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Investigating secondary school learners' academic achievement in physics in Uganda

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Abstract

This study examined secondary school learners' academic achievement in physics in the Wakiso district of Uganda. A cross-sectional correlational design was used with 217 participants. This comprised 121 male and 96 female learners from two government-aided secondary schools in Kira Municipality, Wakiso district. Data were collected using a Self-Administered Questionnaire (SAQ) and analysed using descriptive statistics such as percentages and mean scores. Analysis of Variance (ANOVA) and Pearson's linear correlation coefficient were applied for inferential statistics. The results show a positive relationship between learners' aptitude, learning environment, and academic achievement, while a negative relationship was between teachers' instruction and academic achievement in physics. These results have far-reaching implications for improving academic achievements in physics. The study recommended investing in a more friendly learning environment by upskilling in-service teachers through professional development programs to enhance their pedagogy and conduct parent meetings to sensitise them to create a conducive home learning environment.

Keywords: academic achievement, learning environment, physics, aptitude

Uganda'da ortaokul öğrencilerinin fizik alanındaki akademik başarılarının incelenmesi

Özet (Türkçe)

Bu çalışmada Uganda'nın Wakiso bölgesindeki ortaokul öğrencilerinin fizik alanındaki akademik başarıları incelenmiştir. Çalışmada 217 katılımcı ile kesitsel bir korelasyonel tasarım kullanılmıştır. Bu katılımcılar, Wakiso bölgesindeki Kira Belediyesi'nde bulunan iki devlet destekli ortaokuldan 121 erkek ve 96 kız öğrenciden oluşmaktadır. Veriler Kendi Kendine Uygulanan Anket (SAQ) kullanılarak toplanmış ve yüzdeler ve ortalama puanlar gibi tanımlayıcı istatistikler kullanılarak analiz edilmiştir. Çıkarımsal istatistikler için Varyans Analizi (ANOVA) ve Pearson doğrusal korelasyon katsayısı uygulanmıştır. Sonuçlar, öğrencilerin yetenekleri, öğrenme ortamı ve akademik başarı arasında pozitif bir ilişki olduğunu gösterirken, öğretmenlerin öğretimi ile fizikteki akademik başarı arasında negatif bir ilişki olduğunu göstermiştir. Bu sonuçlar, fizikteki akademik başarının artırılması için geniş kapsamlı çıkarımlara sahiptir. Çalışma, pedagojilerini geliştirmek için mesleki gelişim programları aracılığıyla hizmet içi öğretmenlerin becerilerini artırarak daha dostane bir öğrenme ortamına yatırım yapılmasını ve elverişli bir evde öğrenme ortamı yaratmak için onları duyarlı hale getirmek için veli toplantıları yapılmasını önermektedir.

Anahtar Kelimeler: akademik başarı, öğrenme ortamı, fizik, yetenek

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Introduction

Physics is crucial in developing a country (Erkilic, 2020). It forms the backbone of the basic sciences, namely natural, health and social sciences, and engineering because it explains the universe's existence. Akura et al. (2021) and Hezekiah et al. (2022) show that secondary school learners' academic achievement correlates with their future career opportunities in science, yet it needs to be better done worldwide. The West African Examination Council results showed that poor performance in physics jeopardises many graduates' physical science programmes (Akura et al., 2021). Similarly, the Kenya National Examination Board revealed that the constant poor performance in physics affects the career paths of learners in some of its vital sectors involving the application of knowledge of physics (Hezekiah et al., 2022).

In Uganda, Komakech and Osuu (2014) show that the government has invested heavily in constructing laboratories in schools and on-the-job training workshops through the Secondary Science and Mathematics Teachers' (SESEMAT) program to improve the teaching and learning of sciences in general but physics in particular. The government has also increased the science teachers' salaries, as opposed to the art teachers, as a performance strategy to improve grades in sciences. Despite all the efforts mentioned above to uplift the academic performance of sciences, physics results exhibit low educational returns in the national examinations, as demonstrated by the UNEB 2018 report that ranked physics as the worst-done subject in the 2017 Uganda Certificate of Education (UCE) examinations where less than 20% of the candidates scored distinctions, credits, and passes. The rest failed the subject. The UNEB 2020 report showed that the number of physics candidates at the 'A' level declined from 13.8% in 2017 to 10.5% in 2018. The low grades in physics could result in a shortage of civil engineers, computer scientists, data scientists, software engineers, and physics tutors in the country (Colquhoun et al., 2021). No wonder some projects take a long time, and the quality still needs to be improved. All these are consequences of the problem of low academic achievement in sciences but Physics in particular. Hence, there is a need to establish the causes of the poor performance in physics since this could be one of the factors responsible for such tragedies.

Problem Statement

In 2006, the government of Uganda made science subjects, Chemistry, Biology, Physics, and Mathematics, compulsory at the ordinary level in secondary schools. Wakiso district is a country's heavily populated district with 23 government-aided secondary schools. According to the University Grants Commission 2021 report, only four out of the 23 schools were listed among the best-performing schools in science subjects in the 2020 UCE results, and this trend of low performance has been on for a long time. As a result, the persistent poor performance in physics has created a workforce shortage in the applied sciences, such as engineering, biology and physical sciences, since Wakiso district learners account for many tertiary institutions in the

country. The poor performance in science subjects could be attributed to several factors, including learners' attitudes towards science subjects (Deepak, 2022), absence of learners' incentives and motivation (Main, 2022), lack of experienced teachers, limited laboratory equipment, and the inappropriate teachers' methods of instruction (Ikechuku, 2021). Therefore, this study seeks to utilise the theory of educational productivity (Walberg, 1981) to investigate learners' physics academic achievement in the Wakiso district in Uganda.

