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Original Article

Class Size and Learners' Engagement in Physics Practicals in Ordinary Level Secondary Schools of Bukanga North County, Isingiro District

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Class Size, Learner Engagement, Physics Practicals, Secondary Schools, Student-Teacher Interaction.

ABSTRACT

The study investigated the effect of class size on learners' engagement in physics practicals in ordinary-level secondary schools in Bukanga North County, Isingiro District. The objective of the study was to examine the effect of the number of students on learners' interaction with teachers during physics practicals. The study used a correlational survey design. The study population included senior three learners, physics teachers, laboratory attendants, school headteachers, the District Education Officer, and the District Inspector of Schools. A sample size of 352 respondents was used. Sampling methods included purposive and random techniques. The data collection methods included self-administered questionnaires, interview guides, and observation checklists. Qualitative data was analysed using thematic, content, and narrative analysis while quantitative data was analysed with SPSS. A significant positive correlation (r = 0.820) suggested that as the number of students decreased, the learners' interaction with the teacher in ordinary-level physics practicals increased. The research recommends that schools should reduce student numbers in physics practical classes, provide teacher training, implement flexible seating arrangements, ensure proper classroom resources, determine an optimal number of students, and consider classroom layout adjustments to enhance the effectiveness of physics practicals.

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INTRODUCTION

Worldwide, over 30 states in the USA have enacted legislation for Class Size Reduction programs (Garwin & Ramsier, 2013). Current government policy in England and Wales sets a maximum class size of 30 students, with larger cuts planned in Scotland. In Africa, Goodlad, Soder, and Sirotnik (2014) reported that appropriate class sizes are influential in fostering meaningful discussions and interactions among students, classmates, and functional apparatus in the classroom.

In Kenya, Uganda, and other East African nations, the lecture method is commonly used for teaching physics due to the high teacher-student ratio. However, this technique has been ineffective in improving physics performance, as results remain low (Toplis et al., 2016). The traditional lecture method has been found to produce little or no improvement in most students' understanding of physics (Capanis et al., 2010; Garwin et al., 2013). This method benefits only about ten percent of students, mainly those who are self-motivated and would have learned the subject independently (Gekelman et al., 2011). Listening to lectures is not an efficient way to teach or learn science practicals, which are essential for technological development.

The severe shortage of educational resources in the 1950s caused Ugandan teachers and expatriates to flee the country, leading to high student-teacher ratios, often exceeding the ideal ratio of 1:25. This situation made teaching difficult and diminished teacher morale (Brown & Williams, 2022). This study considers Lev Vygotsky's Sociocultural Theory (1978), which suggests that social interaction plays a critical role in the step-by-step development of cognition.

Statement of the Problem

Secondary schools are expected to maintain an appropriate teacher-student ratio to facilitate positive learning engagement (MoES, 2018). However, most classes in Bukanga North secondary schools are overcrowded, making it difficult for learners to access prepared learning aids and complete their academic tasks during practical lessons (Inspector of Schools Report, 2019). The Ministry of Education and Sports has made various interventions over the years to improve science performance by establishing new classroom structures and reducing the high teacher-student ratio, which affects Ordinary Level learners' engagement during physics practicals (MoES, 2018). As of 2017, the average class size was 42.66 students per teacher.

Despite these efforts, Isingiro District and other districts in Uganda continue to register poor grades in physics at the Ordinary level (UNEB, 2019). Additionally, in the 2020-2021 academic year, 4% of students applying for engineering courses at Kyambogo University were not admitted due to failing to obtain a credit in physics (Daily Monitor, 2021). If this study is not conducted, learners may struggle to meet future scientific and technological challenges in an increasingly dynamic world. Therefore, this study examines how class size affects Ordinary Level learners' engagement in physics practicals by assessing the teacher-student ratio to improve learner-teacher interactions and promote engagement in Bukanga North County, Isingiro District.

Objectives of the Study

The study defined class size (independent variable) as the number of students, and ordinary level learners' engagement in physics practicals (dependent variable) as their interaction with the teacher. Therefore, the objective of the study was to examine the effect of the number of students on learners' interaction with the teacher during physics practicals in ordinary level secondary schools in Bukanga North County, Isingiro District.

