

The interventional strategies of teaching and learning selected topics in mathematics: A case study of Odorgonno Senior High School, Ghana

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Abstract. The purpose of this study was to examine interventional strategies which aided easier teaching and learning of selected topics in senior high schools using the case of Odorgonno Senior High School. Among the various topics in mathematics, the researcher-selected topics were Probability, Geometry, Algebra and Set. The main research approach that was adopted for this study was a descriptive research design. A non-probability sampling method was used to select the respondents, with a sample size of 20 students per program and all Core Mathematics teachers in the school. Data entry and analysis were done using the Statistical Package for Social Sciences (SPSS) version 22. The findings of the study indicated that Teachers were more influenced by the classroom environment and students learning ability. Also, students' learning abilities such as thinking sequentially and procedurally, understanding mathematics concepts and principles and being able to provide reasons to support their solutions motivated the teachers most. Both teachers and students agreed that the greatest learning and teaching strategy was to personalize the learning process by choosing what the learners could relate to, and utilize examples and assignments as a basis for class discussion. It was concluded based on the findings that factors such as utilizing examples and assignments as a basis for class discussion, ensuring that issues generating a disturbance in the classroom are addressed and that students' attention is maintained until the lesson is completed, students motivating each other to learn mathematics and the creation of learning groups are interventional strategies that would aid teaching and learning of mathematics in Odorgonno Senior High School. It is recommended that the management of GES should encourage and train teachers on the use of the curriculum as a tool for selecting appropriate teaching strategies. The training of teachers should not be a one-time event.

Keywords: Mathematics, interventional strategies, teaching strategies.

INTRODUCTION

Mathematics is an essential subject that is taught at all stages of the educational cycle and experienced in day-to-day business transactions. Mathematics is also one of the scientific study tools that students need to build their logical, analytical and critical thinking skills (Tanujaya *et al.*, 2017). Despite its importance in human life, learning appears to be tough. The level of difficulty for students may range from minor difficulties with a single topic to severe learning problems that affect multiple sections of the

mathematical curriculum. Students may face challenges at various points in their academic careers. From learning the basic facts to learning how to apply the knowledge acquired to questions asked or scenarios provided, students with mathematical difficulties face challenges relating to other subjects that integrate mathematical functions in their topics. These issues could be caused by child traits or a poor match between learning qualities and offered to learn instructions. Memory skills, problem-

solving skills, vocabulary, strategy acquisition, motivation, and intellectual functions are among the characteristics of students. Teaching and learning characteristics or strategies are different at different stages of mathematical learning and with each mathematical teacher.

The difficulties faced by students learning mathematics require interventional strategies that would help them meet the demands on their learning abilities as a necessity for lifelong learning. There could be considerable differences in how pupils perceive the teacher's instruction (Talbert *et al.*, 2019). During teaching, teachers can use either a teacher-centered or a student-centered technique. According to Suastika (2017), teacher-centered instructions in mathematics rarely develop or train students' problem-solving skills. As a result, some pupils may misinterpret the teacher's directions. The researcher, therefore, seeks to analyse the intervention strategies for learning some selected topics in Mathematics. Interventional measures are required to assist students with learning disabilities in Mathematics. Education of pupils in all facets or topics, particularly Mathematics, is vitally important as a pillar for national growth (Kaharuddin, 2018). The development of student-centered teaching practices may be hampered by classroom differences. Student-to-student interactions, as well as the student-teacher connection, can provide assistance to students (Talbert *et al.*, 2019). According to Tanujaya *et al.* (2017), a number of factors can contribute to Mathematics students' poor thinking, with the mathematical learning system being one of the most important. According to the 2019 report of the West African Examination Council (WAEC), the performance of students in Core Mathematics has improved significantly. WASSCE scores in Mathematics improved from 38.33% in 2018 to 65.31% in 2019. The passing requirements ranged from A1 to C6. In the same year, 38355 students failed the Basic Education Certificate Examination (BECE) out of 473728 candidates who sat for the examination, according to Graphic Online news (2019). There have been several complaints by WAEC of indiscipline and the reliance of students on leaked questions. This report is very alarming since it indicates that students perceive high difficulty in Mathematics, thus, perceive failure if there are no leaked questions available. It is therefore of great essence to examine the intervention strategies for learning some topics in the mathematics curriculum.