Theoretical Perspective

The Theory

The study was based on Walberg's 1981 theory of educational production. The theory postulated that learners' academic achievement depended on learner characteristics and the immediate environment (Reynolds & Walberg, 1992). The theory explains that learners' academic achievement is based on aptitude (internal traits), which include learners' ability or prior achievement, age, and motivation; instructional factors, which include quality and quantity of instruction modalities; and environmental factors, which have classroom practices, home affairs, peer influence, and mass media (Rugutt & Chemosit, 2005). Thus, the theory investigated three parameters (the learner, the teaching and learning process, and the learners' surroundings) that influence learning.

Learners

The theory explains the learner's internal traits (ability, age, and motivation) and affects academic achievement (Fraser, 1987). Ability or prior achievement is the knowledge the student has already acquired. The age variable includes chronological age but also development and stage of maturation (Keith, 2002). Motivation or self-concept, in the Walberg model, is operationalised as scores on personality tests of the student's willingness to persevere intensively on learning tasks (Walberg & Tsai, 1985).

Teaching and Learning Process

The variables, such as the Quantity of instruction and quality of the instructional experience, examine instructional factors and are also explained by the model (Fraser, 1987). The Quantity of instruction is the amount of time students spend learning (Walberg & Tsai, 1985). It includes the time scheduled, allowed, or assigned for a given instructional unit by the teacher and the fraction of the time the student spends learning the content (Walberg, 1981). The quality of the instructional experience includes psychological and curricular experiences, which were seen as appropriate for the instructional experience (Reynolds & Walberg, 1992). It consists of the number of homework assignments per term in a science class (Walberg, 1986). Suppose the teacher tells students that they are right or wrong. In that case, the

teacher reviews lessons, students report that they understand the teacher (Parkerson & Walberg, 1984), and students say that the teaching is good in their school and that the teacher offers motivation (Walberg, 1985).

Learners' Surroundings

The variables such as home environment, classroom or school environment, peer group environment, and mass media are characterised as environmental factors in the theory (Fraser, 1987). Home environment refers to the support given to students while at home. It includes family interest in school (Parkerson & Walberg, 1984), parental education (Reynolds & Walberg, 1992), the number of times the dictionary is used at home (Walberg, 1985), and home socio-economic status (Walberg, 1985). Classroom and school environment included classroom moral standards (Keith, 2002). Walberg and Tsai (1985) refer to the classroom as a social atmosphere with access to classroom materials.

Aim and Objectives

The study aimed to investigate secondary school learners' academic achievement in physics in the Wakiso district.

The objectives of the study were to:

1. Identify the relationship between secondary school learners' aptitude and their academic achievement in physics in the Wakiso district.

2. Establish the relationship between teachers' instruction and secondary school learners' academic achievement in physics in the Wakiso district.

3. Determine the relationship between secondary school learners' learning environment and their academic achievement in physics in the Wakiso district.

Research Hypotheses

H01: There is an insignificant relationship between secondary school learners' aptitude and their academic achievement in physics in Wakiso district, Uganda.

H02: There is an insignificant relationship between teachers' instruction and secondary school learners' academic achievement in physics in the Wakiso district.

H03: There is an insignificant relationship between secondary school learners' learning environment and their academic achievement in physics in the Wakiso district.

Literature Review

Many studies have been conducted regarding learners' aptitude, teachers' instruction, learning environment, and academic achievement in different countries.

Learners' Aptitude and Academic Achievement

Omeodu (2021) studied self-esteem among learners in secondary schools and its influence on the academic performance of physics in Nigeria. Data was collected using a standardised physics questionnaire achievement test from 50 senior three learners. The results of their study revealed a strong positive association between learners' self-esteem and their academic performance in physics. Jenije (2022) investigated the connection between learners' attitudes and academic achievement in science and mathematics. Data was collected using a self-structured questionnaire and terminal examination scores of 400 students and analysed by Pearson product-moment correlation coefficient. The results revealed a relationship between students' attitudes and their academic performance in mathematics. Alvarado et al. (2022) examined the ability to predict non-cognitive factors on learners' academic performance at the undergraduate level.

Data was collected from 100 students through a Schutte self-report emotional intelligence test and grade point average in the two academic years, 2019 and 2020. Using Spearman's correlation coefficient, mean scores, standard deviation, and multiple regression, their findings indicated a positive association between undergraduate students' academic achievement and emotional stability. Lasisi and Garba (2020) examined factors affecting learners' academic performance in physics based on their perception in Nigeria. The survey method was used to gather data from 150 senior three physics students and analysed using standard deviation and mean scores. The researchers discovered that the students had a clear understanding of the importance of teachers' teaching strategies, instructional resources, communication abilities, students' motivation and environments, and study habits are issues that affect how well they conceptualise physics. These studies suggest that learners' self-esteem, attitude, and emotional stability highly influence their academic achievement since they act as motivational factors that make them focus more on the conceptualisation of physics.