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Research Hypothesis

H_0: There is no statistically significant relationship between the number of students and learners' interaction with the teacher in physics practicals in ordinary-level secondary schools of Bukanga North County, Isingiro District.

LITERATURE REVIEW

Effect of Number of Students on Learners' Interaction with the Teacher in Physics Practical in Ordinary Level Secondary Schools

The effect of the teacher-student ratio on learners' engagement has been a subject of great interest among scholars in the field of education. For instance, in the United States, where the standard ratio is 1:12 across all K-12 levels, Smith et al. (2018) conducted a study using a mixed-method approach, employing surveys and classroom observations to assess learners' engagement levels in different teacher-student ratio settings. Their findings indicated that smaller class sizes positively correlated with increased student engagement, fostering a more personalized learning experience. In contrast, a study by Johnson et al. (2019) in Sweden utilized a longitudinal research design and found that the country's standard teacher-student ratio of 1:12 did not significantly impact learners' engagement, suggesting that factors such as teaching methods and classroom dynamics might be more influential. These differences could be attributed to variations in educational systems, student demographics, or cultural attitudes towards education in the two countries.

A study conducted in Nigeria by Adewale et al. (2019) explored the influence of teacher-student ratios on learners' engagement in public secondary schools. The research employed a mixed-methods approach, combining qualitative and quantitative data collection methods. The population comprised students from various grade levels in randomly selected schools across different regions. Through stratified random sampling, a sample of 800 students and 40 teachers was selected. Data was gathered using structured questionnaires and classroom observations. The findings suggested that schools with a standard teacher-student ratio of 1:40 or lower exhibited higher levels of learners' engagement compared to schools with higher ratios. The study highlighted the importance of adequate resources and support to improve the quality of education in Nigerian public schools and recommended that secondary schools maintain the standard ratios to enhance learners' engagement (Adewale et al., 2019).

In South Africa, a recent study by Johnson and Mandela (2020) investigated the relationship between teacher-student ratio and learners' engagement in a diverse sample of secondary schools across the country. The research employed a mixed-method approach, utilizing both qualitative (interviews, focus groups) and quantitative (surveys, test scores) data collection methods. The study population included secondary school learners from various socioeconomic backgrounds. A total sample size of 1,200 students was selected through stratified random sampling. The study recommended that policymakers and educational institutions allocate resources effectively to ensure smaller class sizes, ultimately fostering a conducive learning environment.

The effect of teacher-student ratio on learners' engagement in Kenya has been a subject of considerable research interest. For instance, a study conducted by Ouko and Mwinzi (2017) utilized a quantitative research design, focusing on secondary schools in Nairobi. The study included a population of 20 public schools, with a sample size of 400 students selected using stratified random sampling techniques. Data were collected through questionnaires and classroom observations and analyzed using descriptive and inferential statistics. The findings revealed a significant correlation between reduced teacher-student ratios and increased learner engagement. Students in classrooms with lower ratios exhibited higher levels of participation, increased motivation, and improved academic performance. Consequently, it was concluded that maintaining an optimal teacher-student ratio is crucial for enhancing learners' engagement in Kenyan

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classrooms. Based on these findings, Ouko and Mwinzi (2017) recommend that educational policymakers prioritize reducing class sizes to improve the overall quality of education in the country. (Kagendo & Kamau, 2019). This study was carried out in rural areas of Bukanga North County, Isingiro district in contrast to the above that was carried out in urban areas of Nairobi, Kenya.

The effect of the teacher-student ratio on learners' engagement in Ugandan secondary schools has been a subject of considerable interest in educational research. Previous studies have shown that the standard teacher-student ratio significantly influences students' engagement and academic outcomes (Smith & Johnson, 2018; Brown et al., 2019). For instance, Smith and Johnson (2018) employed a mixed-method research design, incorporating both quantitative and qualitative data, with a population of 20 secondary schools in Uganda. The sample size consisted of 500 students, selected using a stratified random sampling technique. Data were collected through questionnaires and classroom observations, and analyzed using descriptive statistics and thematic content analysis. The findings revealed a positive correlation between lower teacher-student ratios and increased student engagement. However, the conclusion also highlighted that additional factors, such as teaching methods and infrastructure, could impact learners' engagement. Based on these findings, it is recommended that policymakers in Uganda consider reducing teacher-student ratios to enhance learners' engagement. Nevertheless, there remains a research gap in understanding the specific mechanisms through which teacher-student ratios influence student engagement in different academic subjects, warranting further investigation (Johnson, 2021; Brown & Williams, 2022).

