics and beyond. The implications of this research extend beyond Nyarugenge District, offering valuable guidance for improving the Rwandan education system. Collaborative efforts among government, NGOs, and educational institutions are vital for developing tailored resources for secondary schools. Additionally, further research should explore the long-term impacts of instructional materials across subjects and assess the evolving role of technology in education. By continually adapting instructional strategies, educators can ensure that all students have the opportunity to succeed academically.

Recommendations:-

The government should enhance the availability of instructional materials for Physics and other science subjects in day secondary schools by allocating more resources and strengthening STEM initiatives. The Ministry of Education must ensure that all schools, especially those in underserved areas, receive adequate resources such as textbooks, laboratory equipment, and digital tools. Additionally, a robust monitoring system should be implemented to evaluate the usage and impact of these materials on student performance. Regular workshops and training should be offered to teachers to effectively integrate these resources and modern technology into their teaching practices.

School heads should prioritize the procurement and effective utilization of instructional materials, encouraging collaboration among institutions to share resources and best practices. They should establish accountability measures to ensure proper use of these materials in the classroom and promote the creation of low-cost, locally made resources when official ones are scarce. Furthermore, students should be motivated to engage with instructional materials actively, both in and out of the classroom, using digital tools and online resources to enhance their learning. NGOs should partner with the government to provide additional materials and support teacher development programs that focus on effective resource utilization in Physics, fostering student interest through innovative projects and competitions.

Author Contributions

Nyampinga Yvonne played a key role in conceptualizing and designing the study, validating the software, analyzing the data, and conducting the investigation. She also authored the original manuscript draft. **Dr. FaustinMugiraneza**provided essential feedback and edits, offering supervision throughout the research process.

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The authors affirm that all data related to the study are included within the manuscript.

Conflicts of Interest:

The authors declare no conflicts of interest.

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