Teachers' Instruction and Academic Achievement

Bwenvu et al. (2020) studied the experience of teachers and students' academic performance in sciences in Uganda Certificate of Education examinations. They collected data through focused group discussions, document analysis, interviews, and questionnaires from 375 students, 28 head teachers, and 110 science teachers. They analysed the data collected using descriptive and inferential statistics and

thematic data analysis procedures. Their research showed a substantial connection between teachers' expertise and students' academic performance in science subjects.

Bello (2020) examined instructional materials and their impact on Physics academic performance. He collected data from 45 secondary school students for three terms. He analysed data using percentages. His findings indicated that fewer instructional materials were used instructional materials to teach, which negatively impacted students' performance in Physics. It is because instructional materials give learners a practical experience that enables them to develop conceptual skills as they work in various ways.

Lucero (2021) studied the teaching methods of science teachers and the academic performance of the learners they taught in class. He used a questionnaire to collect data from 9 teachers together with learners. He then analysed the data using frequency, weighted mean, standard deviation, and Pearson correlation coefficient. The findings of his study revealed that teacher-centred, learner-centred, and learner-teacher interaction teaching methods were used mainly by teachers and had no significant relationship with the learners' performance. Teachers could apply other methods, such as project-based and flipped classroom practices, to improve learners' academic achievement.

Azowenunebi et al. (2019) investigated the consequences of inquiry-based teaching strategies on the academic performance of secondary school physics students. Using a Physics practical achievement test, an instructional guide on inquiry, and convectional instructional teaching methods, data was collected from 173 students who were doing physics. Through average scores and covariance data analysis, their findings showed that inquiry instructional strategy significantly positively affected learners' academic performance. This method encourages learners to engage in problem-solving and experiential learning.

Learning Environment and Academic Achievement

Onyenma and Nkechi (2020) investigated the blended learning effect on students' performance in Physics. Data was collected from 81 learners using pre-tests and post-tests. After analysing data using mean, standard deviation, and ANOVA, they discovered that blended learning positively influenced the academic performance of Physics students.

Ajogbeje et al. (2021) studied learners' academic performance in Physics concerning the impact of audio-visual resources in secondary schools. They used questionnaires to collect data from 100 senior two students. They analysed data using frequency counts, percentages, and chi-square data. The results revealed that the audio-visual material approach significantly improved learners' academic performance in Physics. Audio-visual materials allow learners to revisit study

materials and review their work at any time, thus mastering the concepts. Ikechuku (2021) studied students' academic achievement in Physics and how it is impacted by school location according to the 5E learning cycle. He used a Physics achievement test to collect data from 246 students. After analysing data using ANOVA, he found no significant difference between rural and urban learners' academic achievement in Physics using the 5E learning cycle.

Hamed and Aljanazrah (2020) investigated how virtual laboratory experiments influence the academic performance of secondary school students in Physics practicals. They used conventional lesson plans and academic performance tests in Physics practicals to collect data from senior two students. They analysed data using variance, covariance, and t-test. The results revealed that teachers' teaching strategies affect students' academic performance in Physics. These virtual experiments enable learners to re-conduct their desired experiments many times, hence mastering the concepts.

Based on the literature reviewed, only one study about academic achievement in Physics in Uganda has been conducted (Bwenvu et al., 2020), hence leaving a gap for more studies about academic achievement in Physics to be conducted in Uganda. Furthermore, none of the articles in the literature reviewed applied educational productivity theory.

Utilising the theory of educational productivity (Walberg, 1981) to investigate learners' physics academic achievement, the problem of low academic achievement in Uganda, which has been on for a long time, might be redeemed. As a result, the persistent poor performance in physics has created a workforce shortage in the applied sciences since science subjects are compulsory at the ordinary level, even though Wakiso district learners account for many tertiary institutions in the country. The underlying factors for the low achievement will also be established.

Methodology

Research Paradigm

The study used mainly the positivist paradigm because a hypothetic-deductive model was envisaged to verify hypotheses by operationalising variables to derive realistic conclusions about the conducted studies (Yoon, 2022).

Research Design

A cross-sectional correlational survey design was used in the study. It was chosen because it yields reliable data that can be used to generate conclusions that lead to the formation of new hypotheses in similar studies (Zangirolam, 2022). Furthermore, it establishes the relationship between two or more variables.

Data Collection Instrument

Self-Administered Questionnaire (SAQ) was adapted from Walberg's Model of Educational Productivity in student career aspiration (Xin & Jianjun, 2001) and was used for data collection. The adapted instrument was a self-reporting questionnaire to assess how learners' aptitude impacts learners' academic achievement, teachers' instruction, and the learning environment. The SAQ comprised three sections (A, B and C). Section A questions were on demography to classify respondents by gender and age (Table 2). Section B constituted the independent variables and comprised 21 close-ended items about learners' aptitude (6 items), teachers' instruction (6 items), and learning environment (9 items), together with three open-ended items (Table 1). The close-ended items were measured based on a five-point Likert scale ranging from 1=Strongly Disagree (SD), 2=Disagree (D), 3=Undecided (U), 4=Agree (A), and 5=Strongly Agree (SA). The open-ended items required the learners to explain their difficulties in terms of ability and motivation, how they gauge the taught lessons in terms of quality and Quantity, and whether they prefer to have their lessons in class, at home, with peers, or on social media. Section C (Table 1) comprised the dependent variable items (9 items; 3 items for each of the three selected topics), which consisted of learners' level of achievement in Physics. These items assessed different concepts in three topics in form two, namely, Mechanics and Properties of Matter, light and electricity and generated different scores.