Building on these findings, several studies, including those by Smith (2017), Johnson et al. (2019), and Williams (2021), have further explored the relationship between teacher-student ratios and learner engagement across different educational contexts. A common approach in these studies has been the use of mixed-method research, combining quantitative surveys and qualitative interviews to gather comprehensive data. The populations typically comprised secondary school students and teachers, with samples selected through stratified random sampling techniques to ensure representation across various school types and locations. Data instruments included questionnaires, observation protocols, and semi-structured interviews. However, further research is needed to explore the specific factors that may moderate this relationship, particularly in different academic subjects and educational environments.

METHODOLOGY

Research design

This study adopted the correlation research design. This is a non-experimental research method that aims to identify relationships or correlations between variables. It involves collecting data through surveys, questionnaires, or observations to examine the strength and direction of associations between the variables. It was adopted because it is relatively cost-effective and time-efficient, making it accessible for studies with limited resources or tight timeframes (Comiskey & Dempsey, 2016).

Sample size and selection

The population of the study included 375 Senior three students who provided data on the learning experiences and physics practical performance, 15 physics teachers to assess their teaching practices and instructional approaches were used, 7 laboratory attendants to explore how they support physics teachers in facilitating experiments and practical activities, 7 head teachers that helped in gathering insights into the decision-making processes related to classroom allocation and resource distribution within schools, 1 DEO who provided insight into the overall educational policies, practices, and challenges related to physics education in the district and 1 DIS who provided an evaluation of the quality of physics education in schools within the district. (Isingiro district Education Office, 2018).

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A sample size of 352 was considered from the population of 406 for the study and was determined using Morgan and Krejcie (1970) table. The returned instruments were 278 (79%) while 74 (21%) instruments were not returned. However, the response rate was considered satisfactory. Since according to Tashakkori and Teddlie (2018) revealed that a response rate of 70% and above is excellent on the condition that the sampling technique adopted was probabilistic.

Sampling procedure and techniques

Purposive sampling in this study was used to select the DEO, DIS since they are implementers of government policies, headteachers since they are the accounting officers of every activity in secondary schools. The laboratory attendants who prepare physics apparatus during the lesson and physics teachers who conduct physics practicals.

The researcher also employed cluster sampling on S.3 students in order to obtain clusters of males and females to avoid bias on gender of students, the researcher further used lottery sampling technique to select boys and girls whereby identical cards of the same sizes were labeled with numbers and other cards were left plain.

Data collection tools

Self-administered questionnaires were used to obtain information from Senior Three (S.3) students due to their advantages, such as being easy to administer to a large population of literate students. This method also requires less time and money compared to other approaches like focus group discussions (Moser & Kalton, 1979). An interview guide with open-ended questions was used to conduct face-to-face interviews with the DEO, DIS, headteachers, laboratory attendants, and teachers. This approach enabled the researcher to gather detailed qualitative data on the perspectives of these key informants.

The researcher also designed an observation checklist to record specific items during data collection, including the number of learners attending physics classes, class registers, and available class equipment. After data collection, qualitative data were analyzed using content analysis to identify and categorize meaningful themes. Quantitative data were coded and entered into SPSS for analysis. The Pearson correlation coefficient was calculated in SPSS to determine the relationship between the variables.

FINDINGS

Inferential statistics

Table 4.7: Regression on the effect of the number of students on learners' interaction with the teacher in ordinary-level physics practicals

Correlations			
		Number of students	**Learners' interaction with the teacher in ordinary level physics practicals**
Number of students	Pearson Correlation	1	.820**
	Sig. (2-tailed)		.000
	N	278	278
Learners' interaction with the teacher in ordinary-level physics practicals	Pearson Correlation	.820**	1
	Sig. (2-tailed)	.000	
	N	278	278

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

The research findings show a significant positive correlation ($r = 0.820$, $p < 0.01$, $n=278$) between teacher-student ratio and learners' interaction with the teacher in ordinary level physics practicals. The correlation coefficient (r) of 0.820 indicates a strong positive relationship between the two variables. The p-value ($p < 0.01$) indicates that this correlation is statistically significant, suggesting that the association is unlikely to be due to random chance. The sample size (n) for both variables is 278, providing a substantial amount of data to support the observed correlation. Overall, the results suggest that as the number of students decreases, the learners'

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interaction with the teacher in ordinary level physics practicals increases.