The general objective of the study is to examine the interventional strategies for teaching and learning some topics in Mathematics. Thus, the specific objectives are to:

- i. identify some basic teaching strategies used in the study of the selected topics in Mathematics
- ii. identify the challenges learners face in the study of the selected topics in Mathematics
- iii. determine the relationship between assessment of learners' struggles and teaching strategies used in the teaching and learning of the selected topics in

Mathematics.

- iv. design strategies that may improve learners' ability to understand easily the selected topics in Mathematics.

Among the various topics in Mathematics, the researcher-selected topics are Probability, Geometry, Algebra, and Set.

The goal of the study is to add to the body of knowledge by studying interventional ways of learning some concepts in Mathematics. Aside from the contribution to the already available knowledge on the interventional strategies for learning some topics in Mathematics, the study will moreover identify other areas that future studies need to consider.

MATERIALS AND METHODS

The research was carried out at Odorgonno Senior High School, Ghana. It is located on the crest of the Odaw River near Adabraka in the Greater Accra Region. General Arts, Business, Science, Agriculture, Visual Arts, and Home Economics are among the programs offered by the school. As part of their curriculum, all students must learn Core Mathematics.

A descriptive research design was used as the primary research method in this study. Because the study is aimed at exploring interventional strategies for the teaching and study of selected themes in Mathematics in Odorgonno SHS, the descriptive research design will aid in providing answers to the research objectives specified to lead the investigation. This research design was guided by the Positivist philosophy. Positivists believe that reality is stable and can be observed and described from an objective viewpoint using quantifiable methods (Levin, 1988). The study's participants were teachers and students of Core Mathematics in Odorgonno Senior High School. This frame was chosen since the students have been engaging with the interventional tactics used by the teachers in the preparation for their final examinations, the West African Senior School Certificate Examinations. Teachers and students who volunteered to participate in the study were chosen using a convenience sampling technique. According to Babbie (2001), convenience sampling is simply when a researcher uses any people who are willing to engage in a research project. Five Core Mathematics teachers in the school partook in the research study. A sample size of 20 students was selected from each program.

The data for this study was taken from both primary and secondary sources: primary data was collected using two identical questionnaires, one for teachers and one for students. Secondary information was gathered from secondary sources such as journals, related studies, books, unpublished works, etc. Responses on the items were rated on a five-point scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The questionnaires were

Table 1. Age of student respondents.

Age group	Frequency	Percentage (%)
13-16	23	23
17-19	75	75
20-23	2	2
Total	100	100

Source: Field Study, 2021.

Table 2. Age of teacher respondents.

Age group	Frequency
30-39	2
40-49	2
50-59	1
Total	5

Source: Field Study, 2021.

Table 3. Gender of students per class.

Class	Gender				Total
	Male	%	Female	%	
Business	9	45%	11	55%	20
General Arts	5	25%	15	75%	20
Science	9	45%	11	55%	20
Home Economics	0	0%	20	100%	20
Agriculture	7	35%	13	65%	20
Total	30		70		100

Source: Field Study, 2021.

Table 4. Gender of teachers.

Class	Gender	
	Male	Female
Business	1	0
General Arts	1	0
Science	0	1
Home Economics	1	0
Agriculture	1	0
Total	4	1

Source. Field study, 2021.

administered to gather data regarding the importance given to the set of motivational strategies utilised by Shousha (2018). For data entry, the Statistical Package for Social Sciences (SPSS) version 22 was utilised. The research instruments, in particular, were created with the goal of attaining the research objectives. In order to do so, the data was analysed to see if the responses would truly

Table 5. Experience of teachers.

Class	Teaching experience (years)
General Arts	10
Home economics	3
Science	12
Business	3
Agriculture	25

Source: Field study, 2021.

provide answers to the research questions. The charts were created using SPSS once again. The variables were represented graphically using frequency tables and bar charts. The results were first compiled and descriptive statistics were computed before the tables and charts were constructed. The examination of the responses was focused on the majority, with a critique of minority views.