The content validity index (CVI) of the questionnaire was evaluated. This was done by submitting the questionnaire to ten experts, of which eight agreed with the constructs; hence, the questionnaire had a CVI of .80, yet the researchers aimed at a CVI of at least .70, which is the least acceptable level (Amin, 2005).

A pilot study to ascertain the reliability of the instrument was conducted. This was done by administering the questionnaire to 15 learners from some government-aided secondary schools in the Wakiso district, and these students were not included in the research sample. Table 1 indicates that the questionnaire was reliable for data collection since all Cronbach alpha values exceeded .7 (Nunnally, 1994; Amin, 2005) for sections B and C except for section A, which comprised the learners' demography.

Table 1: Cronbach alpha (α) scores for the reliability of the questionnaire

Variable	No. of items	Cronbach alpha (α)
Section B		
Learners' aptitude	06	.704
Teachers' instructions	06	.737
Learners' learning environment	09	.854
Section C		
Learners' Achievement in Physics	05	.741

Population and Sample Selection

A total of 500 form-two learners in two secondary schools (A and B) in Wakiso district in Uganda constituted the study population**.** The choice was based on the ability and prior knowledge of the learners to be measured due to exposure to physics in a new competency-based curriculum in form one. A sample of 217 learners was determined from a population of 500 learners using the table for sample size determination by Krejcie and Morgan (1970). A simple random sampling technique was used where learners' names were written on paper, placed in a box, and selected randomly. So, each learner had an equal chance of being selected.

Data Analysis

Normality and homogeneity tests were conducted using Kolmogorov (2021) to establish whether the data was usually disturbed and whether the sample data had the same variance. The normality test yielded an Asymp. Sig p = .13, suggesting that variables were normally distributed. Levene's test for homogeneity of .56 was established, implying that the variables had the same variance since $p > .05$. The researchers used descriptive statistics, which are means and standard deviations, to represent learners' academic achievements. Also, Analysis of Variance (ANOVA) at p =.05 was used to identify the significant differences between the variables. Pearson's linear correlation coefficient was used to test the hypotheses and determine the relationship between the variables.

Findings

The findings reveal a positive relationship between secondary school learners' aptitude and learning environment with their achievement in physics at a 5% level since $p < .05$. Furthermore, there was no significant relationship between teachers' instruction and secondary school learners' academic achievement in physics at a 5% level since $p > .05$. The learners' academic achievement in Physics from different schools are measured. The findings are presented per the study's objectives: 1) Learners' aptitude, 2) Teachers' instruction and 3) Learners' learning environment.

Presentation and Interpretation of Findings

Demographic Variables of the Respondents

The targeted sample size for this study was 217 senior two students from two Secondary Schools (A and B) of Kira Municipality. In order to avoid non-response issues, 220 questionnaires were distributed to these students in the two schools. Of these, 219 SAQs were retrieved, implying a response rate of 100%; thus, 217 were used for the analysis. The response rate was excellent for allowing generalisation of the study findings. The researcher collected data on the respondents' demographic variables, which helped determine whether the collected data was appropriate for the study population. Thus, the demographic characteristics considered in this study included the sex of the respondent, their school and age. Table 2 presents the distribution of respondents by their demographic variables.

Table 2: Distribution of respondents by demographic characteristics

Variable	Category	Frequency	Percent (%)
Sex of respondent	Female	121	55.8
	Male	96	44.2
Age (years)	12 – 13	11	5.1
	14 – 15	136	62.7
	16 – 17	64	29.5
	18 – 19	06	2.8
School	A	124	57.1
	B	93	42.9

According to the results in Table 2, most respondents (62.7%) were aged 14 to 15 years. Regarding the sex of the respondents, the majority of them were females (51.9%). In addition, the highest proportion of respondents was from Secondary School A (57.1%).

Academic Achievement in Physics

Learners' academic achievements in physics were used as the dependent variable in this study, presented in Figure 1.