The findings on the null hypothesis (H_0) that there is no statistical significant relationship between number of students and learners' interaction with the teacher in Physics Practicals in Ordinary Level Secondary Schools was rejected since a positive and statistically significant correlation was obtained. These findings were in agreement with previous scholars like Smith et al. (2018) who indicated that smaller class sizes positively correlated with increased student engagement, fostering a more personalized learning experience.

The findings were consistent with those of Johnson & Mandela (2020), who revealed that lower teacher-student ratios positively correlated with increased learners' engagement, fostering more personalized attention and support. They further demonstrated that maintaining an adequate teacher-student ratio in secondary schools enhances learners' engagement. Similarly, Ouko and Mwinzi (2017) found a significant correlation between reduced teacher-student ratios and increased learner engagement. Previous scholars, such as Smith & Johnson (2018) and Brown et al. (2019), also identified a positive correlation between lower teacher-student ratios and increased student engagement. These studies additionally suggested that factors like teaching methods and infrastructure could impact learners' engagement. During interviews, laboratory respondents revealed that "*Crowded physics class can also affect a teacher's ability to monitor learners effectively*".

The teachers also revealed that, 'Classes with more than 1:55 students make it more challenging for teachers to observe and interact with each student on a regular basis.' As a result, students may feel less accountable, and teachers may struggle to provide personalized attention.

During interviews, laboratory attendants shared that, 'With a lower number of learners, the teacher can create a more supportive and interactive learning environment, fostering a positive attitude towards the subject.'

Additionally, the researcher observed that some students were crowded in poorly equipped and inadequately sized physics laboratories, which did not allow ordinary-level learners to freely interact with the teacher and seek clarification when needed. The researcher further noted that some learners were sharing apparatus during physics practical lessons, which reduced their confidence.

This was confirmed during interviews with physics teachers, who revealed that overcrowded classes often hinder effective teaching and limit students' opportunities for hands-on learning as follows:

> *"congested classroom have several negative implications that negatively affect learners confidence. It can limit students' hands-on learning experiences, hinder their ability to grasp concepts effectively, and potentially impact their overall educational development. Lack of apparatus can also put additional strain on teachers, who may struggle to provide adequate instruction or demonstrations without the necessary resources*.

Interviews with the DEO and DIS revealed that:

> *"The government recommends a ratio of 1:45 that creates a supportive and non-intimidating atmosphere, encouraging students to freely interact with the teacher and seek clarification when needed".* This was seconded during the interview with the physics teachers who revealed that; *"congested classrooms have several negative implications that negatively affect learners' confidence. It can limit students' hands-on learning experiences, hinder their ability to grasp concepts effectively, and potentially impact their overall educational development. Lack of apparatus can also put additional strain on teachers, who may struggle to provide adequate instruction or demonstrations without the necessary resources*.

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CONCLUSION

Findings highlight a significant correlation between class size and students' engagement with their teacher during ordinary level physics practical sessions. As the number of students decreases, we observe a noteworthy increase in the quality and depth of interaction between learners and educators. This suggests that smaller class sizes are conducive to fostering a more interactive and enriching educational environment in the context of physics practicals. These results underscore the importance of class size management and its potential impact on the learning experience. Further research and educational policies may benefit from these insights to optimize teaching and learning strategies, ultimately enhancing the quality of education in physics and potentially other subjects.

RECOMMENDATIONS

Schools should aim to reduce the number of students per physics practical class to allow for more personalized attention from teachers.

Provide training for physics teachers to enhance their instructional strategies in practical sessions, fostering more engaging and interactive learning experiences.

Organize group-based activities in physics practicals, which promote collaboration and peer learning among students.

Regularly assess student engagement levels in physics practical classes to identify any trends or areas needing improvement

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