RESULTS

The personal characteristics of the respondents considered for the study included age, gender, class and topics taught and studied by teachers and students respectively.

Table 1 indicates that 23% of the respondents were between ages 13-16, 75% were between 17-19 and 2% were between 20-23 years.

Table 2 implies that out of the total number of 5 teachers, 2 of the respondents were between the ages of 30-39 years, while another 2 of the respondents were between the ages of 40-49 years. Only one teacher was near retirement (between the ages of 50-59).

Gender of respondents

Table 3 shows that out of the 20 respondents taken from each class, 30% of the total respondents were males, while 70% were females. All the classes in the study had more female student respondents than males. No male respondent was identified in the Home Economics class, thus the Home economics class had the highest number of female students (100%), followed by General Arts (75%), Agriculture (65%), Business class (55%) and Science (55%). From Table 4, there were 4 male teachers and 1 female teacher for this study.

Table 5 shows that each class had a teacher with Mathematics teaching experience. The teacher for the General Arts class had 10 years of experience in the teaching field; the teachers for the Home economics and Business classes had 3 years of experience each; the Science class teacher had 12 years of experience and the Agriculture teacher had 25 years of experience.

From Figure 1, each teacher spent four hours teaching Algebra, Geometry, Probability, and Set.

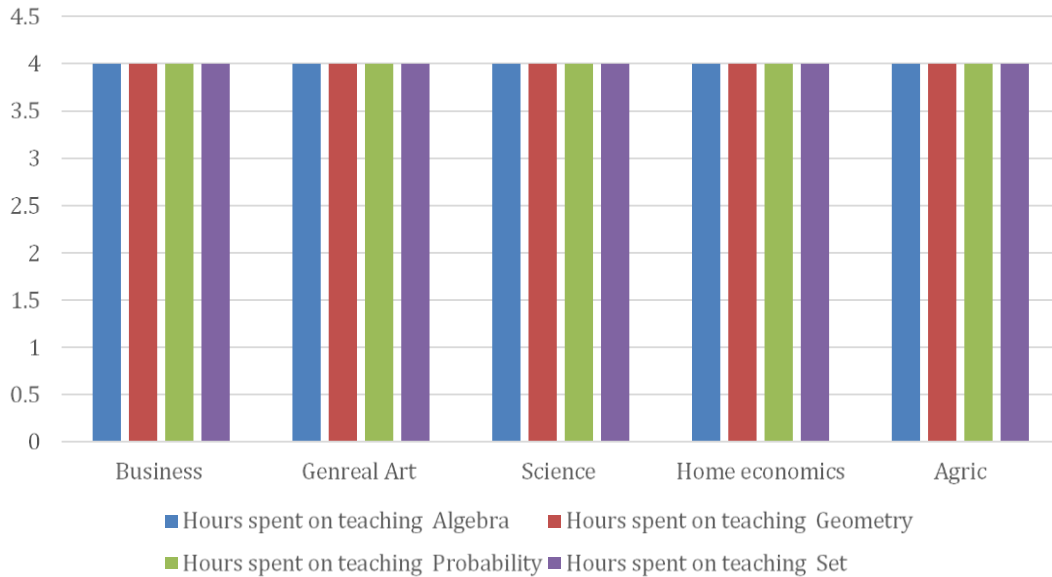


Figure 1. Hours spent on teaching mathematics topics. Source: Field study (2021).