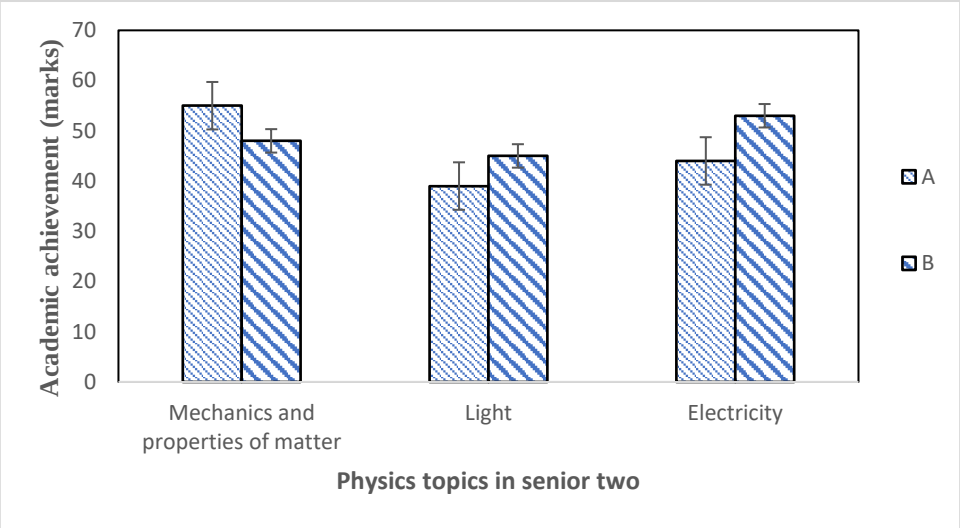

Figure 1: Learners' academic achievement in physics

The learners' academic achievement in Physics by 217 form two students in two schools, A and B, was based on scores of three assessment tests, each assessing three topics of senior two Physics, namely, mechanics and properties of matter, light, and electricity. The mean mark and standard deviation were computed (Figure 1). The learners' academic achievement in Physics shows that the topic of mechanics and properties of matter was best performed by school A, with a mean score of 55%, and electricity by school B, with a mean score of 53%. The worst-performing topic for the two schools was light, with an overall mean score of 42%. The overall mean scores for mechanics and properties of matter and electricity are 51.5% and 48.5%, respectively. This implies that the most significant number of learners scored below average in the given tests in Physics. Furthermore, the standard deviation was 10%, implying that learners' academic achievement differed significantly from the mean scores.

Learners' Aptitude

The first objective was to examine the relationship between secondary school learners' aptitude and academic achievement in physics. The responses are presented based on the Likert scale (Table 3).

Table 3: Secondary school learners' rating of their aptitude toward their academic achievement in physics

Item	Description	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SD	Overall rating
A1	I score highly on physics tests	95 (43.8)	30 (13.8)	35 (16.1)	56 (25.8)	1 (.5)	2.25	1.27	Disagree
A2	I am motivated to study physics by having a calculator	42 (19.4)	42 (19.4)	25 (11.5)	104 (47.9)	4 (1.8)	2.06	1.24	Disagree
A3	I am good at calculations	129 (59.4)	40 (18.4)	11 (5.1)	32 (14.7)	5 (2.3)	2.94	1.23	Undecided
A4	I am motivated to be late for Physics lessons	129 (59.4)	40 (18.4)	11 (5.1)	32 (14.7)	5 (2.3)	2.94	1.23	Undecided
A5	I am motivated to dodge a couple of physics lessons	129 (59.4)	39 (18.0)	31 (14.3)	11 (5.1)	7 (3.2)	1.75	1.08	Disagree
A6	Physics content motivates me to be attentive	71 (32.7)	22 (10.1)	11 (5.1)	52 (24.0)	61 (28.1)	3.05	1.67	Undecided
	Overall						2.49	1.29	Disagree

Source: Primary data from selected secondary schools in Kira Municipality 2020.

Table 3 indicates that the highest proportion of the learners strongly disagreed that they scored highly in physics tests, as represented by 43.8%; those that agreed that they had calculators were represented by 47.9%, while the learners that were good at calculations were represented by 59.4%. Similarly, the learners who were motivated to be late for physics lessons were represented by 59.4%, those who were motivated to dodge a couple of physics lessons were represented by 59.4%, and those who stated that physics content motivated them to be attentive were represented by 32.7%. Generally, the overall mean response of the learner's aptitude corresponded with code 2, which represents disagreement, suggesting that, on average, senior two learners disagreed with the aptitude ratings towards their academic achievement in physics.

The Analysis of Variance (ANOVA) was run, and the results are shown (Table 4).

Table 4: ANOVA results of learner's aptitude on their academic achievement in physics

Learners' aptitude	Sample size (n)	Sample mean	Sample SD	Fisher's statistic (t)	Sig. or p-value
Disagree	118	53.06	1.45	4.79	.009
Undecided	64	52.73	2.39		
Agree	35	62.40	2.27		
Total	217	54.49	1.14		

From Table 4, the F statistics indicated a significant mean difference in physics academic achievement for learners' aptitude for disagree, undecided and agree at a 5% level. The differences in the means could be attributed to the learners' aptitude toward physics.

Teachers' Instruction

The second objective was to establish the relationship between teachers' instruction and secondary school learners' achievement in physics. The responses, based on the Likert scale, are shown (Table 5).

Table 5: Secondary school learners' rating of teachers' instructions towards their academic achievement in physics

Items	Description	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SD	Overall rating
T1	My teacher marks all the exercises	49 (22.6)	43 (19.8)	46 (21.2)	48 (22.1)	31 (14.3)	2.86	1.37	Undecided
T2	The teacher reviews the previous work in each lesson	43 (19.8)	34 (15.7)	21 (9.7)	85 (39.2)	34 (15.7)	3.15	1.39	Undecided
T3	My teacher assigns many exercises to me	80 (36.9)	61 (28.1)	10 (4.6)	31 (14.3)	35 (16.1)	2.45	1.49	Disagree
T4	The teaching is good at school	44 (20.3)	30 (13.8)	21 (9.7)	22 (10.1)	100 (46.1)	3.48	1.64	Undecided
T5	My teacher praises me for working hard	25 (11.5)	20 (9.2)	21 (9.7)	75 (34.6)	76 (35.0)	3.72	1.34	Agree
T6	My teacher listens to me	10 (4.6)	13 (6.0)	10 (4.6)	75 (34.6)	109 (50.2)	4.20	1.08	Agree
	Overall						3.31	1.39	Undecided

Source: Primary data from selected secondary schools in Kira Municipality 2020.

Table 5 indicates that most of the learners strongly agreed that their teachers listen to them (50.2%), that the teaching is good at school (46.1%), and that their teachers praise them for working hard (35.0%). In addition, 39.2% of the students agreed that their teachers review the previous work in each lesson. On the other hand, 36.9% of the students strongly disagreed that their teachers assigned them many exercises, and 22.6% strongly disagreed that their teachers marked all the exercises given to them. Generally, the overall mean response of the learners' rating of teachers' instructions was 3.31, corresponding with code 3, undecided. This implied that, on average, senior two students were undecided on their rating of the teachers' instructions regarding their academic achievement in physics.

The analysis of variance (ANOVA) was run, and the results are presented in Table 6.

Table 6: ANOVA results of teachers' instruction on secondary school learners' academic

achievement in physics

Teachers' instructions	Sample size (n)	Sample mean	Sample SD	Fisher's statistic (t)	Sig. or p-value
Disagree	14	64.29	3.52	2.64	.074
Undecided	68	53.21	2.09		
Agree	129	54.00	1.48		
Total	211	54.43	1.16		

From Table 6, the F statistics indicated a significant mean difference in the learner's achievements based on a rating of teachers' instructions for disagree, undecided, and agree at a 5% level.

Secondary School Learners' Learning Environment

The third objective aimed to identify the relationship between secondary school learners' learning environment and their academic achievement in physics. The responses are presented based on the Likert scale (Table 7).

Table 7: Secondary school learners' rating of learning environment and achievement in physics

Item	Description of Items	SD Count (%)	D Count (%)	U Count (%)	A Count (%)	SA Count (%)	Mean	SD	Overall rating
E1	My parents help out with my homework	100 (46.1)		11 (5.1)	73 (33.6)	33 (15.2)	2.72	1.65	Undecided
E2	My parents provide all the scholastic materials	11 (5.1)		10 (4.6)	67 (30.9)	129 (59.4)	4.40	.97	Agree
E3	My parents encourage me to be focused	10 (4.6)			63 (29.0)	144 (66.4)	4.53	.89	Strongly agree
E4	I feel teachers put me down in class	111 (51.2)	11 (5.1)	10 (4.6)	42 (19.4)	43 (19.8)	2.52	1.69	Undecided
E5	I feel students put me down in class	67 (30.9)	45 (20.7)	11 (5.1)	52 (24.0)	42 (19.4)	2.80	1.56	Undecided
E6	Schooling is important among friends	12 (5.5)			67 (30.9)	138 (63.6)	4.47	.96	Agree
E7	Good grades are important among friends	10 (4.6)	13 (6.0)	11 (5.1)	67 (30.9)	116 (53.5)	4.23	1.09	Agree
E8	I spend many hours on weekends watching TV	33 (15.2)	43 (19.8)	11 (5.1)	42 (19.4)	88 (40.6)	3.50	1.54	Agree
E9	All my evening hours after school are spent on things other than reading physics	32 (14.7)	57 (26.3)	33 (15.2)	11 (5.1)	84 (38.7)	3.27	1.55	Undecided
	Overall						3.60	1.32	Agree

Source: Primary data from selected secondary schools in Kira Municipality 2020.

Table 7 shows that many learners strongly agreed that their parents encourage them to be focused on studying as it is essential in life (66.4%); others stated that schooling is vital among friends (63.6%). In contrast, some learners stated that parents provide all the scholastic materials (59.4%). Similarly, some learners showed that good grades are essential among friends (53.5%), others spend many hours on weekends watching TV (40.6%), and some spend their evening hours after school on other things as opposed to reading physics (38.7%). On the other hand, some learners strongly disagreed that their parents help out with homework (46.1%), while others

felt put down by teachers (51.2%) and students (30.9%) in class. Generally, the overall mean response of learners' rating of their learning environment was 3.60, corresponding to code 4, agreed, which implies that, on average, two senior students agreed that their learning environments contribute to their academic achievement in physics.

After that, ANOVA was run, and the results were presented (Table 8).

Table 8: ANOVA results of secondary school learners' learning environment on their academic achievement in physics

Teachers Instructions	Sample Size (n)	Sample Mean	Sample SD	Fisher's statistic (t)	Sig. or p-value
Disagree	6	43.83	6.40	1.20	.303
Undecided	38	54.13	2.88		
Agree	170	54.49	1.25		
Total	214	54.13	1.13		

From Table 8, the F statistics indicate no significant mean difference in physics academic achievement for learners' learning environment for disagree, undecided and agree at a 5% level.

Pearson Linear Correlation Coefficient was used to determine the magnitude and strength of the learners' aptitude, teachers' instruction, and environment on their academic achievement. This correlation was run at the 95% confidence interval; the results are stated in Table 9.