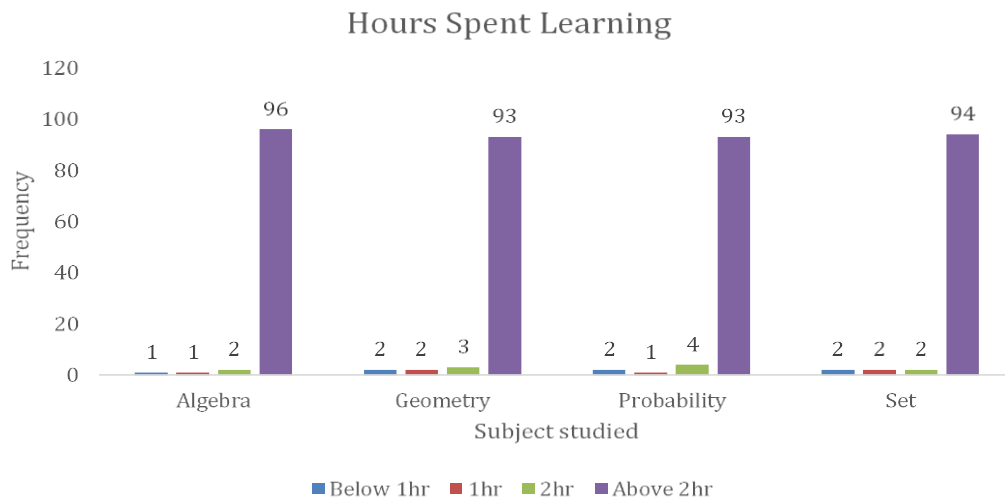


Figure 2. Hours spent on learning Mathematics topics. Source: Field study (2021).

Hours spent on learning Mathematics topics

From Figure 2, it is indicated that most of the respondents (96%) studied Algebra for more than 2 hours, likewise Set (94%), Geometry (93%) and Probability (93%) were studied for more than 2 hours. Only a few students spent less than 2hrs learning Algebra, Geometry, Probability and Set.

Section B: What influence does the following have on your learning in the classroom?

Table 6 implies that learning in the classroom was mostly influenced by an assignment given by the teacher,

according to the majority of the respondents (96) with a mean of 3.94. Only a few (1) were not influenced by the teachers’ assignment to study Mathematics. This was followed by a future career goal with a mean of 3.76. Future career goals influenced 89 respondents a lot. 4 of the respondents indicated some influence on their learning while 1 had little influence and 6 respondents did not influence their future career goal. Textbooks were the next to influence students learning habits in the classroom with a mean of 3.69. 77 of the respondents who formed the majority, selected textbooks as what influenced them a lot to learn. 17 of the respondents said textbooks had some influence on their learning in the classroom while 4 of the respondents said the textbook had little influence, and 2 indicated that they were not influenced by textbooks. The

Table 6. Activities that influence learning.

Statement	None	Little	Some	A lot	Mean
Teacher assignment	1	0	3	96	3.94
Textbooks	2	4	17	77	3.69
Class time table	4	19	47	30	3.03
Peer influence	20	31	40	9	2.38
Future career goal	6	1	4	89	3.76

Source: Field Study, 2021.

Table 7. Influence on teaching strategies.

Statement	None	Little	Some	A lot	Mean
GES curriculum	0	0	2	3	3.6
Textbooks	0	0	1	4	3.8
Students learning ability	0	0	0	5	4
Subject matter	0	0	2	3	3.6
Classroom environment	0	0	0	5	4

Source: Field study, 2021.

majority (47) of the respondents indicated that the class timetable had some influence on their study while 30 of the respondents indicated that the class timetable influences their learning a lot. Few (19) of the respondents selected that class timetable had little influence on their learning while 4 respondents indicated that there was no influence of class timetable on their learning. The class timetable had a mean of 3.03. The next influence in learning mathematics was Peer influence, with a mean of 2.38. Out of 100 respondents, 31 of them indicated that peer influence had little influence on their learning of mathematics while 40 showed some influence and 9 indicated a lot of influence on their learning.

Analysis of basic teaching strategies used in the study of the selected topics in Mathematics

From Table 7, the classroom environment and students learning ability had the highest mean of 4. Textbooks had a mean of 3.8 which was the next highest, while the Ghana Education Service (GES) curriculum and subject matter or topic of the day were the least with a mean of 3.6.

Teacher's expectations of students' ability for mathematics

In performing their duties as Mathematics teachers, the teachers had expectations of what skills their students should possess, which also guided the interventional strategy set by the teacher in the classroom. From Table 8, thinking sequentially and procedurally, understanding mathematics concepts and principles and being able to

provide reasons to support their solutions are mathematical abilities with the highest mean of 3, followed by the skill of remembering formulas and procedures (2.8), while being able to think creatively and understanding how mathematics was used in the real world had the least mean of 2.6.

Section C: Students' perspective of interventional teaching strategies

As shown in Table 9, the majority of the student respondents (96) strongly agreed or agreed that a good relationship between teachers and learners could motivate them to learn Mathematics while 4 strongly disagreed that a good teacher-learner relationship motivated their learning. The majority of the respondents (95) strongly agreed or agreed that proper assignment presentation was a good teacher motivational strategy, while 5 respondents strongly disagreed or disagreed. The majority of the respondents (94) strongly agreed or agreed that making the class interesting was a good teacher motivational strategy, while 6 respondents strongly disagreed or disagreed. The majority of the respondents (95) strongly agreed or agreed that making the classroom atmosphere pleasant by using interesting tasks and topics was a good teacher motivational strategy, while 5 respondents strongly disagreed or disagreed. Most of the respondents (96) strongly agreed or agreed that increasing the learners' self-confidence by giving positive feedback was a good teacher motivational strategy, while 4 respondents strongly disagreed or disagreed. The majority of the respondents (95) strongly agreed or agreed that increasing students' goal orientation by emphasizing the

Table 8. Students' ability for learning mathematics.

Statement	Not important	Somewhat important	Very important	Mean
Remember formulas and procedures	0	1	4	2.8
Think in a sequential and procedural manner	0	0	5	3
Understand mathematics concepts and principles	0	0	5	3
Be able to think creatively	0	2	3	2.6
Understand how mathematics is used in the real world	0	2	3	2.6
Be able to provide reasons to support their solutions	0	0	5	3

Source: Field study, 2021.

Table 9. Teachers' interventional strategies by students.

Statement	Strongly agree	Agree	Disagree	Strongly disagree	Mean
Good relationship with learners	85	11	0	4	1.23
Proper assignment presentation	65	30	2	3	1.43
Make class interesting	70	24	3	3	1.39
A pleasant classroom atmosphere	81	15	3	1	1.24
Increase learners' confidence	83	13	1	3	1.24
Increase students; mathematics goal orientation	44	51	3	2	1.63
Familiarize learning with real-life examples	48	47	4	1	1.58
Personalise learning process	37	53	6	4	1.77
Provide more examples and assignment	69	23	3	5	1.44
Use assignment as a basis for class discussion	48	43	4	5	1.66

Source: Field Study, 2021.

goal of learning Mathematics and its positive effect on the student's lives was a good teacher motivational strategy, while 5 respondents strongly disagreed or disagreed. Most of the respondents (95) strongly agreed or agreed that familiarizing learners with the usage of real-life examples to convey meaningful feedback was a good teacher motivational strategy, while 5 respondents strongly disagreed or disagreed. The majority of the student respondents (90) strongly agreed or agreed that personalizing the learning process by choosing topics that students could relate to was a good teacher motivational strategy, while 10 strongly disagreed that personalizing the learning process by choosing topics that students can relate to could motivate their learning. Most of the respondents (92) strongly agreed or agreed that providing more examples and assignments was a good teacher motivational strategy, while 8 respondents strongly disagreed or disagreed. The majority of the respondents (91) strongly agreed or agreed that using the assignment as a basis for class discussion was a good teacher motivational strategy while 9 respondents strongly disagreed or disagreed.

Based on the mean findings, personalise learning process had the highest mean of 1.77; followed by the use of assignment as a basis for class discussion (1.66); increase students' mathematics goal orientation (1.63); familiarise learning with real-life examples (1.58); provide more examples and assignment (1.44); proper assignment

presentation (1.43) and make class interesting (1.39). A pleasant classroom atmosphere and increased learners' confidence had (1.24) each, while a good relationship with learners had the least mean of (1.23).