Table 9: Pearson's linear correlation coefficient for learners' aptitude, teachers' instruction, and learning environment on academic achievement.

Variable	Pearson correlation (r)	Sig(2-tailed) (P)
Learners' aptitude	.141*	.037
Teachers' instruction	-.084	.217
Learning environment	.139*	.042

*Correlation .05 (2-tailed)

Table 9 shows a weak positive association between learners' aptitude and environment with learners' achievement in physics $p < .05$ ($r = .141$ and $.139$, $p = .037$ and $.042$, $\alpha = .05$). Therefore, the first and third hypotheses were rejected; hence, learners' aptitude and learning environment and academic performance were positively linearly correlated but with a fragile relationship. Furthermore, there was no significant relationship between teachers' instruction and learners' academic achievement in physics at a 5% level since $p > .05$ ($r = -.084$, $p = .217$, $\alpha = .05$). Therefore, the second hypothesis was accepted. Hence, though insignificant, teachers' instruction and academic achievement were negatively linearly correlated.

Difficulties Faced by Students While Learning Physics and How They Gauge Physics Lessons and the Environment Where They Study

This section presents answers to open-ended questions about difficulties students face in learning physics, how they gauge physics lessons, and the environment they study from. These were thematically analysed and quantified presented (Table 10).

Table 10: Difficulties faced by students while learning physics and how they gauge physics lessons and the environment where they study from

No.	Variable	Frequency	Percentage (%)
1	Difficulties faced in learning physics in terms of learners' ability		
	i) Calculations are hard		
	ii) Teachers teach faster	149	68.7
	iii) No reference materials to use	34	15.7
		34	15.7
2	Difficulties faced in learning physics in terms of learners' motivation		
	i) I have a poor attitude toward physics		
	ii) Classmates make fun of me	73	37.6
	iii) Dodging of lessons	100	51.5
	iv) No reading materials to use	10	5.2
		11	5.7
3	How students gauge physics lessons in terms of coverage		
	i) Wide syllabus	95	49.2
	ii) Too many complex notes	87	45.1
	iii) A few lessons learned	11	5.7
4	How students gauge physics lessons in terms of quality		
	i) Good	153	74.3
	ii) Moderate	32	15.5
	iii) We take a long to understand	21	10.2
5	Reasons for gauging physics lessons in terms of coverage		
	i) Too many theoretical notes	32	16.6
	ii) Hard to understand	11	5.3
6	Reasons for gauging physics lessons in terms of quality		
	i) Practical lessons make us understand	119	70.0
	ii) Teachers dodge classes	51	30.0
7	Reasons why students prefer studying physics in class		
	i) Get encouraged	72	67.3
	ii) Get different ideas	35	32.7
8	Reasons why students prefer studying physics at home		
	i) Quietness at home	44	78.6
	ii) Get enough time	12	21.4
9	Reasons why students prefer studying physics from peers		
	i) Get more knowledge and skills	53	81.5
	ii) They get encouraged	12	18.5

10	Reasons why students prefer studying physics from social media platforms			
		i) A lot of different materials are used	121	91.0
		ii) Some form parts of the curriculum	12	9.0

Results in Table 10 established that the most significant challenge faced by students while learning physics in terms of ability was that calculations are complicated (68.7%). Regarding the difficulties faced in learning physics regarding motivation, 51.5% of the learners said classmates were making fun of them when they responded. Regarding how students gauged physics lesson coverage, most learners (49.2%) said physics had a comprehensive syllabus. Similarly, 74.3% of the students gauged the physics lessons to be good quality. Likewise, 77.7% of the learners noted that discouragement was the reason for gauging physics lessons as comprehensive coverage. Furthermore, 70.0% of the learners noted that practical lessons make them understand better, so they gauged physics lessons concerning quality work.

In addition, students were asked about the environment they prefer to study physics from and why. The environments considered were class, home, peers, and social media. Of the students who preferred to study physics, 67.3% said they preferred practical physics in class. Likewise, of the students who preferred studying physics from home, 78.6% said that the home environment encouraged them to study physics from there. Similarly, of the students who preferred studying physics from their peers, 81.5% of them said that they get more knowledge and skills from their peers when they study physics. Last but not least, of the students who preferred studying physics using social media platforms, 91.0% said that they get material from social media, so they prefer to study physics from social media platforms.

Discussion of Results

This study aimed to investigate secondary school learners' academic achievement in physics in the Wakiso district of Uganda. The study found a weak positive relationship between the learners' aptitude and learning environment with achievements in physics. However, the relationship between teachers' instruction and achievement was weak and negative.

Learners' Academic Achievement in Physics

The mean achievement score in physics was 47.3% (Figure 1), which shows a relatively poor academic achievement of learners in Physics. This low academic achievement in Physics is mainly attributed to the poor learners' attitudes towards science subjects but Physics in particular (Deepak, 2022).

Learners' Aptitude and Academic Achievements in Physics

When the results show a weak positive relationship between learners' aptitude and academic achievement in physics, suggesting an increase in learners' aptitude

slightly increases their academic performance. With improved motivation, which positively impacts aptitude, learners' physics achievements can improve every time. These findings are in line with some previous studies conducted.