Analysis of Teachers' perspectives on interventional teaching strategies

According to the mean findings, the highest mean of 4.0 was for appropriately presenting tasks, making math sessions engaging by employing intriguing problems and themes, creating a nice, relaxed atmosphere in the classroom, and increasing the learners' self-confidence by providing positive comments (Table 10). Following that, provide more examples and assignments for topics that students find difficult (3.8), personalize the learning process by choosing topics that students can relate to (3.6) while developing a good relationship with the learners, increase learners' goal orientation by emphasizing the goal for learning Mathematics and its positive effect on the students' lives, familiarize learners with the use of the subject matter in the environment to convey the meaning.

Section D: Limitations on performance of the interventional strategy

Based on the mean findings in Table 11, Shortage of

Table 10. Teachers' strategies by teachers.

Statement	Strongly agree	Agree	Disagree	Strongly disagree	Mean
Develop a good relationship with the learners	4	0	0	1	3.4
Present the tasks properly	5	0	0	0	4
Make the maths classes interesting by using interesting tasks and topics	5	0	0	0	4
Create a pleasant, relaxed atmosphere in the classroom	5	0	0	0	4
Increase the learners' self-confidence by giving positive feedback	5	0	0	0	4
Increase learners' goal orientation by emphasizing the goal of learning Mathematics and its positive effect on the student's lives	2	3	0	0	3.4
Familiarize learners with the usage of the subject matter in the environment to convey the meaning	2	3	0	0	3.4
Personalize the learning process by choosing topics that students can relate to	3	2	0	0	3.6
Provide more examples and assignments for topics learners' find difficult	4	1	0	0	3.8
Use assignments as a basis for class discussion	2	3	0	0	3.4

Source: Field study, 2021.

Table 11. Students' limitations.

Statement	Not at all	A little	Quite a lot	A great lot	Mean
Peer influence on learning	31	41	9	19	2.16
Lack of mathematics text book	12	45	22	21	2.52
Disruptive students	16	34	20	20	2.64
Shortage of income	45	27	18	10	3.06
Low morale of teacher	8	26	18	48	1.93
Low morale among students	6	31	34	29	2.86
Poor performance of self in previous assignments	17	32	15	36	2.7

Source: Field study, 2021.

income had the highest mean of (3.06); followed by Low morale among students (2.86), Poor performance of self in previous assignments (2.7), Disruptive students (2.64), Lack of Mathematics textbook (2.52) and Peer influence on learning (2.16). Low morale of teachers had the least mean of 1.93.

Limitations to how teachers teach mathematics class

Based on the mean findings in Table 12, Disruptive students, shortage of instructional equipment for use in demonstrations and other exercises, low morale of students, and poor performance of learners in previous assignments had the highest mean of (4.0). These were followed by students with special needs, inadequate physical facilities and low morale among staff or administration recording a mean of (3.8) each. Uninterested students and a high student/teacher ratio had a mean of (3.6) each while students with different academic abilities (3.4) had the least mean value.

DISCUSSION

The findings of the study indicated that the majority of the student respondents were between the ages of 17 and 19 years. This presupposes that most of the respondents are in their late adolescence and are active in making personal decisions about learning. Furthermore, the majority of the teachers had worked for more than ten years before retiring. This presupposes that the teaching and learning interventions had been employed for a long time. The statistics revealed that female students made up a large share of the student body at Odorgonno Senior High School. Science and Business classes had the highest percentage of male students (45 percent). With the exception of the Agriculture class, Science and Business classes were heavily concerned with calculation-related disciplines such as Mathematics, Accounting, Physics and many more. This suggests that male students are more interested in math-related studies than in reading-related programs. The findings support the Ugandan research that found that boys outperform girls in mathematics (Ochwo, 2013).

Table 12. Teachers' limitation on interventional strategies.

Statement	Not at all	A little	Quite a lot	A great lot	Mean
Students with different academic abilities	0	0	3	2	3.4
Students with special needs	0	0	1	4	3.8
Uninterested students	0	0	2	3	3.6
Disruptive students	0	0	0	5	4
Shortage of instructional equipment for your use in demonstrations and other exercises	0	0	0	5	4
Inadequate physical facilities	0	0	1	4	3.8
High student/teacher ratio	0	0	2	3	3.6
Low morale among fellow teachers/administration	0	0	1	4	3.8
Low morale among students	0	0	0	5	4
Poor performance of learners in previous assignments	0	0	0	5	4

Source: Field study, 2021.