The study by Sugano (2021) found that learners' aptitude in terms of their abilities and motivation directly impacted their achievement, and it acted as the basis for determining learners' career strengths. Therefore, learners who are highly motivated are capable of promoting good study habits like attending to all given assignments, doing regular tests, allocating more time to complex content, carrying out daily study programmes, taking notes of meaningful content that fosters conceptualisation of new learning concepts, thus achieving higher performance in physics than those who are less motivated to do self-study. Therefore, teachers should motivate learners by boosting their confidence through question-and-answer techniques, encouraging peer teaching and learners' presentations, giving positive feedback, and rewarding learners' achievements. These findings also align with the study by Omeodu (2021), which showed a strong positive association between learners' self-esteem and their academic performance in physics. Further still, the study by Lasisi and Garba (2020) also established that teachers' teaching methods, instructional materials, teachers' communication skills, students' motivation, learning environment, and students' study habits were equally important factors that would enable faster conceptualisation and learning of Physics.

Teachers' Instruction and Academic Achievement in Physics

When the teachers' instruction modalities and learners' achievement in physics were analysed, it was established that a weak negative relationship existed between teachers' instruction and achievement in physics. This relationship indicates that the teachers needed to fully utilise better instructional methods to cause effective learning, which could have led to a slight decrease in students' academic performance. The finding aligns with the study by Michael (2018), who emphasised that teachers who need help to engage with diverse learners and create conflicts based on communication and learning style differences hinder students from attaining higher academic success. This mismatch is often attributed to inadequate teacher training and a lack of follow-up on values and knowledge acquired from workshops, ultimately negatively impacting learners' academic achievement. The study by Bello (2020) reported that insufficient instructional materials negatively affect learners' performance in physics. According to Bwenvu et al. (2020), poor instruction methods, negative student attitudes, limited resources, and inadequate textbooks contribute to poor performance in science subjects. Hence, as established from this study, the challenge of teachers' poor delivery methods could be one of the most significant factors hindering learners' improved performance in physics in Wakiso district and Uganda.

Learning Environment and Learners' Academic Achievement

When the findings of the learning environment and academic achievement in physics were analysed, it was found that a weak positive relationship existed between learners' learning environment and achievement in physics, suggesting that a conducive learning environment enhances academic achievements. Conducive learning environments such as well-ventilated and spacious classrooms with sufficient light, schools with well-built laboratories and digital platforms, and blended learning improve learners' achievement. This finding concurs with the study by Ajogbej et al. (2021), who stated that if the different learning environments are correctly utilised, it provides a safe and conducive space and possibilities for learners to communicate with one another and access resources that help them learn and comprehend knowledge in different ways. For example, some learners may try to learn by listening to the teacher, while others might be interested in the behaviours of the teacher and yet others may learn better by watching films and pictures on CDs and DVDs (Onyenma & Nkechi, 2020). Therefore, parents and school administrators should work hard to create an environment that encourages the open exchange of ideas, thoughts, and skills among instructors and students to accomplish the intended educational outcomes. Students' attention improves due to the creation of a conducive learning environment, which promotes meaningful learning experiences.

Limitation

The study's primary limitation was the small sample of government-aided secondary schools selected and the selection of only Kira Municipality out of the 41 municipalities in Uganda. The implication is that although the findings can apply to Kira Municipality, these results may only represent some nations. Therefore, further studies covering the whole of Uganda are highly recommended.

Conclusions and Recommendations

Conclusions

The study findings show that learners' aptitude, teachers' instruction, and learning environment impact learners' academic achievement in physics differently. The learners' aptitude and learning environment positively correlated with academic performance in physics. However, the teachers' instruction modalities negatively affected academic performance in physics. These results could arise because teachers use inappropriate teaching methods, which might have impacted learners' academic achievements in physics. Therefore, it is concluded that the poor methods of teacher instruction while teaching physics in class are the primary cause of low conceptualisation and the persistent poor academic achievement in physics in the Wakiso district. The study vividly informs policymakers and researchers that much as many factors affect learners' academic achievement in physics, teachers' instruction plays the most significant role. Therefore, before making policies and investments in other areas, such as infrastructural development, teachers' training,

retooling, and motivation must take prime precedence. This will create a conducive learning environment that promotes better content delivery and faster conceptualisation of physics.

Recommendations

The study recommended that the school management motivate learners through positive reinforcement, such as awarding the best performers in physics with bursaries and gifts. The teachers should positively reward learners' activities and answers during the teaching and learning sessions and improve academic relationships with them. The government should follow up through school inspectors to confirm that teachers implement the knowledge and values acquired through teacher-upkilled professional development programs. Parents and teachers should be sensitised to establish an enabling environment that enhances learning for the learners at home and school.

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Author Contributions

The researchers obtained a research authorisation letter from the Dean School of Education, Makerere University. Later, they sought permission from the Education Office in Fort Portal City and the respective secondary school head teachers whose schools were involved in the study. In addition, the researchers introduced themselves and obtained consent from all the study participants, providing them with precise information about the purpose and procedures of the study and data collection processes. The participants were further informed of the potential benefits and risks and were assured of the confidentiality of the information given and not to disclose their identities anywhere.

Conflict of Interest

The authors declare there is no conflict of interest in this study.

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