Basic teaching strategies used in the study of the selected topics in Mathematics

According to the findings, teachers were more influenced by the classroom environment and students learning ability. Student learning abilities such as thinking sequentially and procedurally, understanding mathematics concepts and principles and being able to provide reasons to support their solutions were what motivated the teachers most. Teachers were impacted by textbooks in the same way that students were. The GES curriculum, as well as the subject matter or topic of the day, had little or no influence on the strategic decisions made by the teachers. The result raises a concern about the relationship between the content knowledge offered by GES and the teacher's pedagogical qualities. The impact of Ghanaian pre-service teachers' content knowledge on their mathematical ability for teaching elementary school Mathematics was explored by Asante and Mereku (2012). According to their findings, there is a moderate relationship between content knowledge and mathematical expertise among instructors.

Challenges learners and teachers face in the study and teaching of the selected topics in Mathematics

Disruptive students, a lack of instructional equipment for demonstrations and other academic exercises, low income, low student morale, and poor performance of learners in previous assignments were all identified as limitations or challenges to the teaching and learning strategies used in Mathematics by both students and teachers' respondents. There is a clear correlation between a student's lack of financial resources and their low academic achievement. Rittle-Johnson *et al.* (2017) discovered that children from low-income families struggled academically. Student morale may suffer as a result of this. According to the teachers in the survey, low student morale is a hindrance to effective teaching.

Dealing with unruly students is a challenge in today's world (Dewi and Primayana, 2019). Teachers are essential in ensuring that issues that disrupt the classroom are addressed and that students' attention is kept until the lesson is completed.

The relationship between assessment of learners' struggles and teaching strategies used in the teaching and learning of the selected topics in Mathematics

Per the students' responses, learning Mathematics was mostly influenced by the teachers' assignments. Future career goals and textbooks were the next to influence students learning habits in the classroom (Enu *et al.*, 2015). Their research revealed that a student's attitude toward Mathematics learning was influenced by their teacher's actions. In comparison to the other components, peer influence had a higher percentage of respondents (20%) who said it had no effect on their math learning in class. This shows that the majority of respondents (51) were only moderately motivated to learn mathematics by their peers. This indicates that the vast majority of students do not encourage their classmates to learn maths. Burke and Sass (2011), discovered that students performed better when their classmates had a positive impact on them. As a result, it may be stated that the study's low peer impact resulted in poor mathematical achievement. It is therefore the obligation of the teacher to foster peer support through the development of study groups and to encourage group work.

Strategies that may improve learners' ability to understand easily the selected topics in Mathematics

Per the results, creating good relationships with students or teachers is the least interventional method that would improve the learning and teaching of Mathematics in Odorgonno SHS, according to both teachers and students.

Teachers' and students' responses were adversely connected to familiarization of learners with subject matter usage, the formation of a pleasant classroom environment, boosting students' mathematical goal orientation or increasing learners' self-confidence, and proper assignment presentation. Nonetheless, both teachers and students agreed that the greatest learning and teaching strategy was to personalize the learning process by choosing what the learners could relate to and utilizing examples and assignments as a basis for class discussion.

CONCLUSION

The study aimed to explore the teaching and learning interventional strategies of selected topics in Mathematics: a case study of Odorgonno SHS. It was concluded based on the findings that, factors such as utilizing examples and assignments as a basis for class discussion, ensuring that issues generating a disturbance in the classroom are addressed and that students' attention is maintained until the lesson is completed, students motivating each other to learn mathematics and the creation of learning groups are interventional strategies that would aid teaching and learning of Mathematics in Odorgonno Senior High School.

RECOMMENDATION

Findings from this study will urge policymakers to change teaching practices that do not support the learning strategies of students. It will also assist school administrators in gaining a better understanding of how Mathematics teachers influence the knowledge of children who struggle with Mathematics, as well as making recommendations for methods to lower the rate of Mathematics failure in their schools. As a result, it will contribute to the advancement of Mathematics education and the enhancement of student outcomes.

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